The 8th Framework Programme of the European Commission
and the Safeguard of Cultural Heritage

THE EACH PROJECT

2nd Report - January 2011

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Foreword

The motto of the European Union is "***United in diversity***"; European citizens want to preserve their identity, grounded on their cultural Heritage. However, such a Patrimony is fragile and Public Administrations spend yearly significant resources to save it

The purpose of the EACH Project is to show how crucial may prove the contribution of scientists and technologists saving our common Patrimony and saving public money often wasted for erroneous interventions.

A special opportunity is offered by the next 8th Framework Programme of the European Union for the years 2014-2020; even if it may seem a lot of time ahead, experts agree on stating that years 2010 - 2011 are the right time to act.

We submitted the 1st Report, July 2010, to the European Commissioner as a contribution to the future "*Discussion Document*" to be prepared for the next Framework Programme that starts next 2014. The Commissioner Mrs. Máire Geoghegan-Quinn answered, September 2010, that our Report had been given to her Offices for further consideration.

As clearly shown by the EACH Project logo, we are working for the years "*2010-2014*" "*towards FP8*" and on "*Cultural Heritage*": i. e. any scientific and technological activity for the safeguard of our common Cultural Heritage.

This deeply revised 2nd Report contains the full text of the "*Preliminary Draft*" of the EACH Project approved by the delegates to the Congress on Cultural Heritage held in Cairo last December 2009 plus all the amendments and enrichments carried out by contributing scientists throughout year 2010.

The Report is a bottom-up initiative supported by thousands of scientists and technologists of the 27 Member States and the 9 Mediterranean Partners, open to further suggestions.

The Report contains a provisional list of thousands of scientists the EACH Project was submitted to and a provisional list of scientists who made comments, suggestions and adjournments to the Project text: we deeply thank them for their contributions.

Angelo Guarino

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1.1 - *Towards the 8th Framework Programme*

During the 1st World War soldiers used to sing on the battlefields a popular British anthem:

"It's a long, long way to Tipperary,
It's a long way to go.
It's a long, long way to Tipperary,
to the sweetest girl I know."

Nowadays, European scientists sing the same anthem: in this case their hearts do not beat for Tipperary in Ireland but for Brussels in Belgium where the "*sweetest girl they know*" works: the new Commissioner for Research, an Irish Lady.

To begin with: is it possible another Framework Programme for the years 2014-2020? Our answer is "yes": documents, workshops and conferences prove that many stakeholders, Member States of the Union as well as the European Commission are getting ready for this occurrence.

However, which will be the procedure to prepare and adopt the new Framework Programme? ([1-5])

Even if procedures changed many times since the first Programme started in 1983, experts agree on a roadmap similar to that followed for the 7th Framework Programme; in that case the European Commission prepared a "*Discussion Document*" in collaboration with the Programme Committees (where EU Member States have their Official Representatives), the European Research Advisory Board, (ERAB), the Scientific and Technical Research Committee (CREST), etc.

The *"Discussion Document*" was submitted for an "opinion" to the Council (Ministries of the Member States) and to the European Parliament, receiving many "*Common positions*" suggesting "*Amendments*" with a final "*Conciliation*" giving rise to a "*Joint Text".* The roadmap ended up with the "*Adoption*" of the "*Final Text*".

A second no less important step was the preparation by the European Commission of the "*Specific Programmes*" which contained the "*pulp*" i.e. the "*Thematic Areas"* and the "*Actions"* to be financed. Quite obviously, also the "*Specific Programmes*", in order to be adopted, were submitted by the European Commission to the Council and to the European Parliament.

The Specific Programmes adopted for the 7th Framework Programme are:

SP Cooperation	**32.365**	**billion Euro**
SP Ideas	**7.460**	**"**
SP People	**4.728**	**"**
SP Capacities	**4.217**	**"**
Other Activities	**4.502**	**"**

The total funding for the years 2007-2013 will be 53.272 billion Euro.

In addition to the *"Framework Programme*" and the "*Specific Programmes*" every fiscal year the European Commission must prepare an "*Annual Work Programme*".

For 2010, the milestones of the "*Annual Work Programme*" were:

1 – "*Consultation"* (internal i.e. compliance with FP7 and Specific Programmes, budget outcome from previous years, etc. and external i.e. Advisory Groups, the European Technology Platforms, Expert groups, Workshops, Conferences, etc

2 – "*Preparation"* of the draft of the "*Annual Work Programme*" which is mainly completed inside the Commission.

3 – "*Adoption"* after receiving the opinion of the Programme Committees.

The whole process for the 2010 "*Annual Work Programme*" took about seven months from January 2009 to the end of July 2009.

Before starting to prepare the 8th Framework Programme the European Commission evaluated during 2010 both the results of the 6th Framework Programme and a "Progress Report" on the 7th Framework Programme which started in 2007.

For the 8th Framework Programme the European Commission should complete its proposal in autumn 2011 followed by a discussion of its text with the European Parliament and the Council during 2012. The final adopted text should be ready in the middle of 2013 and its formal start should be in 2014.

It is worth observing that the "*Specific Programmes*" of the 8th Framework Programme, containing details on the Actions to be financed should be prepared and submitted by the European Commission to the European Parliament and to the Council after the submission of the 8th Framework Programme: this step is quite delicate because it is usually the right moment for bargaining among Member States asking specific priorities.

The experience of the previous Framework Programmes shows that after the European Commission prepared the "*Discussion Document*", it is rather difficult to eliminate or deprioritize its "*Actions*". It is much easier to insert new activities and put new priorities which better fit the interests of single Member States or groups of Member States.

As a consequence, it is clear how important and delicate is the stage of the preparation of the Discussion Document (Framework Programme and relative Specific Programmes). Experts agree on one point: this is the right moment to submit suggestions to the European Commission as well as to other Authorities. ([6-8])

In any case, the "*Discussion Document*" is an absolute need: no further discussion, addition or amendment coming from stakeholders is possible without such a document.

1.2 –The new Research Commissioner

The new European Union Commissioner for "*Research, Innovation and Science*" is Máire Geoghegan-Quinn (pronounced Moira Gey-gan-Quinn). She held many ministerial positions in the Irish Government (1980-1990) and next at the European Court of Auditors.

According to Geoghegan-Quinn, the next 8th Framework Programme should have a less bureaucratic framework. At her confirmation hearing to the European Parliament she said of herself: ***"This is a politician who is in charge of doing things, who wants results and who wants delivery. I won't be a mouse, I won't be quiet".*** ([9])

Definitely, she will not be a "*quiet mouse*"!

On the "*Innovation Summit*" of the Lisbon Council held in Brussels on the 5th of March 2010 she said: ***"My job in short is to work with the Member States, business and other stakeholders to transform Europe into a really vibrant innovation economy, what I call an "i-conomy……"*** ([10])

She added:

"The secret to success now lies in collaboration across borders and cultures. ***That is why we must have a single, unified research area in Europe, within which researchers and knowledge can move around freely. It is known as the European Research Area and I am determined to make it a success…… I am also convinced that, in key area connected with the major societal challenges it will be necessary to launch strategic initiatives of European interest aiming at solving particular problems. We are all innovators now and the task ahead is to build not just the "i-conomy" but a cohesive and prosperous "i-society".*** ([10])

These words are impressive for all European scientists and we all shall encourage the Commissioner to succeed in her work for the next five years!

1.3 –The structure of FP8

In the case of the actual 7th Framework Programme (FP7) a large consultation was carried out on thematic areas and topics. However, it was difficult from these consultations to obtain documents which fulfilled the criteria of being eligible for a Framework Programme, i.e. to possess "*European Added Value*", to tackle fragmentation, to allow mobility as well as better common infrastructures.

In particular, the Commission received ca. 1700 suggestions from scientific Organizations and individuals; ca. 8000 written comments and 150 contributions as "*Position Papers*" from the various Member States.

It seems highly probable that for the 8th Framework Programme there will be a larger integration with national and regional activities of the 27 Member States through various European structures like the "*Joint Programmes*", etc.

How complex is anyway the route from the "Discussion Document" prepared by the European Commission up to the "Adoption" of a Framework Programme by the Council and the European Parliament is shown by the next table: ([2])

FP	Discussion Document	Adoption	FP Duration
FP5	June 1996	December 1998	1999-2002
FP6	October 2000	June 2002	2003-2006
FP7	June 2004	December 2006	2007-2013

About two years are needed to produce the "*Final Text*" of a specific Framework Programme. We have to add the time needed to prepare the "*Specific Programmes*", and the "*Annual Work Programmes*" up to the annual "*Call for Papers*".

We have also to account for changes in the "*Specific Programmes*" as occurred in the previous seven Framework Programmes: many different nomenclatures were employed giving different emphasis to specific "*Actions*".

Experts argue that it is highly probable that the new 8th Framework Programme will correspond to a change of nomenclature, with a change of priorities with respect to the 7th Framework Programme.

Even if it is difficult to foresee these changes, we may point out some unavoidable facts: [11-15]

1st - All Member States push for more participation. according to the "*Ljubljana Process*", which means more integration between national and European research. As a consequence, there will be an increase, with respect to the 7th FP, of Joint Programmes, Private-Public Partnerships, etc.

However, a "*Specific Programme*" similar to the one called "*Cooperation*" should be present, may be with a different name

2nd - All Member States push for a common area of innovative research: this is also the opinion of the new Research Commissioner.

In any case, there will be a "*Specific Programme*" which will finance new and innovative "*Ideas*" and again it is not influential how it will be called.

3rd - All Member States push for an increased mobility among scientists all over the Union and for better common infrastructures.

A "*Specific Programme*" will be for sure devoted to this subject even if, according to the new Research Commissioner, many bureaucratic difficulties represent an obstacle to overcome.

4th - Finally, all Member States push for better instruction: according to the "*knowledge triangle*" there is a strong complementarity between innovative research and better instruction.

Also this point will be a priority for the Commission and a Specific Programme will be devoted to this important subject.

Even if the names of the various "Specific Programmes" might be different from those used for the present 7th Framework Programme, it is rather reasonable that a similar nomenclature should be used to name the internal structure of the future Specific Programmes: i.e. a certain number of "Actions", divided in "Areas", subdivided in "Topics".

The budgets of the Framework Programmes, starting from the first one (1984-1987) increased steadily, as shown in the next Table: ([2])

FP1	1984-1987	0.94	billion Euro/year
FP2	1987-1991	1.35	"
FP3	1990-1994	1.425	"
FP4	1994-1998	3.304	"
FP5	1998-2002	3.74	"
FP6	2003-2006	4.375	"
FP7	2007-2013	7.767	"
FP8	2014-2020	10.00 (?)	"

Many experts estimate that the next FP8 might have a budget between 70 and 100 billion Euro for the seven years 2014 - 2020.

However, we must answer a formidable question: which will be the impact of the world financial crisis of the years 2008-2010 on the budget of the next Framework Programme which has to be decided within next 2012?

More clearly, for the next decade, what will happen to the EU Member States economies?

Probably it is easier for an audacious meteorologist to guess whether in London it will rain the 1st January of 2014 than for an economist to guess which will be the economic condition of the European Union for the same date.

We may only assume tentatively, according to experts with an optimistic approach, that starting from the 53 billion euro of the present 7th Framework Programme, we may expect an increase up to twice this value for the next 8th Framework Programme.

However, how much the real increase is more matter for Magicians!

Many European Organizations were generated in the last decades with the purpose to organize and plan in a more ordered way the specific needs of the stakeholders, on a national basis and on a Regional basis; it is worth observing that Regions of Europe are becoming more and more important stakeholders towards the European Commission.

It is impossible to make even a short list of these Organizations and Institutions; all of them will be actively working with the European Commission to prepare the "*Discussion Document*" for the 8th Framework Programme: they are: ***ERA:*** *European Research Area and its Board ERAB;* ***ERC:*** *European Research Council;* ***ARE:*** *Assembly of European Regions*; ***ERRIN:*** *European Regions Research and Innovation Network, etc.*

All of them possess nice web sites where it is possible to obtain good information about their activities.

Quite obviously, stakeholders, industrial companies, scientific communities, will push on the European Commission to shape "*Actions*" and "*Areas*" for any single "*Specific Programme"* according to their own interests.

For scientists to contact the European Commission and other national Authorities: by means of "***bottom-up concerted actions***" or by "***top-down single national actions***".

In the first case a large community of scientists belonging to the 27 Member States submits to the European Commission a "*concerted document*", discussed and approved in a very transparent way, containing activities with high "*European Added Value*". In the second case, scientific public Institutions politically supported by one of the 27 Member States submit to the European Commission documents which represent the scientific interests of a single Member State or of a group of Member States.

This document, called EACH Project, represents a "bottom-up concerted action" supported by thousands of scientists belonging to all the 27 EU Member States, with the contribution of the so called 9 Mediterranean Partners.

1.4-– Cultural Heritage and the 8th Framework Programme

It seems useful to define the following expressions:

To begin with, what does it mean "*Cultural Heritage*"?

The usual answer is "***Every object of historical and artistic interest".***

However such an answer is a rather poor definition because it stresses our Heritage in art objects like paintings, statues and historical buildings but ignores other significant matters like our Biological Heritage.

A better definition is ***"Cultural heritage represents every material and immaterial evidence of the cultural identity of a population."***

Cultural heritage represents the cultural roots of the Identity of a population like in a tree the branches, the flowers, the fruits stand up and draw their lymph from the roots.

Cultural heritage defines the diversity existing among our populations.

Cultural heritage helps to fight against cultural poverty, which represents a large part of poverty nowadays and poverty should be defined as a lack of knowledge and education, lack of cultural opportunities.

By consequence, we may agree on one point: our national cultural identities are in danger and will be wiped out in a few decades if we continue to ignore the problems connected with their state of conservation .

However, why should we spend significant human and financial European Union resources safeguarding Cultural Heritage, subtracting resources necessary to face other major problems like poverty and unemployment?

There are people who strongly believe that it is a "moral duty" for the whole mankind, a *"kategorische Imperativ"* to use the words of Kant.

In this case, the only interest should be of leaving our Cultural Heritage to future generations.

There are other people who believe that safeguarding Cultural Heritage has to be done just for the pleasure of enjoying life, or, to use an expression of the European Commission, to enhance their "*quality of life*": this belief is probably the "*driving force*" for tourism and tourism helps generating jobs and developing new infrastructures like roads, hotels, houses, all over Europe, Africa and Middle East.

Both opinions are probably right and represent different sides of the same truth: the safeguard of our Cultural Heritage is a "*must*" for our societies.

We all know that our common European Patrimony is fragile and continuously under attack for natural disasters like earthquakes and floods, and for human caused disasters like fire, vandalisms, robberies and wars.

To preserve our common Patrimony we need a wide involvement of actors, private and public subjects, resources and energies which go well beyond the sphere of single States.

To preserve our common Patrimony we need to behave as a community, to elaborate innovative strategies, to experiment new tools and new methods.

We do really need very skilful scientists!

The commitment of scientists is crucial: for the protection, restoration and exploitation of Cultural Heritage, either by transferring technologies developed in different areas, or by developing new scientific tools suitable for specific domains in Cultural Heritage.

1.5 - The Treaty of Lisbon

Starting from the 1st of December 2009, the Treaty of Lisbon has been adopted in its final formulation by the European Union and the "*Treaty of the*

European Union" and the "*Treaty of the Functioning of the European Union*" have been adjourned.

The "*Treaty of the European Union*" contains now the following statement, art. 3, point 3:

Art. 3

***"The Union**……..*

Shall promote scientific and technological advance.

……..

Shall respect its rich cultural and linguistic diversity, and shall ensure that Europe's cultural heritage is safeguarded and enhanced".

Hence, according to this Treaty, the European Union *"shall"* not only *"ensure"* i.e. guarantee the *"safeguard"* of its Cultural Heritage but *"shall enhance"* i.e. increase its value.

Also the "*Treaty of the Functioning of European Union*" was adjourned.

Title XIII "Culture", Art. 167, states:

Art. 167

"1. ***The Union shall contribute to the flowering of the cultures of the Member States, while respecting their national and regional diversity and at the same time bringing the common cultural heritage to the fore.***

2. Actions by the Union shall be aimed at encouraging cooperation between Member States and, if necessary, supporting and supplementing their action in the following areas:

— Improvement of the knowledge and dissemination of the culture and history of the European peoples

— Conservation and safeguarding of cultural heritage of European significance."

In conclusion, the new "*Treaty of the European Union*" contains a quite strong and explicit declaration of intent: ***"The Union shall ensure that Europe's cultural heritage is safeguarded and enhanced".***

No Member State, no European Commission, no Council or European Parliament shall ignore it!

1.6 –Our "CERN Laboratories"

Several years ago, some European countries decided to finance researches on elementary particles by creating the CERN Laboratories [(1)] close to Geneva, in Switzerland.[(16)]

Also for the safeguard of the European Cultural Heritage we need a kind of CERN Laboratories: a large area where scientists and technologists of the

European Union Member States may experiment innovative methodologies and technologies for diagnostics, restoration and exploitation of our common Patrimony.

Wherever it may stay, this area must be rich of monuments, easily accessible, with sufficient infrastructures; an area close to the sea in order to experiment researches concerning underwater monuments.

There are all over Europe many areas or basins eligible to act as our CERN Laboratories: the Baltic Basin, the Mediterranean Basin, the Black Sea Basin, etc.

The best suited area seems to be the Mediterranean Basin because it fulfils all the criteria needed for researches eligible within a EU Framework Programme.

In fact, researches in this Basin:

- possess "*European Added Value*"
- avoid fragmentation
- encourage easy mobility for scientists

By choosing the Mediterranean Basin, a large area rich of monuments of any kind, fulfils all these criteria.

We need to account also for the so called Mediterranean Countries according to the European Commission nomenclature, i.e. the following nine nations: Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Syria, Tunisia, and Turkey.

These countries possess an extraordinary cultural patrimony, in many cases better saved than in Europe, from the ancient Egyptian civilization of more than four thousand years ago up to the Islamic civilization. A scientist has a "*continuum*" to study and experiment on; no other place the world over can be found with similar features. There are many good reasons to consider these countries as a significant part of our CERN Laboratories where scientists of all over Europe may experiment innovative scientific researches and new technologies to be applied later in their own countries

There is a clear similarity between the CERN Laboratories in the field of Physics and the chosen area in the field of scientific research for Cultural Heritage.

Northern or Central European physicists go to the CERN Laboratories in Switzerland because the equipments they need stay in that place; analogously, Northern or Central European scientists can study and experiment innovative methodologies of diagnostics or restoration on a specific monument using the Mediterranean Basin as their own laboratory. Their achievements will be then exploited in their own country, avoiding fragmentation.

1.7– The EACH Project

It is worth observing that both FP6 and FP7 supported scientists working in the field of safeguarding Cultural Heritage. However, no organized, no overall strategy was possible for the lack of a "*master plan*" to make coordinated activities all over the European Union.

Many initiatives are nowadays active like MEDA, NET – HERITAGE, ERA-NET Projects, etc. Full details can be obtained on their web sites.

A preliminary successful attempt was carried out in Italy between 1997 and 2001 with a Special Project called "Cultural Heritage" by CNR (National Research Council) and by the Ministry of Scientific Research, with a budget of more than 30 million Euro.

It is worth observing that European governments spend every year for the safeguard of their Cultural Patrimony many billion Euro. A lack of common rules and guidelines imply that many million Euro are wasted in incoherent or dangerous interventions!

This Project should avoid the weak side of many scientific similar projects: very many projects financed according to their "*excellence*", carried out by small highly skilled research groups with scarce or no impact of public utility. How many local Authorities in our countries during the last twenty years really used or exploited the "*results*" of these researches, which nonetheless had a cost of many million Euro?

In other words, the money spent was certainly useful for the advancement of science and technology but had a scarce impact on the safeguard of Cultural Heritage which basically remains on the shoulders of Public Administrations which pay scarce or no attention to the scientific methods developed and reported in hundreds of papers spread in hundreds of scientific journals.

The Project covers most of the scientific and technological applications which may be useful for the safeguard of our common Cultural Patrimony.

Achieving this objective implies that a quite large community of scientists and technologists is required, not only those who have been working since decades in this area, but also those who might experiment for the first time their skills, intrigued by the complexity and beauty of studying our common Patrimony.

Contributing to save even a small piece of this Heritage is both a scientific success and a personal satisfaction for doing something important for future generations!

The Project acronym EACH has been chosen to mean specifically that "*each scientist*" of "*each country*" should give her/his contribution to preserve our common Cultural Patrimony. It may correspond to "*EuroMediterranean Actions for Cultural Heritage*" or "*EuroMediterranean Agency for Cultural Heritage*" where the word "*Mediterranean*" simply states that the

"*Mediterranean Basin*" is the area where to perform scientific activities by scientists coming from any part of Europe, Middle East and North Africa.

The word "*Agency*" may suggest the rationale of establishing a specialized agency dealing with this subject, according to other European Union Agencies which:"... *are an answer to the need to cope with new tasks of legal, technical and/or scientific nature*." (See EU web site on EU Agencies).

Actually, an increase of the actual EU Agencies is rather difficult for various reasons; such an event could only occur In case one of the 27 Member States or of the 9 "*Mediterranean Partners*" is ready to host such an Agency and pay for its costs.

However, what scientists really need is a Project or better a "*Framework Project*" containing clearly stated "*Actions*" required by the Public Administrations to preserve our common Cultural Patrimony; "*Actions*" to be inserted inside the "*Discussion Document*" of the next 8th Framework Programme of the European Commission. It does not matter how we name this Project or Framework Project.

The milestones of the EACH Project for the period 2009 – 2011 are:

2009 –Milestone 1

Presentation of the Project as a "*Preliminary Draft*" at the 4th International Congress on ***"****Science and Technology for the Safeguard of Cultural Heritage of the Mediterranean Basin****"*** held in Cairo, Egypt on December 2009. During the Congress, with a participation of about 350 scientists coming from 22 countries, the text of the Draft was amended and approved.

2010 – Milestone 2

The same Draft was put at disposal of the scientific community in order to obtain a better amended and enriched text.

During the whole 2010 we contacted more than 2.250 scientists living in all the 27 Member States of the European Union and in the 9 Mediterranean Partner Countries. About 600 scientists made observations, amendments or suggested new items to be included. The actual Project text of December 2010 contains all these changes.

In July 2010 the Project was submitted as a "*Preliminary Draft*" to the European Commissioner Mrs. Máire Geoghegan-Quinn.

In September 2010 the Commissioner answered, saying:

"Thank you for your letter of 22 July and for sending me the report on the EACH Project – The 8th Framework Programme of the European Commission and the Safeguard of Cultural Heritage". I have forwarded the information to my services and I'm sure they will study it with extreme interest."

2011 - Milestone 3

We will continue to adjourn the Commissioner on any further step of our Project

The "*Final text*" of the Project will be submitted to the delegates of the next 5th International Congress on ***"Science and Technology for the Safeguard of Cultural Heritage of the Mediterranean Basin"*** scheduled in Istanbul, Turkey, November 2011. We are also inviting the Commissioner to join us during the Congress hoping to know details about the 8th Framework Programme and to know whether the activities suggested by the EACH Project will enter the Programme.

2013 - Milestone 4

The fourth and last milestone will occur during the 6th International Congress on ***"Science and Technology for the Safeguard of Cultural Heritage of the Mediterranean Basin"*** scheduled to be held in Athens, Greece, November 2013.

This date corresponds to the start of the 8th Framework Programme (2014-2020); the right time to know which activities concerning the safeguard of our common Cultural Heritage will be inserted and consequently how successful have been our efforts with our bottom-up concerted initiative.

The Each Project may be taken for the European Commission as a useful "tool" to decrease a flood of small individual projects. All the activities for the safeguard of the Cultural Heritage of whichever type are inside the proposed "Key Actions", directly chosen by scientists. How much of this project shall enter the "Annual Work Programmes" will be a decision of the European Commission: in any case the Commission Officers will possess not just another "shopping list" but a document containing what scientists believe necessary for the safeguard of our common Patrimony.

The Project follows the nomenclature of the actual 7th Framework Programme, which probably will be changed in the next Programme.

It is divided into five specific "*Key Actions*" each one subdivided into several "*Areas*". The "*Areas*" contain specific "*Targets*" needed to solve "*Problems*" suggesting possible "*Expected Results*".

The first Report was put on line on www.eachproject.eu, July 2010. The second Report is on line starting from January 2011; the third Report, with additional comments, suggestions and amendments will be on line in May 2011 and the "*Final Text*" of the Project will be submitted for approval to the Delegates at the Istanbul Congress on Cultural Heritage, scheduled to be held in Istanbul next November 2011.

1.8 – What we expect from the European Commission

The purpose of this Project is to submit to the European Commission a "*working tool*" useful for the preparation of its "*Discussion Document*" for the next 8th Framework Programme.

Obviously, it does not matter which "*nomenclature*" will be used by the Commission: "*Actions*" and "*Areas*" might have different names in the future Programme and also the "*Specific Programme Cooperation*" might have different name.

What we do expect, for the various documents to be issued by the European Commission starting from 2011 is the following:

8th Framework Programme

According to the new text of the Treaty of the European Union, the "*Discussion Document*" should contain both a statement where the safeguard of Cultural Heritage is reported and specific attention is given for the suggested *"Key Actions"* proposed in the EACH Project.

Specific Programme "*Cooperation*"

The "*Areas*" reported in the EACH Project should be inserted into this Programme, whichever name will be adopted..

Annual Work Programmes

The Annual Work Programmes for the seven years (2014-2020) of the 8th Framework Programme should contain the "*Areas*" and relative "*Targets*" suggested within the EACH Project.

1.9– A Joint Programme on Cultural Heritage

Last April 2010 the European Commissioner Mrs. Maire Geoghegan-Quinn approved a *"Recommendation*" for a Joint Programme in the field of Cultural Heritage concerning specifically the effects of Global Change on our common Patrimony.

It seems useful to report some sentences of this important document [(17)]:

"Cultural heritage, in the meaning of the Unesco Conventions concerning the Protection of the World Cultural and Natural Heritage and the Safeguarding of the intangible Cultural Heritage is a very fragile patrimony and is exposed to multiple risks due to ageing, adverse environmental conditions, and human pressure.

For most European citizens, cultural heritage assets are unique and irreplaceable in their tangible form of historic buildings, collections, sites and movable objects as well as in their intangible value, which includes history, collective memory and identity.

The combined effects of climate change, other environmental changes,

human interventions and security risks threaten Europe's cultural heritage. In particular, climate change may lead to cultural heritage assets being irreversibly damaged or lost because of their fragility and age. In addition, disasters and security risks threaten the physical nature of cultural heritage assets as symbols and icons of European cities and sites.

Member States are encouraged to cooperate with the Commission with a view to exploring possible Commission initiatives to assist Member States in developing and implementing the strategic research agenda, and to coordinating the joint programmes with other Union initiatives in this field."

1.10 - References

1. The web site http://cordis.europa.eu/ is like the fabulous ***"King Salomon's gold mines***" to read any European Commission act!

2 – ***Dan Andrée***, ***Priority–Setting in the European Research Framework Programmes , Vinnova , Sweden 2009.***

The Report of Dan Andrée is an impressive and extensive (70 pages) document which gives probably the best and most precise details about Framework Programmes and in particular about the next 8th Programme. Dan Andrèe has been a former member of the Research Directorate General.

3 ***- Priority setting in Food, Agriculture and Fisheries, and Biotechnology Research - 11 December 2009 - Copenhagen, Denmark***

This document is a nice presentation on a specific subject giving hints about the next Framework Programme***.***

4 ***- EULARINET Annual Meeting - 15 March 2010 - Montevideo***

Also this document is a nice presentation on a specific subject giving hints about the next Framework Programme***.***

5 - ***Commission of the European Communities: towards Joint Programming in Research. - 15 July 2008***

This paper has to be read attentively: it is a study of the European Commission on a point which will influence the next 8th Framework Programme i.e. the Joint Programming.

6- ***Richard L. Hudson, Stop the R&D train, I want to get off. Science Business, 28 January 2010***

In this brilliant article the Author says he wants to get off: of course, nobody wants that.

7 – ***Research: European Union governments in funding tug-of-war., Nature, 21 January 2010***

The Author states that an **"*intense lobbying is expected as the EU considers how to spend the next multi-billion euro Framework Programme which will be the largest such fund in the world***"

8- A ***Framework for success - Nature, 463, 710, February 11, 2010***

The Author states that "***As the EU's Central Administration has become more powerful, lobbying activities in Brussels have grown. Lobbyists from other sectors….have no scruples about fighting to win. Those who stay out of the rough-and-tumble will lose.***"

Who wants to lose?

9 ***- Report of the Day: Renaissance of European Research? - Strategic Affairs.net - February 10, 2010***

A speech of the new Commissioner, at her confirmation hearing.

10 - Maire ***Geoghegan-Quinn: Towards an "i-conomy" - 5 March 2010 - Brussels***

A lecture held by the new Commissioner, at the Lisbon Council's Innovation summit. It contains many guidelines of her future activity.

11 ***- EU looks to developing world as it mulls FP8. - Times Higher Education, 18 March 2010.***

The Author of this "news" states that the European Commission is thinking to extend the area of activity of the next Framework Programme outside Europe, including the Mediterranean area, North Africa and Middle East as well as Latin America.

12 - . ***The Royal Academy of Engineering: Capturing UK business views on the 8th European Framework Programme - 15 January 2010 - United Kingdom***

This document is a clear demonstration of how Institutional subjects and important stakeholders are correctly preparing themselves to influence the process of organizing the next Programme: "***The Royal Academy of Engineering in association with the Department for Business, Innovation and Skills will hold a workshop on 15 January 2010 for business stakeholders interested in influencing UK priorities for the 8th European Framework Programme***"

13 ***- EU Framework Programme for R&D – towards FP8. What is at stake for the South West of England? - December 2009, Brussels Office***

This document shows how important is, even for European Regions, to discuss strategies to compete .

14 ***- North East England Office e-Bulletin – FP8, Key Sector Trend Reports, New Skills, New Jobs – 10 September 2009***

Also this document shows how important is, even for European Regions, to discuss strategies to compete .

15 ***- Assembly of European Regions – Priorities 2010***

This document is another impressive example of the contribution that single Regions of Europe give to decide priorities; they somehow give the impression to act independently from the Member States!

16**–**The ***CERN website*** gives all the details about this fundamental European Research Laboratory.

*17 -**Official Journal of the European Union**; Recommendation 2010/238/EU .of the 28.4.2010.*

THE EACH PROJECT

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THE EACH PROJECT

KEY ACTION X.1 – RESOURCES OF THE TERRITORY

KEY ACTION X.1 – RESOURCES OF THE TERRITORY

AREA X.1.1 – Survey of the territory

TARGETS:

1 - Remote sensing
2 - Topography and cartography
3– Development and test of 3D visualization
4 - Excavation computerised systems
5 - Sensors and photographic data
7- Conversion systems
6 - The hypogeal environment

AREA X.1.2 – Geophysical, chronological & underwater determinations

TARGETS:

1 - Standardisation of geophysical methods and surveying
2 - Chronological determinations
3 – Development and test of 3D visualization
4 – Underwater methodologies

AREA X.1.3 – Provenance of the resources

TARGETS:

1 - Metallic materials
2 - Stones and lithic materials
3 - Ceramic and vitreous materials
4 - Organic materials

KEY ACTION X.1 – RESOURCES OF THE TERRITORY

INTRODUCTION

It seems appropriate to use the term "resources" for indicating artefacts, testimonies, and documents that constitute the cultural heritage which is entrusted the identity and the conscience of each human society. These resources are allocated individually in the territory, but also there has to be systems and articles in the time dimension.

The two themes (territory and time) will be developed and examined utilizing surveys and chronological determinations. Surveys are concerned with the systematic approach to the individualisation of the resources in the territory that contains all of the pre-existing to the single artefact. Chronological determinations refers to some of the methodologies or choices because these are most significant for the width of applications and for the strong approximation of obtainable results.

AREA X.1.1 - Survey of the Territory

PROBLEMS

The systematic acquisition of information regarding the physical and cultural aspects of a territory is essential to a complete identification of its cultural resources. This may lead to an interpretation procedure for the historic reconstruction of human presence and for a control and utilisation of such resources.

In a more general perspective, it is evident that all this - efficiently organised and co-ordinated - constitutes the basis for an essential knowledge for every decision and activity of the public authorities and private individuals with regard to cultural heritage, from its supervision and protection to its recovery, preservation and exploitation.

Within this framework, the necessity for consistency gives first consideration to the acquisition, processing and interpretation of multi-temporal and multi-spectral images from satellites and low or very-low altitude aeroplanes, the latter employed for obtaining data with an increasingly higher resolution. The product of the interpretation must be interfaced with photogrammetric data in order to exactly

geo-referencing all the data acquired and to compare them with geophysical, mechanical and other field observations.

The basic research problem for cultural resources is to optimise the remote-sensing procedures for images from existing orbital or aerial platforms and to develop new suitable platforms for shots from low and very low altitudes (between 300 and 50 m), as well as the most appropriate equipment and methods for the purpose, while taking into consideration the environmental conditions for filming and the possibilities for correlating thermal images with those in the visible wavelength.

As far as the topographical survey is concerned, it is important to optimise the procedures for aerial and ground photogrammetry both analytical and digital, for the special needs of the cultural patrimony. It seems important to develop the research in order to best utilise so-called “quick” photogrammetry and research on electronic photogrammetry, with the use of high-resolution CCD television cameras. An interesting objective also appears to be the study of plotting programs from surveys made by means of reckoning through the use of total stations.

Also relevant with these problems is the study of specific sensors for specialised applications in the visible wavelength: the study of the optimal environmental filming conditions for data acquisition and of the techniques for controlling and guaranteeing the stability of the acquired data and the repeatability of the measurements. Lastly, attention is given to the digitalisation procedure of the signal, with the aim of reducing conversion noise to a tolerable minimum.

TARGETS

1 - Remote sensing

Acquisition and processing of images taken from an orbital or aerial platform in an area that is physically and historically defined.

By “pre-existence” is meant every trace that can be referred to human activity, the properties and forms of which are derived from the nature of the subsoil, and the characteristics of the surface. Methods of remote sensing can be very useful in order to identify pre-existences.

Development and optimisation of innovative methods for the photogrammetric plotting of remote-sensing images.

Having taken into account the always greater resolution of the images and of their ever-growing importance in the acquisition n of information on physical and human pre-existences, even to a rather large scale. The line of research must identify and define the most efficient methodology for geo-referencing the remotely-sensed imagery.

Acquisition and processing of multi-temporal and multi-spectral images shot from low and very low altitudes.

The research must deal with a large-scale detailed study of the data collected by means of the images derived from orbital or aerial platforms. For this purpose

are necessary the multi-spectral images taken from low or very low altitudes (between 300 and 50 m), so as to correlate the interpretation of the thermo-grams with the photogrammetric plotting at large and very large scales. The first objective is to optimize the filming platform (aeroplane and gondola, raised by balloon and cable-driven from the ground); then, to define suitable equipment and study processing and interpretation programs oriented towards this type of imagery.

Optimisation of the use of satellite positioners for the survey of cultural resources.

The research will have to develop, and orient towards the specific objective, the methodologies that are operative in the field for the specific requirements of the cultural heritage, and study programs for recording and graphically display while respecting the greatest accuracy of the survey.

Special methodologies of photogrammetric plotting of the near and very near wavelengths. Here, it is necessary to define the applications of photogrammetry in order to document particular operations carried out on cultural resources, such as microphotography, as well as to initiate the correct use of “quick” photogrammetry and of electronic photogrammetry with the use of solid-state, high-resolution television cameras.

2 - Topography and cartography

Development and processing of urban and territorial, historical archaeological cartography based on the direct recognition and precise definition of archaeological sites and monuments by means of the application of innovative techniques and methodologies implying codification and simplification of the procedures.

To the traditional research methods which start from literature sources, specific bibliography, archive research, and continue with the direct prospecting of the ground with relative computerised indexing, will be added the support of the aerial-photographic survey, of photogrammetry and of remote sensing. Of these latter techniques, the procedures that are most adequate for the analysis and interpretation of the archaeological substratum will be identified and experimented also by means of the application of image-improvement treatments and the emphasising of the information contained in the digital datum.

The detection, by means of the point co-ordinates of through total stations and the precise definition on spot space-maps, obtained from pre-processed images at the maximum level of cartographic accuracy, will be flanked by a positioning on traditional cartographic bases.

For archaeological purposes, the combination between digital elevation models of the ground and spot images for 3D visualisation of the areas, complexes and archaeological situations and the consequent implicit applications of a change of point of view and projection levels, will be experimented.

3– Development and test of 3D visualization

Development and test of 3-D visualization tools for the high-resolution non-invasive exploration of sites of archaeological interest.

Integration of geophysical output with other types of datasets like aerial photographs, satellite images, archaeological maps, geological maps and digital elevation models, using mapping tools (e.g. GIS, Google Earth) for improved management of archaeological information about buried cultural resources.

4 - Excavation computerised systems

The aim of the research is to develop processing methods for archaeological data, or more precisely:

a) graphic data, such as the archaeological cartography to different scales produced through data processed according to the above lines of research, the excavation maps and sections obtained also with the aid of automated procedures by means of television cameras, detailed maps of single structures or monumental complexes, the photogrammetric surveys of near and distant objects;

b) raster images, such as aerial photographs, remote-sensing images, photos of materials, etc.;

c) alphanumeric data, derived from the indexing and catalogue of monuments and findings.

The system must provide not only for the perfect integration among the three types of data and the possibility of autonomous treatment of the graphics, but also, in particular, for observation of the excavation data by means of the system of stratigraphic units with the related materials.

Furthermore, the system will be characterised not only by the possibility of recovering complex and heterogeneous information, with the analysis of graphic and alphanumeric data, but also of high-level statistical processing of the spatial-temporal distribution of the structures and materials concerning both the entire site and the environmental context.

5 - Sensors and photographic data

In managing the artistic and cultural heritage, the acquisition of data is considered essential for any sort of operation and benefit; furthermore, the characteristics and properties of the procedures involved in the operation depend on the peculiarity of these.

By giving specific attention to the images in the visible wavelength, the typology of the information requested involves aspects relative to the photographic conditions of the scene: specifically, therefore, the photometric, geometrical-dimensional and conversion aspects.

Since the sphere of cultural resources is extremely varied - it can range from a small painting to a large fresco, from small manufactures (e.g. jewels, furnishings) to statues, monuments, and to archaeological sites - this poses problems of accessibility and protection. Therefore, the sensoristics for acquisition systems and the environmental conditions must verify a series of elements that are essential reference parameters for the validity of the data acquired.

The subjects of research to be developed in this line will involve the problems related to the following parameters:

1. Fidelity. The acquisition of a datum must be as independent as possible from the context, and be linked therefore solely to the physical characteristics of the object and not to the photographic conditions; as such it must be repeatable in time and space;

2. Completeness. The data acquired must contain a quantity of information greater than or equal to the human perceptive capability, and the photometric datum must be associated with the dimensional datum.

3. Passivity. It must not act physically on the source and on its environmental conditions.

As far as the acquisition systems and relative sensors are concerned, there already exist sensors on the market that are prototypes or instruments such as photographic cameras or scanners with digital output and ultra-high resolution level. What is lacking and will, therefore, have to be the subject of study is the product area that satisfies the union between the specificity of the application, the operative environment and the cost/performance ratio. From this aspect, within the sphere of sensor technology, the role of special applications is important both in the spectral wavelength and in the resolution domain.

As far as environmental conditions are concerned, the research will have to cover lighting aspects, both as geometry and as wavelength for the sources, and the problems relative to the repeatability of the observation as an unchanging dimension in time and in space. The latter requirements are fundamental for applications such as monitoring, preservation (maintenance), and support to restoration.

6 - The hypogeal environment

The underground environment is currently the subject of considerable attention. Some international organizations such as the International Union of Speleology, the International Union of Geography and the International Association of Show Caves, have already faced the problem of their conservation and protection, in view of their use for tourism. However, it is still lacking their identification as a "*subject*" of culture.

In fact it is almost always highlighted the morphological component, or its being part of a fragile underground ecosystem, leaving the anthropic component except for the fact that such environment has been enjoyed as a prehistoric settlements.

The cavities are suffering from this reductive attitude. They are considered only an accessory to the monuments of archaeology. The knowledge of water management in the ancient world is shown only for some achievements, like aqueducts. However, little attention has been devoted to hydraulic works, which allow drainage.

A Mediterranean project could aim at the development of a "*typological atlas*" of these structures, highlighting the synergies that several societies have realized their design, construction and maintenance. The purpose of this activity could lead to a series of directions to be given to States, especially of

the Mediterranean area, to undertake concrete measures for their protection and touristic exploitation.

7- Conversion systems

The “digitalisation” process of a multi-dimensional signal is one of the key points in digital analogical conversion systems. It consists of two phases: sampling and quantization.

Sampling is conditioned by the spectral characteristics of the signal and is controlled by the Nyquist theorem, while quantization converts the size of the continuous wavelength (domain) to the discrete one, by introducing a distortion in the representation of the said size which is called a “quantization error”.

If not carried out correctly, respecting therefore the statistical/spectral properties of the signal to be “digitalized”, both of these operations introduce into the conversion system a noise that, once introduced, can no longer be eliminated. It can thus be understood how important and fundamental this process is and how it is conditioned by the characteristics of the source and of the applications requested.

The aim of this research therefore is to identify, in accordance with the characteristics of the signal to be converted, the parameters of the process, having taken into account the electronic performance of the available devices or those that will be made available over the space of coming years.

In particular, in cases in which the signal-generating system is a shot from a television camera or from a sensor in the not-visible wavelength, the part of the signal processing in the analogical domain will have to be studied by orienting attention on the electromagnetic and electronic compatibility of the same compared to the digital one.

EXPECTED RESULTS

The methodologies of remote sensing must be considered as one of the main instruments of general application for studying the territory and for systematically identifying cultural resources, contributing in this way to an enrichment of the process of decisions concerning cultural resources.

Of particular relevance within the sphere of remote sensing will be the acquisition, processing and interpretation of images derived from low and very low altitudes, from which the most extreme resolutions are obtained.

Topographical plotting with the innovative methods of satellite positioners and with those of the total stations based on wavy distance-measuring devices is fundamental, and must be rendered applicable to the current requirements of remote sensing, such as the use of photogrammetry with symmetrical cameras and of electronic photogrammetry.

Experimentation and optimisation of the coupling procedures from archaeological cartography to remote sensing are aimed at making possible its continuous contextualization from the point of view of territorial planning and

protection. Archaeological cartography will be connected to a data bank, with an organisation of the information that will make possible the most extensive production of specific thematic maps.

The surveying and cataloguing of excavation data, carried out according to innovative computer methodologies, will contribute to the formation of graphic, raster and alphanumeric data banks; contemporaneously, always more refined procedures will be experimented as far as the level of interrogation and exploitation of the data banks is concerned, in accordance with the needs of the research carried out at the various Centres (university and non-university) and of the different activities of the Authorities made responsible for the protection and preservation of cultural resources.

In the technological sphere, the development of one or more sensors optimised for specific applications of particular technical-scientific interest, can be hypothesised.

Preparation of maps of archeological sites of minor relevance can supply original documentation for military forces operating in the Mediterranean Area. Teaching programs for special military Corps could be the argument of a specific European project.

AREA X.1.2 – Geophysical, chronological & underwater determinations

PROBLEMS

The analysis of an area of land can be developed by means of a series of controls using geophysical techniques and core drilling. This kind of investigation, well developed for the identification of mineral resources, has been systematically used for some years also in the exploration of archaeological sites or more generally in the recognition of buried structures and in the study of the conditions of the foundations of architectural complexes.

Geophysical surveying has the advantage of supplying information on the subsoil rapidly, and relatively economically, through the identification of anomalies in the physical properties of the materials.

Until now the most widely used methods for identifying anomalies associated with pre-existing anthropic activities have been those based on measurement of the intensity of the magnetic field (magnetic methods) and measurement of electrical resistance (geo electric methods). Seismic methods, used for the most part in mineral exploration, have not been used due to methodological difficulties. Interesting results are emerging as regards

electromagnetic induction methods, georadar and acoustic impulses and the study of the phenomena of induced or spontaneous electric polarization.

The use of geophysical techniques on the surface and in very thin subsoil strata has been partly made possible by the development of systems of data collection and elaboration by means of appropriately prepared computing programs. Although it is possible to obtain indirect information on the subsoil using geophysical exploration, on the other hand this information must be integrated with direct data obtained with continuous core drilling, which must replace the materials as undisturbed as possible during the penetration of the probe. This requires notable technological effort because the probe is working with loose material. Continuous boring supplies samples for chronological, palaeo botanical, palaeo zoological, sedimentological and geophysical data and for obtaining geophysical measurements in the borehole.

Another area where geophysical exploration is ever more applied is in the underwater environment. Artefacts of historical and artistic interest are very frequently found by chance by amateur enthusiasts during underwater activities. However, there is no continuous and systematic scheme of exploration of the sea bottom based on essentially geophysical methods, which would give a relatively complete picture of underwater finds.

Geophysical exploration and regular core drilling can contribute decisively to our knowledge of the subsoil and sea, lake and river bottoms, in which there is evidence of settlement and the presence of artefacts. Geophysical methods can produce rapidly and at low cost geophysical maps of the subsoil and sea bottom, together with material for dating and for various other study purposes. They can also lead workers more accurately to precise areas for excavation.

TARGETS

1 - Standardisation of geophysical methods and surveying

Reconversion, scaling and adjustment of surveying methods used in the field of mineral resources. Development of specific equipment for subsoil exploration. Preparation of methods and creation of intelligent systems for the collection, elaboration and interpretation of data.

Application of new methods of geophysical exploration in archaeological areas; creation of circumscribed areas and experimental fields with clearly identified targets and buried structures.

Development of responses given by acoustic and inductive and impulsive electromagnetic equipment. Development of micro seismic and induced and spontaneous polarization techniques.

Design of specific equipment for mechanical surveying. Methods to obtain undisturbed samples through processes of freezing of the soil, development of boring, light and very mobile probes.

Geophysical exploration of the sea bottom, lake and river beds; refining of positioning methods; preparation of methods for recovery of archaeological finds.

Geophysical techniques give useful information on the state of decay of buildings.

In particular, the propagation of elastic and electromagnetic waves depend on the physical state of the structure involved; methods such as ultrasound and GPR (electromagnetic) surveying allow identification both of the characteristics of the structure under examination and identification of the different elements (built with different materials) of which it is composed, besides their state of conservation.

Surveying in the architectural field with geophysical methods can be carried out with standard instrumentation. Excellent results have been obtained with this instrumentation in the monitoring of large construction projects and in industry for the inspection of materials.

Geophysical surveying also has the advantage of operating in situ without altering the state of the structure being examined.

The application of indirect methods in architectural contexts, however, needs a refining of the techniques applied to this particular objective and also the standardisation of the processes of elaboration and interpretation of the signal.

2 -Chronological determinations

a) Dating by nuclear methods

The proportional counter technique, that measures the beta radiation from C-14 gives excellent results (thousands dating operations have been performed) but needs a big sample (several grams), often unavailable. The second technique is Accelerator Mass Spectroscopy that is the direct measurement of the isotopic ratio C-14/C-12 by means of an analytical technique which uses a particle accelerator and ion bean analysis system to measure rare radioisotopes in natural samples. The quantity of sample necessary to carry out this technique ranges from a few milligrams to man milligrams. This is why this method can be considered virtually non-destructive and more sensitive than the traditional one.

Moreover, a through study of the present hypotheses on which C-14 is based should be carried out: distribution in time and space of atmospheric C-14; precise knowledge of its half-life; atmospheric origin in living organisms and influence of human activity in the last decades.

b) TL Dating

Thermo luminescence or Thermally Stimulated Luminescence (TSL) dating is particularly suitable for ceramic material, almost always present in human ancient settlements. Therefore it is a valid method to be applied to the historical archaeological research, from the pre-history to the present age, with a precision rate of 5-8%. Studies aiming at improving the performances must be developed focused both on sample preparation and on calibration techniques.

It would be useful to investigate also other materials, such as burnt flints and stones.

Another method, strongly connected to TSL is OSL, Optically Stimulated Luminescence, whose potential shall be examined. Finally an effort must be made to understand the origin of the so-called Spurious TL that limits or even inhibits sample dating. It is therefore important to organise a service which can meet the requirements of the cultural environment.

c) Other methods of dating

Other methods of dating can be considered and compared with those used up to now. Particularly interesting is dendrochronology, an extremely precise dating method that played an important role in the calibration of C-14 dates. An effort to get ring sequences as long as possible on woods used in construction, largely used in ancient times, would be very useful and precise to study pile dwelling, wooden structure of monuments, etc.

3– Development and test of 3D visualization

Development and test of 3-D visualization tools for the high-resolution non-invasive exploration of sites of archaeological interest.

Integration of geophysical output with other types of datasets like aerial photographs, satellite images, archaeological maps, geological maps and digital elevation models, using mapping tools (e.g. GIS, Google Earth) for improved management of archaeological information about buried cultural resources.

4 – Underwater methodologies

Methodologies for underwater explorations are almost completely based upon acoustic waves because electromagnetic waves are drastically absorbed in water. Acoustic techniques for explorations into deep sea sub bottom had a remarkable development from oil-research, mainly concerning acoustical signal processing, while no substantial contribution has been given to the improvement of resolution which is an indispensable requirement in shallow exploration. Actually, oil-research is interested to large-scale anomalies connected with the profitable big oil-fields, for which resolution is not an important requirement. On the contrary, the exploration of shallow sea sub bottom,- namely a range from a few to tens of meters,- needs high resolution in order to reveal small anomalies and objects. This is the case of marine archaeology, where high-resolution is a compulsory requirement in order to reveal also small anomalies and antique objects. Detecting sea sub bottom sediment structures and archaeological objects is a very important topic, especially for the Mediterranean Sea Basin. Actually, in this area, the succession of manifold geological events, which caused submersion of secular strata of various civilization man-made structures, and thousands of shipwrecks from the ancient age to today, render the top layers of the sea bottom particularly interesting. The presence of archaeological remains on the sea sub

bottom is often correlated to particular marine environment situations, so their detection and unearthing also help to investigate the geological characteristics of the submersed sites, as well as to enrich the historical heritage of the neighbouring countries.

Today the objective of the underwater archaeology is the recovery and conservation of the objects and their study after recovery. The conservation of the objects where they were found would constitute the presupposition for the constitution of underwater archaeological sites which could be visited by lovers of underwater activity.

The realization of such an idea needs to study how to preserve the underwater site and how to facilitate its availability. A great field of research would be open.

EXPECTED RESULTS

Technological advancements in the existing methods for subsurface imaging and characterization and development of original and dedicated tools to identify and map buried cultural heritage. In particular:

- Development of efficient data acquisition protocols and tools for high productivity, simultaneous acquisition of topographic data, rapid Ultra-High-Resolution (UHR) integrated geophysical surveying in case of hostile site conditions and in case of necessity of complementary data to constrain and reconstruct the subsurface model. Variability of target and soil conditions requires maximum flexibility of the data acquisition phase to optimize the information content attainable. This Area will focus on the implementation of procedures and tools that can be adapted to face the most complete range of site conditions and to provide the geophysical datasets best suited for subsurface imaging and characterization;
- Development of processing, inversion and interpretation tools to rapidly deliver useful information about buried cultural heritage to end-users (archaeological teams, site managers, engineers). The proposed tools will be dedicated to imaging (model-based and model independent imaging solutions), processing (coherent noise reduction in environmental datasets, multi-attribute extraction from GPR and UHR seismic datasets based on wavelet transform, attribute classification), inversion (AVO data extraction and analysis, inversion of dispersive guided waves and joint inversion of different waves based on genetic algorithms and Multi-Objective evolutionary algorithms, joint inversion of seismic and resistivity data) and interpretation (joint interpretation of processed geophysical volumes, multi-attributes volumes and inversion results). The data processing, inversion and interpretation activity aims at the extraction of information of use for archaeological site mapping through a combination of state-of-the-art geophysical technology;

AREA X.1.3 - Provenance of the resources

PROBLEMS

The provenance studies and the investigation of the original usage of historical and archaeological artefacts are very important in order to gain information on its historical placing and to know it well. It is also possible to determine the chemical composition and the morphology of the artefact and of the materials from which it was obtained using traditional and advanced analytical techniques. It is well known that from the comparison between these data and the ones that can be obtained by chrono-typological analysis of the archaeological sources we can discover the provenance of raw materials, the placing of production sites and the trade routes. This study leads to a better knowledge of the progress of production technology and of usage of the artefacts together with a deep understanding of the economic, social and cultural development of ancient societies. Therefore it is important to put together different disciplines such as history, archaeology, geology and physical-chemistry.

The physical and chemical characterisation of a certain material involves the mineralogical and petrographic study, the quantitative analysis of components (also traces), the determination of isotopic ratio, the study of surfaces and of interfaces. It is often necessary to use non-destructive analytical techniques or at least techniques that involve very small samples.

In order to validate the analytical procedures it is useful to compare data concerning a single artefact taken by the application of different procedures an to calibrate with appropriate standards.

Statistical methods such as PCA, can be useful to understand the correlation between different data sets or allow us to evaluate the influence of variable in the creation of data sets. These methods together with data base (ore bodies, artefacts composition) and information retrieval systems are very important in many fields, such as provenance studies.

With this aim it would be very useful to create some data base containing data obtained from provenance studies and characterisation of raw materials, slags and waste products.

TARGETS

1 - Metallic materials

By means of analytical techniques, both traditional and advanced, a research on metallic artefacts, such as ingots and end products, and any other

trace of metallurgical production, such as slags, crucibles, etc. will be carried out. The results will be integrated by historical, anthropological, and geological studies in order to spot the ancient mining areas, the trade routes and the metallurgical technologies.

2 - Stones and lithic materials

In order to define precisely the provenance and usage of lithic and stony artefact, petrographic, chemical (principal components and traces) and isotopic analysis on artefacts and raw materials are very important. Besides this, it is necessary to examine a great number of samples with different analytical techniques, all of which should be fast, useful and standardised so that the information gained will be valid for archaeometric studies. Experimental data will then undergo multivariate statistic analysis.

3 - Ceramic and vitreous materials

This research on glass and ceramic includes also majolica mosaics and terracotta. Any analysis that will be made on artefacts, raw materials and waste products will be carried out as quoted in the previous topics.

The creation of a data base for every type of artefact, the spotting of the production sites and the identification of traffic routes will be a great utility.

4 - Organic materials

The aim of this study is to find out which organic compounds (even if in traces) are present in various type of archaeological artefacts. These compounds can shed light upon everyday life, social and religious habits of different cultures and ages. Their identification will also give information on provenance of the artefacts, on production activities and on trade routes.

EXPECTED RESULTS

A common objective of all the different research topics is to establish some specific analytical methods (preferably non-destructive), and standardized analytical procedures to insure that analytical results are reliable and comparable.

In the end it is better to point out that in some cases it can be necessary to analyse if present, some organic compounds in order to discover and identify any anthropic traces and the usage of the artefact.

THE EACH PROJECT

KEY ACTION X.2 - DIAGNOSTICS AND RESTORATION

KEY ACTION X.2 - DIAGNOSTICS AND RESTORATION

AREA X.2.1 – Evaluation of damage: restoration and conservation of mobile Cultural Heritage

TARGETS:

1 - Development and application of analytical methodologies for the knowledge of nature and structure of the works of art.
2 - Development of nondestructive techniques
3 - Set up mobile units: design and development of prototypes
4 - Seismic early protection system for movable and semi-movable objects

AREA X.2.2 - New diagnostic systems for the characterization of the state of conservation

TARGETS:

1 - Causes of material decay
2 - Noninvasive sensors
3 - Development of materials for conservation
4 - Laser applications in Cultural Heritage

AREA X.2.3 – New technologies and products

TARGETS:

1 - Design and development of materials for the consolidation, aggregation and gluing
2 - Development of new materials for restoration
3 - Design and development of physical methods for the protection.
4 - Design and development of protective
5 - Development of applicative techniques and control procedures of products used in the interventions
6 - Sources of light and photosensitivity of the artifact surfaces
7- Biotic damage: characterization, treatment and protection

AREA X.2.4 - Evaluation of damage: restoration and conservation of monuments, buildings and historical gardens

TARGETS:

1 - Historical knowledge of the building
2 - Provenance studies of the building materials
3 - Numeric and physical model
4 - Characterization of materials.
5 – Energy and sustainability

AREA X.2.5 Methodologies for reversible mixed technologies use in seismic protection of historical constructions

TARGETS:

1 - Strategies for the safety of cultural heritage

AREA X.2.6 – Evaluation of damage: restoration and conservation of paper, parchment, etc.

TARGETS:

1 – Paper weakening
2 – Other documents
3 – Ageing, de-acidification and de-infesting treatments
4 - Electronic restoration and retrieval of information on documents

AREA X.2.7 – Nanotechnologies in preservation of Cultural Heritage

TARGETS:

1 – Diagnosis by nano or molecular deterioration markers
2 – Intervention by nano-systems for restoration
3 – Protection by nano – systems for conservation
4 – Protection by nano – systems for conservation
5 - Monitoring and maintenance by nano devices

KEY ACTION X.2- DIAGNOSTICS AND RESTORATION

INTRODUCTION

This Activity will deal with the revision and setting up of current methods for the control of the conservation state of Cultural Heritage and for the research of new methodologies devoted to a deeper and more reliable knowledge of this control.

The aim will be the identification of the deterioration and/or instability causes and of the mechanisms responsible for the verified deterioration phenomena.

However the finalization of the activities is of primary importance to achieve results directly transferable to conservation actions for diagnosis and treatment of artifacts and for normative regulations.

A - Diagnostics

Deterioration of materials is the main problem for the protection of cultural heritage from the attacks of different external agents (environmental, biological, physico-chemical agents, etc.) and from the internal factors to the material (endogenous to the material).

The antiquity of the materials, their sensitivity to pollutants, their vulnerability in consequence of corrosions, are the most frequent causes of deterioration of cultural Heritage. Thus it is necessary, after a preliminary knowledge of the conservation conditions, to study carefully the phenomena in order to identify the main causes which have contributed to deterioration, also taking into account that the nature and the physico-chemical properties of the materials give rise to strongly diversified aspects of degradation.

Instability of structures is a theme of predominant although not exclusive, interest of the architecture heritages, as instability phenomena are mainly due to the action of loads or to the co-actions on buildings.

Again the preliminary knowledge must allow the accurate identification of the revealed phenomena and the formulation of a preventive diagnosis for the possible treatments.

As for the deterioration, the symptomatology of the instability strongly depends on the type of material (wood, masonry, concrete, steel, etc.), and on the cause responsible for the phenomenon (instability of soils, yielding of foundations, dynamic actions, seismic effect, concentration of tensions, etc.).

The identification of these causes is the necessary basis for analyzing and comparing the possible methodologies of treatment.

B - Conservation and restoration

Any treatment must be justified by a preventive diagnostic investigation aimed at the research and identification of the causes of deterioration and instability.

The subsequent treatment must rigorously be justified and finalized to the recovery and conservation of goods.

It is necessary to know the whole historical, environmental and diagnostic picture of the single artifact and/or of the artifact system in order to act responsibly and appropriately, because they are goods of high historical and documentary relevance.

When the need of the treatment is proved, it is necessary to adopt the best solution, on the basis of general criteria based on reliability, certainty and durability

First of all it is necessary to make a reasoned choice, after an accurate comparative analysis of different possibilities, of the solution one intends to carry on. This solution should be preferably unitary to make the treatment as general, repetitive and hence checkable as possible. However different treatments on buildings, artifacts or on other systems cannot be ruled out.

An artifact, which had suffered historically and functionally different structural or productive events, will require diversified operations. As an example, for the architectural heritages artifacts the treatment will be diversified according to the material features or structural typologies, the type of treatment which may involve an adaptation or improvement of resistance to quakes or a simple repairing or restoration of the damaged components.

Another criterion regards the choice of the materials compatible with the pre-existing ones in order to avoid rejection crisis which would compromise the durability of the treatment. This requires preventive investigations in order to design the most acceptable material of integration.

In addition to the materials it is important that the reclamation techniques are possibly soft as they do not have to put irreversible tensions in the artifacts or to give rise to actions difficult to be controlled. This can be governed by a simulation on a numeral model or, if possible, by tests on a physical model.

AREA X.2.1–Evaluation of damage: restoration and conservation of mobile Cultural Heritage

PROBLEMS

Works of art consist of an extremely complex and variable set of objects and artifacts differing both historically and physically. Such works have been produced in different periods and geographical areas, and therefore within different cultural

environments using different techniques. They have been retouched by the artist himself or modified and restored by others or, finally, altered by the elements over the centuries.

A deep analytical approach is therefore necessary to guarantee a correct interpretation, which is not only based on the evident morphology or the object under examination.

The analytical methodologies may be applied to a wide variety of works of art which include paintings, sculptures, metallic artifacts, potteries, etc.

In addition to a series of analytical methods in chemistry, physics, mineralogy, petrography and geochemistry currently applied in the Cultural Heritage field, it is necessary to set up new, specific methodologies suitably designed to aid in a correct way a reliable characterization of the material composition of works of art.

Another aspect of paramount importance, which affects subsequent investigations, concerns the sampling techniques. Indeed we like to consider in principle every sample extraction “invasive”, even though the modern technology can allow for microscopic sampling.

However, it is also necessary to keep in mind the relationship between the significance of the measurements and the completeness of the investigated (and therefore sampled) area.

From the above considerations. it becomes necessary to develop analytical techniques and methodologies which are completely non-invasive or that minimize the need for micro samples, exploiting the complementary information from various sensors and detectors, designed to provide multiple information from the same sample.

TARGETS

1 - Development and application of analytical methodologies for the knowledge of nature and structure of the works of art.

In addition to the traditional analytical technologies, such as diffractometry, microscopy and spectrophotometry (Including fluorescence and micro Raman), its application should be extended to techniques not yet used in the field of cultural heritage conservation. Among them, mass spectrometry, Mossbauer, electronic emission and X-Ray spectrometry (PIXE, XSP, Auger. SIMS, XRF) seem to be promising. Application potentialities of different magnetic resonance techniques should also be considered.

Pairing of different complementary techniques will be further used in completing the information on the same sample. Among these the mass spectrometry and FT-IR spectroscopy can be mentioned, together with various chromatographic techniques.

2 - Development of nondestructive techniques

Nowadays traditional analytical techniques can provide very precise and reliable results even on very small specimens; however the sampling of a work of

art should be limited only to particular cases. As a consequence of the latter consideration it is necessary to develop completely “non destructive” or better “non-invasive” new technologies, which best describe the absence of any impact on the work of art.

Among such techniques recently employed in this field, spectrophotometric techniques deserve mention as they use optical fibers to guide the radiation and work in various intervals of the electromagnetic spectrum (ultraviolet, visible, Infrared) together with image spectroscopy, thermo vision, use of grazing laser light and holography, which provide detection of small variations or microscopic damages to the artifact. Finally, the ultrasound techniques are also valid for this type of activity.

Besides the optical range, other spectral regions can often be useful for non destructive evaluation through appropriate inspection techniques, namely, the radio-to-millimeter-wave and the X-ray ranges.

3 - Set up mobile units: design and development of prototypes

Design and realization of portable equipment to be used directly in museums, archeological digs or wherever the artifact, to be investigated, cannot be transported.

4 - Seismic early protection system for movable and semi-movable objects

Generally, the problem of protecting the movable objects in the Museums from the strong actions induced by the ground motion has to be faced in a specific way, which is different from the one normally followed for avoiding damage due to the structural collapse of the building. So, it is clear that the methodology for collections’ protection have to be set up in different way. One of the most effective systems for the movable and semi-movable objects’ protection from earthquake damage is represented by the “seismic early protection”. This is a strategy that can be planned through a system called Early Protection system, which is based on some key concepts, which have to guarantee no invasivity, no contact, early detection and identification of the risk. The main system consists of three sub-systems:

a) A dedicated Seismic Early Warning (SEW) on-site network, which can also be nested within the regional seismic networks (when available); e.g., in Italy, within the National Geophysics and Volcanology seismic network.

b) A number of reliable and efficient non-intrusive devices (e.g. anti-seismic devices, air bags, elastic net etc.) for the preventive conservation of an object or item, or a group of object or items in display cases, during the earthquake excitation aimed at avoiding and minimizing their deterioration or loss.

c) A robust, secure and interoperable communication systems based on improved supervisory control and data acquisition to support the awareness, command and control capabilities, helping the museum responsible to manage the pre and post event with technologies and tools for rapid and efficient survey.

A suitable answer for market production: the semi-passive devices

This high-tech product must be suitable for market production; in this perspective, the collaboration with important high-tech service companies become remarkable. Therefore, this cooperation allows to be based on both existing knowledge and products available on the market for developing this technology, in combination with the new knowledge, methods, tools and system components studied.

As a result, new semi-passive non intrusive & no contact protection devices can be activated by the early warning triggering signal few seconds before the catastrophic event occurs, which represents one of the primary objectives to be obtained.

The first step is the definition of the possible time scale of actions: the scale of seconds, through the possible actions activated by a warning signal from a network of sensors dedicated to the early detection and identification of the parameters univocally significant each of the critical event scenarios defined in a risk assessment analysis for the selected infrastructures.

The system has to protect statues and museum objects through the use of these innovative semi-passive devices, blocked in normal conditions and unblocked by a Seismic Early Warning (SEW) triggering signal.

The nesting of a dedicated network of SEW sensors within the regional early warning networks (when available) has to be implemented to activate the new ceramics semi-passive devices.

In the field of the prevention, protection and post earthquake management for the cultural heritage assets, including maintenance, the priorities can be synthetically summarized as follows:

A) Critically review of the existing methodologies and tools for protecting cultural heritage assets from risks and damages resulting from earthquakes.

B) Significantly reduce the vulnerability of movable and semi-movable Cultural Heritage Objects and items through preventive measures and actions taken to mitigate the earthquake effects and to reduce the risk of damage or loss, with appropriate remedial conservation actions and the use of passive and/or semi active anti seismic devices activated by the early warning triggering signal.

C) Develop sustainable integrated methodologies and innovative systemic tools helping the museum managers to manage the pre and post event their collections, their conservation, maintenance and care and emergency planning.

- About priority A, the existing methodologies and approach in terms of spatial and time scale to protect the cultural heritage assets must be analyses, introducing the time scale of seconds and milliseconds for the possible actions to reduce the effect of earthquakes.

- About priority B, the enhanced prevention and protection of cultural heritage assets will be achieved by means of studying and developing protection systems for movable and semi movable Cultural Heritage objects (statues, altars, museum display cases, etc…..) based on innovative semi-passive and semi-active protection devices. The new semi-passive devices will be blocked in normal conditions and unblocked by the Seismic Early Warning triggering signal.

- About priority C, an earthquake risk management and decision support system, addressing the specific decision situations for the bodies responsible of the cultural heritage site before, during and after an earthquake should be realized from an integrated and sustainability perspective. A uniform basis for the representation of the uncertainties dominating the decision problems must be developed and specified. The effective integration of various sensor techniques has to be realized through multi sensor data fusion and data correlation techniques for fast, sensitive and affordable identification of the physical parameters significant the critical event for the cultural heritage goods to be protected, build-up and maintain a robust, secure and interoperable communication systems based on an improved supervisory control and data acquisition (SCADA) functions coupled with advanced Data Fusion capabilities in a Score Event Board (SEB) to support the awareness, command and control capabilities of the earthquake pre and post event.

As a good practice, we may take into account a suggestion given from a scientist of Puerto Rico, as part of a programme referred to the Caribbean Tectonic Plate. The physical environment plays a significant role in the Risk Assessment Plans for Cultural Heritage conservation, so that, starting from the geological and atmospheric reality, it is part of a procedure developed for a GIS or remote sensing analysis, preparing a Risk Assessment and Vulnerability Profile, a simple document based on a GIS analysis of any cultural heritage artefact that have a geographical position that will be of use to visualize in a simple language for any community the importance of the conservation of the cultural patrimony.

EXPECTED RESULTS

The main results of the previous targets include the optimization of the procedures, standardization of investigation methods, selection and directives for the most appropriate techniques for solving specific analytical problems related to the nature of the artifact.

Evidence should be given of the non-invasive techniques that can be widely employed and are most liable to substitute current partially destructive methods.

Finally manufacturers, especially those in optoelectronics, should realize specific prototypes of transportable, easy-to-use equipment, properly designed for application in the conservation of the cultural heritage.

It is particularly important the protection against seismic emergencies for mobile cultural heritage.

AREA X.2.2 - New diagnostic systems for the characterization of the state of conservation

PROBLEMS

It is important to emphasize that the different possible locations of works of art and the extreme variety of materials they are made, can create problems for their conservation. Once again, the interdisciplinary character of the research into the causes of decay and the state of conservation appears to be of primary importance. As far as the state of conservation is concerned, it will be necessary to review and improve present methods as well as to search for new procedures which will provide more reliable and detailed information. Of course, any future research cannot be carried out knowing the causes and mechanisms of decay. As a matter of fact, although causes and processes of decay may be supposedly well understood, even today we often ignore exactly how synergies among different agents (physical, chemical, biological and anthropic) take place. At the same time we have neither exact information regarding the evolution of the different processes of decay, nor the safety limits which any particular kind of artifact can be conserved in. The evolution of the state of conservation is, up to now, an open question. The main difficulties lie in obtaining reliable methods of measurement. These techniques should be preferably non-invasive and able to detect even the slightest changes in the artifact composition, structure, etc., during the process of decay.

TARGETS

1 - Causes of material decay

This line studies alteration affecting different constituent materials: paintings (wall-painting, oil and tempera painting on wood, canvas and other supports); metal, stone and marble statues; glass, ceramics, mosaic, tapestry, ivory, leather and wooden artifacts, traditional handicraft as a form of cultural heritage, such as embroidery, traditional stitches, traditional and unique patterns.

First of all, it is necessary to characterize the original materials, those introduced later with restoration as well as the alteration products. The investigations must identify the chemical and physical conditions which favour endogenous and/or exogenous processes of decay. Special attention must be given to the examination of surfaces and interfaces as primary sites of decay.

Characterization of materials in order to express the kind and degree of decay

This line must be approached first because any further line depends on its results. Normally, some specific physico-chemical parameters related to the state

of conservation are indirectly used. It will therefore be necessary to verify, over a wider range of materials and situations, if these parameters (and relevant techniques of measurement) are suitable for the evaluation of the general state of decay.

Development of techniques of artificial ageing of different materials at different degrees

It is very important to know the behavior of the constituent materials of the artifact and of those used during conservation, over time, and whether polluting agents are present or absent. This study will also allow acquisition of knowledge of decay processes and the choice of the most appropriate materials and methods of conservation. For this purpose, it will be important to compare old materials of known origin and age with recent materials artificially aged in special climatic chambers.

2 - Noninvasive sensors

- Different kind of scanning devices, suitable to digitalize with extremely high resolution all kind of material cultural heritage, from large buildings to micro jewelry should be mentioned, as indication that time are mature for they diffuse utilization as shared studying tools.
- The use of internet to share the knowledge about material cultural heritage, especially as a studying tool, should be strongly supported, in order to share “know how” on common problems also in case of an impossible real on-site interaction. Since the sensor answer is nowadays fully digital, and often supplied in as bi-dimensional images or three-dimensional models, time are mature for this significant progress.
- High resolution photogrammetry performed from satellite sensors, suitable to use in identification of new archeological sites.

3 - Development of materials for conservation

Synthesis and evaluation of appropriate materials that may be employed for conservation/restoration of cultural property and pointed out of the procedure for their application.

This line also studies the suitability of new materials to be used for restoration interventions. It is very important to have at disposal materials that are compatible ith the one which constitute the object to restore.

In the case of silicate materials, like many natural stones, ceramics and mosaics, for example, the development of geo polymeric composites seems very interesting, because these materials give the possibility of simulating a large amount of different materials.

4 - Laser applications in Cultural Heritage

This line of research will indicate the importance of laser and its applications in cultural heritage.

Upon irradiation with laser pulses at high laser irradiances, massive material ejection is observed. This phenomenon has been named “ablation”.

Lasers have been found important and various applications in the preservation and restoration of artworks, as their use offers a number of distinct advantages over conventional methods. A most important aspect of the application of lasers in art conservation lies in analysis. However, because of the particular emphasis of this volume on laser ablation, it is also used exclusively on the cleaning of works of art, in particular of paintings, parchments, etc. In all these cases, laser irradiation is exploited in order to effect highly precise and controlled material removal (either for the purpose of eliminating unwanted degraded material/pathogenic tissue or for the purpose of appropriately shaping the substrate (micro structuring)) with minimal collateral damage to the substrate predominantly from organic materials.

In comparison with conventional techniques, laser processing offers some well demonstrated advantages (e.g. automation, selectivity, versatility, a high degree of on- line control by interfacing with a variety of in-situ laser based analytical techniques etc.).

- Consequent to the recent application of lasers for cleaning Cultural Heritage objects there is a strong need for internationally accepted protocols on how to proceed and use this technique.

- New microscopes based on synchrotron radiation, neutrons, ion beams, lasers and other radiations, or particles that can reveal non-destructively the structure and composition of cultural heritage materials. The analyses are applied to a variety of ‘hard’ materials, such as artefacts in metal, ceramics, stone or fossil human teeth and ‘soft’ materials, such as textiles, wood and paper. Each kind of material requires a different analytical strategy and the use of a suitable probe.

EXPECTED RESULTS

The investigations about the causes of decay must be significant and useful for the present diagnostic practice in the conservation of works of art. The real causes of decay must be discovered through the study of the morphology of alterations and through specific experimented analyses; these causes, in fact, are the primary factors to be removed or reduced, when applying specific methods of intervention. Another important result will be the univocal assessment of the state of conservation for each type of support in different situations. Great expectation lies in the possibility to develop new, easy - to - use equipment which permits the authorities to constantly monitor the actual state of conservation of the artifacts.

AREA X.2.3 - New technologies and products

PROBLEMS

Once the physico-chemical properties of a movable or immovable artifact have been established and the degree of decay has been quantized, it is necessary to define the plan of the intervention, which will be the more appropriate and reliable, the more detailed careful and deeper the investigation on the historical or historical-technical nature and on the causes, degree and mechanisms of alteration.

The interaction will be organized into a series of operations and treatments, correlated and corresponding to the currently accepted principles of conservation, which involve the use of particular products and techniques of application according to suitable methodologies.

Both technologies and products used must take into account the set of complex conditions and criticisms determined by the uniqueness of the artifact and by its constructional and conservative history.

To satisfy the above, it is necessary to direct the research towards the design and preparation of new technical procedures, the analysis of the materials of the constructional procedures and of the (building) yard, and to new products particularly suitable for specific uses and finally to the control of their suitability by laboratory experiments on samples and under conditions simulating real situations, then by the check of the efficiency of the treatments and of the technologies adopted in situ.

This investigation, which for the variety of materials forming the works of art requires great coordination efforts to design and experiment with specific techniques and products, is further complicated by the fact that the state of conservation, inside every single artifact and also for a single material, shows very localized if not punctual peculiarities which therefore need diversified treatments. Particularly in the field of architecture these peculiarities are also due to the complex geometries of the buildings and to the different exposure of the various components.

TARGETS

1 - Design and development of materials for the consolidation, aggregation and gluing

The design and the development of materials exhibiting these three functions, but not necessarily efficient on all the supports, is scheduled: this requires the development of specific products or the modification of already available products.

The effectiveness of traditional products already employed in the past is also to be verified.

A specific investigation will be devoted to a careful control of the durability properties of the existing supports in order to guarantee calibrated and limited interventions.

2 - Development of new materials for restoration

This line studies the suitability of new materials to be used for restoration interventions. It is very important to have at disposal materials that are compatible with the one which constitute the object to restored.

In the case of silicate materials, like many natural stones, ceramics and mosaics, for example, the development of geopolymeric composites seems very interesting, because these materials give the possibility of simulating a large amount of different materials.

3 - Design and development of physical methods for the protection.

In order to protect the restored patrimony a great deal of attention will be devoted both to the efficiency and cost of physical barriers for the protection of monuments (for instance a film of air or similar systems) and to passive defense methods (roofing, canalization of water, partial filling up, etc.), especially in the architectural field.

4 - Design and development of protectives

Suitable products will be prepared for an effective protective action against decay agents. These products will be developed by taking into account the supports they have to cover. The possibility to use traditional materials, already used in the past, will be carefully evaluated.

Furthermore photocatalytic products will be prepared and tested on different stone materials in order to verify their effectiveness as self-cleaning agents and the absence of damages on the surfaces. It is well known that TiO2, in the presence of sun light, catalyses the dissociation of a large variety of inorganic and organic molecules. In particular, the photocatalytic oxidation of nitrogen dioxides, promoted by TiO2, leads to the formation of soluble nitrate salts that can be removed from the surface by the action of the rain. Moreover nitrogen oxides, acting as catalysts, promote the reaction of sulphur dioxide with water and oxygen which leads, on the lime stone surface, to the formation of gypsum. Therefore, the abatement of nitrogen oxides, due to the TiO2 action, slows down the formation of gypsum which is a component of the black crusts, limiting in this way the frequency of the conservative actions.

5 - Development of applicative techniques and control procedures of products used in the interventions

The aim of this research is to formulate, on the basis of illustrative inventories, procedures of general value, adaptable for a restoration project, where in addition

to the representation of the scientific basis the related operations and the technical sequences are justified and described. Experiments in the field, also for a long period of time, will be of interest to verify the natural and/or non-natural modes of ageing.

6 - Sources of light and photosensitivity of the artifact surfaces

Photo physical and photochemical studies will be devoted to establish the possible decay effects on the artifacts and on the surface protectives in consequence of the frequency of the incident radiation light. In the architectural field, modes and effects of the color change of paintings and decorations will be investigated.

7- Biotic damage: characterization, treatment and protection

Particular attention will be devoted to autotrophic (algae, lichens, musk, bacteria, weeds, etc.) and heterotrophic organisms (fungi, insects, etc.). The different species and their danger will be established together with adequate methodologies of protection against the risk, and, in case of attack, the best way of treatment which, taking into account the nature of the assets, must be respectful both of them by not causing further damages and also of the people who will benefit from the work of art.

Moisture in wall paintings. As well known rising damp is a major cause of decay to masonry materials such as stone, brick, mortar and plaster. Rising damp occurs as result of capillary rise (suction) of water from the ground through the network of pores in the permeable masonry material. Accurate diagnosis of the cause and extent of the damp problem is a fundamental step in the case of conservation science of wall paintings. The porous mortar backing provides an easy route for the flow of diluted salt solutions. Salts contained in the mortar can be transported to the plaster underlying the painting. The volumetric expansion associated with the crystallization of these salts affects the plaster-pigment adhesion and leads to the disintegration of the surface. Such processes of leaching, transport, accumulation, solute concentration, precipitation, fractionation, and local concentration depend on the moisture content of the masonry which in turn is subject to seasonal variations in atmospheric humidity. For these reasons, before performing any restoration treatment the moisture distribution in a wall painting should be known. Nevertheless, the dampness distribution within a wall painting is difficult to determine. The moisture content and distribution measured directly on the wall painting is an important information which was obtained using unilateral NMR, a fully portable instrument allowing measurements to be performed in situ and in a fully non invasive way. With a suitable calibration procedure and processing the experimental data in a proper way, it was possible to obtain a precise quantitative map of the moisture content in the very first layers of the painted film and in the plaster underlying the wall painting. Investigations were performed in situ on wall paintings of S. Rocco church, Cornaredo, Milan (Italy) and S. Clement Basilica, Rome, Italy. The very good agreement found between results obtained by unilateral NMR and results obtained by gravimetric methods allowed the validation portable

NMR as a new nondestructive tool for measuring in situ the distribution and the amount of moisture in wall paintings as well as in any porous material.

Evaluation of performances of protective treatments in porous stones. Water infiltration is one of the main causes of damage in porous stones, in fact freezing and thawing cycles of water may cause fractures inside the porous structure, besides water often acts as a transporting agent for aggressive pollutants that cause corrosion. Protective treatments are usually performed on porous stones to reduce water infiltration. An analytical protocol based on portable NMR allows to evaluate both the performances of protective treatments and the precise depth of penetration of the treatment inside porous stones. According to this protocol it is also possible to evaluate the performances of protective treatments on various types of porous stones.

Investigation of materials, wooden manufacts. Non invasive unilateral NMR was used in situ to evaluate the state of conservation of the wood constituting an ancient Egyptian sarcophagus and to detect the possible presence of organic substances on the surface of the wood and/or embedded into the wooden matrix. ^{13}C CPMAS NMR spectroscopy is a very powerful analytical technique to study structural changes in ancient wood. The position and the integral of each carbon resonance in the spectrum gives important information concerning the type of wood, namely hardwood (woody angiosperms) and softwood (woody gymnosperms or coniferous tree), as well as indicating the state of degradation of the wood. The occurrence of cellulose depletion, lignin depletion and hemicellulose depletion in the ancient wood was precisely evidenced. Besides the structure of organic substances possibly used in undocumented restoration may be clarified by ^{13}C CP-MAS NMR spectroscopy.

Investigation of materials, volcanic tuffs. Solid state ^{27}Al, ^{29}Si, ^{23}Na MAS NMR spectroscopy was used to differentiate volcanic tuffs from different sources and to investigate various degradation processes occurring in ancient tuffs found in the Etruscan necropolis of Norchia (Viterbo, Italy) which induce changes in the Si/Al ratio.

Investigation of materials, raw clays and fired clays. Solid state ^{27}Al, ^{29}Si, ^{23}Na MAS NMR spectroscopy was applied to investigate the firing process in ancient pottery.

EXPECTED RESULTS

Design, development (achievement) and use of easy transferable technologies and of specific products for restoration (operations). In particular synthetic products will be designed and developed for the gluing, aggregation, consolidation and protection of Cultural Heritage.

The efficiency of products already used in the past will be checked in order to evaluate their possible reuse, also after a modification of their physico-chemical properties and/or of the application techniques.

Research and development of specific instruments and technologies for evaluating the effectiveness of the products in the causes of time, by natural or artificial ageing processes.

Indication of techniques, methods, materials and protectives to be used in the conservation and in the scheduled clearing treatments to be executed on artifacts, after the intervention, also taking into account the environmental variations.

Development of guide methodologies for the preliminary analysis of the buildings, for the design and for the intervention of architectural restoration.

Preparation of stable protectives against sun or artificial-light. Setting up of a protocol for the conditions of lighting, aimed at reducing the photo decay action, with an acceptable availability of the work of art.

List of the main bio deteriogenic organisms for the different classes of goods and for the related danger, with the indication of the degree of possible damage, of the threshold of the intervention and of the more appropriate fighting for every typology.

Development of new photocatalytic TiO2 based treatments and verification of the maintenance of the aesthetic characteristic of treated surfaces, of the absence of harmfully and of the compatibility with other conservative treatments. The idea to develop coatings, whose formulation includes TiO2, can offer an advance contribution for a preventive conservation and maintenance, slowing down degradation processes and limiting cleaning intervention.

AREA X.2.4 – Evaluation of damage: restoration and conservation of monuments, buildings and historical gardens

PROBLEMS

The assessment of the state of preservation of a building is the focal point in any decision regarding the need to repair, strengthen or adapt the structure in question. This requires the adoption of a methodology that will provide all the information required for the correct formulation of a readable diagnosis.

The assessment begins with historical investigations into the origin of the building, details on its construction and the events of its life. Of particular interest is the response of buildings to aggressive environmental phenomena-such as pollution, landslides, earthquakes, improper use and urban congestion and physiological phenomena such as aging and consequent decay.

This investigation is fundamental because the historical picture constitutes a veritable full-scale laboratory in which the future behavior of the building can be forecast.

The difficulties encountered in this type of investigation lie in the fact that the documentation (texts, drawings, paintings) are mainly concerned only with the exploitation or use of the building: the researcher's task is therefore not only to plough through the enormous amount of historical information available and extract what is pertinent to its decay, degradation and state of preservation, but also to interpret and weigh this information in relation to the original purpose of the documentation. For instance, buildings or monuments are often represented, in contrast with other sources, as being intact or altered. This is due to the symbolic value which is often not pertinent to their actual state of preservation.

TARGETS

1 - Historical knowledge of the building

This research must identify all the parameters required in order to determine the building's construction characteristics and forms of decay, leading to the formulation of hypotheses, Programmes and proposals for intervention.

The objective of the research line should be to establish a checklist as a standard procedure prior to drawing up a project for the architectural restoration of a building.

Another important objective is to set up an information system capable of managing the acquired data in order to rationalize the research procedure.

2 - Provenance studies of the building materials

This will lead to determine the origin sources (quarries) of these materials, and it will be important not only to choice suitable stones for architectural restoration and replacement of highly weathered blocks, but also to collect similar samples to perform artificial ageing in order to evaluate the durability of conservation materials.

3 - Numeric and physical model

The use of model studies plays a prominent role in numerous disciplines and generally tends to distinguish between the actual object of the study and the surrounding environment, which must be defined on the basis of a number of parameters.

The advantage offered by model studies is numerous. For example, they are used to:

1. Obtain information on processes that could otherwise not be observed : for instance, when it is physically impossible to take measurements or when the act of measuring itself is invasive;

2. Obtain an extension in time because simulated time can be as long as the user chooses, thus making it possible to analyze individual phases which otherwise could not be recorded with a rapid evolution of the system ; time can also be compressed so as to forecast the evolution of the situation over a very long period ;

3. Obtain information on the spatial distribution of dimensions which could only be achieved using innumerable instruments, whereas models are usually general and the act of measuring is mostly very specific.

4. Obtain information on stonework bio deterioration by microorganisms.

Taking the above considerations into account, we can decide to use modeling for the following uses: Devising a system for processing high-definition three-dimensional images, operating at great speed, for diagnostic purposes as well for the design of restoration measures

The system must provide a series of utilities to facilitate the implementation of patching and painting of buildings. It will rely on a database that can be accessed from the screen and capable of indicating the treatment required point by point.

Finalizing a specific low-cost system to study degradation and to manage systems of partial derivative equations with variable boundary conditions and complex geometry. The system will do simultaneous computations and have all the functions required for simulating degradation processes.

- If we include the Mediterranean Partner Countries, these countries have not been so much involved previously in co-ordinated European efforts to develop models for predicting corrosion based on the environment. As the pollution and climate situation is different from main Europe there is a need to perform additional exposures of standardised materials to develop the models further.

4 - Characterization of materials.

1 - Inspections and monitoring.

The identification of degradation and/or impairment processes, which are generally irreversible conditions, and the measurements of their evolution enable to determine their causes. This is an essential step towards the conservation of a building.

Up to some time ago, however, it was fairly difficult to identify the causes because there was no reliable system for acquiring data on the causes of degradation or on its effects on buildings.

Today we can use a versatile instrument that can be adapted case by case using the appropriate translators according to the dimensions to be measured.

We therefore suggest the following steps:

a) Devise a system, preferably portable, to monitor exposure and environmental conditions, as well as the stress and strain to the building.

b) Perfect a system to monitor heat and humidity conditions in rooms and buildings.

c) Portable digital systems to acquire images for the purpose of visualizing and evaluating the extent of decay and impairment and their localization.

d) Development of materials for conservation.

Synthesis and evaluation of appropriate materials that may be employed for conservation/restoration of cultural property and pointed out of the procedure for their application.

2 - Static and dynamic analysis of masonry structures

Many historically and artistically important masonry buildings of the world's architectural heritage are in dire need of maintenance, restoration and seismic rehabilitation. An appropriate modeling of such operations before their execution can allow the optimization in terms of cost-effectiveness benefit, architectural impact and static effectiveness. This requires the use of a constitutive law that is able to describe in a realist way the mechanical behavior of masonry materials and the use of appropriate numerical techniques for non linear static and dynamic analyses. In the last twenty years, many advances have been done in this direction and now numerical codes are available which can give important information on the static behavior of masonry buildings. Concerning the vulnerability evaluation of a structure it is necessary to quantitatively determine its response to ground motions of different intensity, frequency content and duration. Models and calculation techniques used so far, very often linear elastic models investigated solely through equivalent static analysis, have proved incapable of accurately predicting the dynamic behavior of masonry structures. The constitutive model that has been successfully used in performing static analyses can be turn out to be useful also for dynamic analyses provided that degradation due to the load reversals are taken into account.

Importance of the industrial heritage structures

A number of factories, warehouses, power-plants and other industrial construction works, built since the beginning of the Industrial Revolution, has been registered as industrial cultural heritage worldwide. Such structures are mostly of significant architectural, historic, technological or social value.

The industrial heritage structures often form part of the urban landscape and provide the cityscape with visual historical landmarks. Protection of the industrial heritage structures helps preserve cultural values, avoids wasting energy and facilitates economic regeneration of regions in decline.

Present insufficient attention to systematic recognizing, declaring and protecting the industrial heritage may, however, lead to their extinction. Desired protection of the industrial heritage structures requires a public recognition of the industrial heritage to be equally important as other cultural heritage. Introduction of educational programs and relevant legislation is needed.

Probabilistic assessment of heritage structures

Reliability assessments of heritage structures have to account for significant uncertainties related to actual structural conditions that can hardly be described by simplified deterministic procedures used for structural design. Such assessments may lead to expensive repairs and losses of the cultural and heritage value. The use of probabilistic methods in the assessment is thus proposed to facilitate:

- Better description of uncertainties related to material characteristics, actions, degradation aspects and modelling,
- Inclusion of results of inspections and tests and the satisfactory past performance in the assessment.

The probabilistic assessment of heritage structures should be based on:

• Models for basic variables determined taking into account the actual situation and state of the structure,

• Target reliability levels that are primarily dependent on costs of safety measures and consequences of failure including loss of the cultural heritage value. The target levels may be specified on the basis of the total working-life cost optimisation.

The probabilistic updating, accounting for the satisfactory past performance, may substantially improve the estimates of the reliability level for heritage structures (Miroslav Sykora)

- In the same area we also have the section 4 - Characterisation and monitoring. During the recent years there have been advances in developments of sensors for corrosion (not only using nano technology) and I think that these could fit perfectly into this section. Therefore I propose that you modify point a) so that it instead reads "a) Devise a system, preferably portable, to monitor exposure and environmental conditions and their resulting corrosion risk, as well as the stress and strain to the building." (Johan Tidblad***)***

5 – Energy and sustainability

The issue of energy and sustainability worth for the buildings of new construction has to be extended to historical monuments.

The critical problems already encountered in the application of the European Union legislation on energy conservation and environmental emergencies are now unavoidable. In various degrees and in different ways according to the climatic conditions of the EU Member States there are functional and architectural requirements that involve the use of both heating and environment cooling with increasing costs and serious reflections on climate change.

This is particularly true in urban centers as well as in monumental complexes including museums and worship sites. The systematic avoidance of the problem by curators, technicians and the lack of interest among scholars and industry in the search for more sophisticated methodologies suited to the peculiarities of these assets, are producing serious harm to the maintenance of the architectural heritage as well as an energy waste..

The scientific-methodological research should be carried out in three (or more) directions:

a) the search for high-tech materials and processes, of nanotechnological nature, for the production of functional layers with low thickness and high performance, or cover structures not opaque or of translucent thermal insulation capacity, fully reversible;

b) the verification process with methodological intervention designed to detect scientifically verified protocols. This action includes the use of analytical instrumentation, survey and calculation software, adaptable to different environmental situations and types of the Cultural Patrimony monuments of the various EU Member States;

c) the search for best practices, that can ensure both the architectural heritage conservation and its adaptation of energy needs and functional performances with sustainable management costs.

EXPECTED RESULTS

This Area focuses on the investigations meant to assure the systematic collection of data leading to the choice of appropriate restoration measures. The historical checklist, modeling and assessment of the durability of the materials used will provide the basic framework, to be completed with specific information required for remedial measures. The overall results of the research will make it possible to establish a plan of action to solve problems of impairment and decay and therefore make the best possible use of the building.

The investigation must also establish the nature of the soils on site, and the building materials and techniques adopted at the time of construction, so as to provide a reliable assessment of the consequences of the restoration measures in relation to the original characteristics of the building.

The static and dynamic analysis of masonry structures should:

improve the constitutive model, especially in order to describe the evolution of decay in material properties;

improve the numerical methods and implement them in a numerical code to perform dynamic analyses of masonry structures;

promote the knowledge and the use of the proposed software among specialists in the field of restoration and prevention against earthquakes of the masonry heritage.

AREA X.2.5 - Methodologies for reversible mixed technologies use in seismic protection of historical constructions

PROBLEMS

Although many territories on Earth (Mediterranean Sea, Pacific islands, Central America) face seismic risk from the origin of civilization, events form the past seem to suggest that the ancient architects and builders gave not enough importance to earthquakes. But if one goes deeper into the matter, one can put into evidence the existence of brilliant seismic strategies in ancient buildings. These strategies were implemented through intuitive and simple solutions, like e.g. the symmetric distribution of the masses in plan, the proportions of walls and openings, which indeed never prevail over the aesthetical rules of old times. It is therefore important to investigate more deeply these solutions, which display in different manners in different geographical areas, but always share a great simplicity and sustainability.

Further, it will be important to translate the above ancient strategies into modern solutions, possibly adaptive to many building typologies. The economic and environmental sustainability of these strategies should be coupled with the architectonic feasibility of the intervention (i.e., obeying as much as possible the rules of reversibility), as compared to invasive and expensive modern solutions like base isolators and viscous or tuned mass dampers, which are normally very difficult to apply to the historical heritage manufacts.

Synthetically, three categories of seismic strategies can be outlined in ancient buildings:

a) Seismic isolation

In the Alhambra complex in Granada (XIV century A.C.), the columns in the patio of "Los Leones" contain thin lead plates in between the marble pieces, which allow a smoother load transmission through the disks and help to isolate the upper parts from the foundations.

According to the archaeologists' excavations (1930), the monumental walls of the city of Troy were built upon a layer of hard-packed soil, purposefully positioned over the bedrock and below the wall foundations. Clearly, the aim of this layer was not to reduce the excavation volume but simply to work as a "cushion of earth" below the wall (see also the original descriptions by Plinius the Old, 79 A.C.). This was the definition used by F.L. Wright, who tried to reproduce the same solution below the Imperial Hotel in Tokyo (... to float on the site's alluvial mud "as a battleship floats on water", 1890).

b) Energy dissipation

The barracked houses, diffused throughout Europe during XVIII and XIX centuries, were normally made with limestone regular masonry walls with oblique

timber beams embedded inside the masonry. The role of these timber beams was only partly that of a (elastic) reinforcement able to prevent crack opening, but mostly that of a dissipating mechanism. Thanks to the high friction coefficient between limestone blocks and timber beams, a relevant amount of shaking energy can be dissipated during seismic oscillations, optimizing the dynamical behavior of the bearing walls.

c) Ductility

Japanese pagodas, entirely made of timber, show many interesting anti-seismic solutions, ranging from the wing-shaped flooring system (which is itself very deformable thanks to the usage of cantilever beams), to the presence of the central tall mast. The latter, called shinbashira, is suspended like a pendulum from the top roof and simply supported on the soil below, obeys to the Buddhist mysticism and plays a fundamental role for energy absorption swinging freely backward and forward. The vertical loads are transmitted to the foundation through two orders of columns, and each floor is simply supported upon the lower one, leaving the freedom of relative horizontal movements. The result, under an earthquake or a hurricane, is a kind of "snake dance" of the pagoda, with high ductility and energy absorption capacity.

TARGETS

1 - Strategies for the safety of cultural heritage

Since the beginning of civilization, history tells of the movement of art pieces, monuments and manufacts from site to site. The causes are multiple: starting from the displacements due to the "spoils of war", to the displacements ordered by kings and emperors, through the movements caused by the need for reuse, especially in the early Christian period, and so forth. Considerations about the events of the past, yield a possible strategy to transform this concept into a technique for natural hazard prevention of archaeological sites.

The seismic safety retrofits have often proved to be scarcely effective on archaeological manufacts, because of the difficulties involved, especially in complex sites. The aim of this study is to analyze an “alternative” method of preventing natural disasters like floods, eruption and earthquakes, moving the most representative structural elements of archaeological sites by effective disassembly of the masonry and stones. The procedure considers a process of "cutting optimization", calibrated on the characteristics of the specific material that has to be cut and then displaced in safer places (“manufacts evacuation plan”).

This process should not create excessive problems to the structure from which the pieces are collected, and aims to re-assembling the manufacts in contexts able to guarantee safety through advanced earthquake-resistant expedients (e.g., inspired from the past).

A few examples of such "manufacts evacuation plan" are the following:

1) The famous temples of Abu Simbel (Egypt) were cut into pieces, disassembled and rearranged in a safer (higher) place, in order to save them from

flooding due to the construction of the Aswan dam (1960-1968). In this occasion, for the first time, the cutting process was investigated and optimized to reduce damage and material waste. Actually, a millmetric tolerance was ensured for almost the manufacts. 2) More recently, a Greek-roman site (including a temple) was discovered in Naples during the excavations for the subway. The manufacts were cut into pieces and re-assembled partly in the National Museum, partly into the new subway station. In order to reduce the impact on the manufacts, and to preserve the beautiful mosaics, the cutting operations had to be carried without water cooling. Dry cutting, as is well known, is much more difficult to control, due to vibrations and heating production. Therefore, it was necessary to develop a specific theory to optimize the process and minimize cut thickness.

2) A similar study has just started on the archaeological Pompeii site, where the seismic and volcanic hazards are very strong and the manufacts possess high vulnerability. The past interventions, up to now, have performed poorly. Moreover, modern computer predictions show their scarce effectiveness in case of a large earthquake or eruption.

3) General methodology for the quantitative evaluation of the seismic vulnerability of historical buildings and building complexes

Several Countries, all around Europe, the most in the Mediterranean area, are greatly exposed to seismic hazard. In these countries cultural heritage is strongly at risk of severe damage or/even destruction due to earthquake. This problem mostly stands for historical building complexes, due to the fact that majority of them frequently lack basic anti-seismic features and/or were never fitted with adequate provisions against earthquake actions.

The latest seismic events (Friuli-Italy, 1976; Vrancia-Romania, 1977; Campania and Basilicata-Italy, 1980; Spitak-Armenia, 1988; Banat-Romania,1991; Erzincam-Turkey, 1992; Dniar-Turkey, 1995; Umbria-Italy, 1997; Adana-Turkey, 1998; Iznit and Duzce-Turkey, 1999; Athens-Greece, 1999, Bam-Iran, 2003, Sumatra (followed by tsunami), 2004, Sichuan-China, 2008, Abruzzo, Haiti, 2009, Chile, 2010 to mention the most important, only) showed that the degree of seismic protection in these Countries is largely unsatisfactory. Many constructions, in particular, old masonry structures built up in stricken Countries, often poorly collapsed. All happen for clear reasons, like degradation in quality of materials, lack of appropriate maintenance, use changing but, most of all, absence of elementary ant seismic provisions.

This evidence confirms that historical constructions to be by far the most vulnerable from the seismic point of view and, therefore, demand for the definition of urgent strategies for the protection of the cultural heritage from seismic hazard. As a consequence, advanced surveying and identification techniques are needed for the evaluation of the structural vulnerability as well as for a reliable modelling and analysis of the building structural behaviour. At the same time, the integrated application of innovative, low-intrusive and reversible technological systems is needed, for providing solution not only to specific structural or architectural problems, but also aiming at improving the global performance of the constructions, intended as a “system”. In this context, great attention is paid not

only to reliability and durability, but also to the possibility to be easily monitored and removed if required (reversibility), according to the widely shared policy, aiming at the safeguard of existing buildings, in particular in case of historical and monumental works, from inappropriate restoration operations.

So, in case of historical constructions, alone or agglomerates, several issues deserve to be further investigated, such as the methodologies of surveying and identification as well as the evaluation of the seismic vulnerability. This last, represents an important aspect; in fact, nowadays the quantitative evaluation of the seismic vulnerability of historical buildings and building complexes in the framework of the modern Performance Based Design (PBD) it's still missing in the current practice.

The Performance Based approach is a new way to face the structural design against seismic actions, having the purpose to ensure a proper degree of structural reliability under any specified working conditions, including both serviceability and ultimate limit states. Till now, the Performance Based Design has been applied to new structures only, which can be easily designed complying with relevant behavioural thresholds set by PBD itself. Applications in the field of existing constructions are very few at the moment. In particular, neither criteria nor methodologies are available for achieving a satisfying design level against strong intensity earthquakes. This is indirectly confirmed by most of national seismic codifications, which, as a matter of fact, allow to avoid a rigorous seismic retrofit in case of historical constructions. This approach, of course, tends to preserve the monumental value of the construction, but does not guarantee an adequate protection against severe earthquakes.

Moreover, there are some lacks that must to be faced: above all, but not only, simplified calculation tools are not yet available to practitioners, which results in a quite difficult - when not impossible - prediction of the dynamic behaviour of the building; so it is clear how much it is important to face this lack by establishing a direct relationship between construction surveying/monitoring, structural analysis and vulnerability assessment methodologies.

Moreover, a great amount of research has been carried out in this field at both national and international level (see PROHITECH FP6 project), mostly on buildings and other types of historical constructions; contrary, as little as nothing has been made for the seismic protection of building complexes and, in general, of historical agglomerates, which need a different approach compared to single buildings as far as structural identification and vulnerability evaluation are concerned.

At the same time, rules are still missing as to cost assessment of proposed solutions, set-up of expert system for selection of intervention techniques and decision making, application to selected study cases and, last but not least, development of guidelines and dissemination of results.

The proposed methodology could be potentially applied to the relevant buildings and building complexes (urban nuclei, complex of monuments, etc.) erected from the ancient age to the first decades of the 20th century, all of which can be considered, with good conscience, as belonging to the cultural heritage of

the concerned Countries. Such buildings cover a wide and diversified range of structural categories, including mostly masonry constructions, needing to be fitted with adequate anti seismic provisions. The main aim of a further activity should be to develop suitable methodologies and advanced, user-friendly tools for ensuring both protection and preservation of such category of buildings and, more in general, of cultural heritage assets against earthquakes. The proposal basically addresses the set-up and the validation of new technologies (e.g. integrated automatic building surveying techniques, advanced methodologies for structural identification of buildings, etc.) for the calibration of simplified calculation tools aimed at the definition of a suitable earthquake vulnerability assessment methodology for historical buildings, as well as to the appropriate use of non destructive and low intrusive retrofitting and reinforcement techniques. This would primarily involve saving human lives and reducing both economic and cultural losses due to earthquakes.

Within the technical field of seismic rehabilitation, two aspects are receiving an increasing attention by engineers and researchers, namely:

- Preservation of Structural Integrity of existing buildings under severe or exceptional seismic actions (SI).

- Improvement of building seismic performance by means of Reversible Mixed Technologies (RMT);

Both these aspects are closely interrelated each other, in the sense that the application of Reversible Mixed Technologies is, in some cases, the only tool to achieve a satisfying level of Structural Integrity under severe earthquake actions. The concept of Structural Integrity relies on the necessity to ensure seismic protection against collapse also in case of destroying events.

Reversible Mixed Technologies (RMT) are based on the integration of structural members of different materials and/or construction methods into a single construction. An important progress in the application of RMT to historical buildings has been achieved within the PROHITECH FP6 project (2004-2008).The basic feature of RMT is that their application should be always completely recoverable, that is reversible, if required. This is considered as an essential design requirement in order to prevent historical and monumental buildings from unsuitable rehabilitation operations. The main aim of RMT is the best exploitation of material and technology features, in order to optimize the structural behavior under any condition, including very severe limit states involved by strong seismic actions.

This practice, initially concerned with new, technologically advanced buildings, is now being looked up with increasing interest in the field of structural rehabilitation, too, due to the greatest possibilities of structural optimization and, hence, performance maximization, achieved for thanks of mixed technologies. In a few words, the use of reversible mixed technologies would involve the best exploitation of each material and/or technology used in the intervention, providing in such a way the best performance from both technical and economical point of view.

The main subject should be represented by relevant buildings erected from the ancient age to the first half of the 20th century, all of which can be considered as historical and, therefore, belonging to the cultural heritage. Such buildings cover a wide and diversified range of structural categories, including both masonry and reinforced concrete buildings and also some wooden and steel constructions, needing to be fitted with adequate ant seismic provisions. Studying activity must be mostly focused on the use of innovative technologies, namely those relying upon mixed systems, an urgent necessity for a more advanced understanding of both material and device behavior, as well as for a deeper insight into the seismic response of constructions is felt. This means specific objectives to be pursued in this direction are aimed at:

1. Drawing the attention of industry, research centre, engineers and competent authorities of European and Mediterranean Countries on the problem of safeguard of construction heritage from seismic risk, in particular when historical buildings are concerned;
2. Improving the awareness of operators listed above about the importance of using advanced materials and technologies in the seismic up-grading of constructions;
3. Improving the average knowledge of practicing engineers about innovative systems of seismic protection, so as to contribute to the institution of specialized skills in the field of seismic rehabilitation;
4. Promoting the use at a wide scale of reversible and environmentally friendly technologies, in order to fit existing constructions with easily removable and modifiable seismic protection systems;
5. Supporting the adoption of “smart” materials and special techniques for the seismic protection of constructions as a cheap and effective alternative to traditional, highly intrusive strengthening methodologies, especially when historical constructions are faced;
6. Advancing the state-of-the-art in the field of seismic protection of constructions, by adding new information about the behavior of structures fitted with special systems and/or using advanced materials or devices for improving the seismic performance;
7. Allowing engineers to use simple and reliable tools for analyzing the behavior of constructions provided with advanced systems for seismic protection, as well as for detailing up-grading interventions;
8. Developing advanced, PBD-complying guidelines for the practical application of innovative materials and technologies in the field of seismic restoration.

In short, innovative materials liable to be applied for mixed solutions in structural rehabilitation should possess the following peculiar properties:

− High strength-to-weight ratio. This is an inherent property of all materials liable to be used for reversible strengthening systems (e.g. metals, including constructional mild steel, and innovative materials such stainless steel, titanium alloys, aluminum alloys and SMAs). It allows reinforcing interventions as well as the introduction of special devices to be made without significant increase of weight and hence with no influence on the mass distribution over the construction.

− Good ductility. This makes innovative materials suitable for the fabrication of structural elements or special devices provided with dissipative features. These elements are used to improve the seismic behavior by means of passive control of input energy, sometimes together with viscous damping devices used to reduce the displacement magnitude. A new chance in the field of energy dissipation is now offered by the so called shape memory alloys (SMA), mostly nickel-titanium alloys, able to undergo a transformation of the internal crystalline structure according to temperature and state of stress, which is the main responsible of their hysteretic behavior under cyclic loads.

− Ease of fabrication and erection. All innovative materials involved in mixed technologies, and most of all metals, can be processed with modern and cheap techniques such as cutting, welding, machining, cold and hot forming. Furthermore, in the erection stage, the immediate availability of load bearing capacity can be ensured, yielding a reduction of both time and workmanship.

− Low maintenance cost. This property is obtained thanks to the small size of components, when used both for reinforcing elements and for special dissipative devices, which allows the additional elements to be concentrated in limited areas of the structure, where the maintenance operations are made easier. Furthermore, some metals, such as stainless steels, shape memory alloys and other alloys do offer a good corrosion resistance, which is why most of these materials have a very good behavior in atmospheric and humid environments. In rehabilitation, this feature involves the possibility to hide the intervention if required, with no risk of future reject due to corrosion. This allows, for example, the possibility to insert tie rods or confinement elements into masonry members for improving their strength to horizontal actions.

− Reliability. Due to good corrosion and fatigue resistance of innovative materials, most of solutions making use of mixed technologies offer high short and long term reliability. Moreover, the stable behavior under cyclic actions make such materials ideal for the construction of special devices for seismic control.

− Aesthetic appearance. And hence architectural value, provided by the possibility to be finished with different products in order to obtain specific exterior aspects. The good resistance to corrosion of some alloys provides an attractive look and a nice harmonization between new and old materials when used for rehabilitation interventions.

− Reversibility. This is the most important requirement, which allows added elements to be easily removed if necessary. Because of their recyclable character, most of materials and devices used in the form of mixed technologies can be re-used for different purposes. Thus, when the total lifetime is considered, the choice of such solutions can be sometimes less expensive than traditional nonreversible technologies. Furthermore, reversibility means negligible impact on environment, as well as minimum degree of disturbance for existing constructions; this turns to be quite important in case of monumental buildings.

− Product availability. This results in a great number of items existing on the market in the form of prefabricated elements. By considering materials and

devices altogether, several hundreds of products are commercially available, so to meet any design requirement for both structural and non-structural applications.

All the above outlined properties, even though well known by themselves, still deserve further investigation, aiming especially at making design guidelines available for design purposes. Existing design rules, in fact, are not completely satisfying as most aspects, namely those referring to the seismic protection of historical and monumental constructions, are not yet thoroughly assessed. In addition, the proposed systems still lack a basic understanding of their potentials, as well as suitable criteria for their practical implementation.

The situation in Europe for the development of RMT aimed at the increase of structural integrity threshold under seismic action is now very good. Interesting results have been already achieved in the field of new urban buildings, where Mixed Technologies demonstrated the chance both to widen the creative possibilities of designers and to improve, at the same time, the global urban building quality in terms of economy, technical reliability of the physical city (building and infrastructures), and impact of the construction works on the functioning of the city. A similar perspective is deemed to exist for the seismic retrofit of historical constructions, too.

Market production and main development possibility: unfortunately, analyzing the industries associated to structures made of steel, reinforced concrete, steel-concrete composite, timber, polymeric composite and structural glass, it is found that they operate, in most cases, independently each other. This greatly limits the possibility to reach synergy among the different intervention techniques, with a consequent poor level of optimization and, inevitably, a scarce exploitation of the great potential of Mixed Technologies (MT).

Benefits resulting from the consideration of all these aspects can concern not only the constructional process, but also the end-users and their communities, the local and global environments.

EXPECTED RESULTS

Protecting existing construction heritage from seismic risk is one of the most challenging tasks of the new millennium. Its basic concern is a mix of technological, economic and cultural issues at the same time. Safeguard of constructions from earthquake, in fact, would mean in first place protecting human beings from life-threatening situations, but also protecting valuable buildings from severe damage or even from destruction, and this has an indubitable economic sense. Such considerations help to understand the importance of the use of new technologies in the field of seismic rehabilitation. Innovative reversible technologies, indeed, ensure an increased safety level under any load condition, with an overall cost comparable with or lower than the one required by traditional options.

At the same time, they allow the existing configuration of constructions to be preserved as much as possible, and this turns to be very important in applications in the monumental field. Also, the use of such technologies is also environmentally

friendly, as most of materials involved can be easily removed and recycled at the end of their operational lifetime.

As most of investigated solutions are not yet codified from neither theoretical nor practical point of view, there is a pressing need to help the introduction of new policies of seismic protection into common rehabilitation practice. Supporting the adoption of materials and systems which are reversible, recyclable, reliable, environmentally friendly and economically sustainable (cost efficient) for the mitigation of potential damage to cultural heritage assets resulting from earthquakes and of the related social, cultural and economic losses.

AREA X.2.6 – Evaluation of damage: restoration and conservation of paper, parchment, etc.

PROBLEMS

Much systematic research carried out in many countries, have shown the serious problems related to the preservation of paper documents and book material.

This problem is especially serious for material which was produced in the past two centuries, because paper used in these last two hundred years, compared to that produced in other periods, has a higher degree of acidity, which causes its very quick ageing and brittleness.

Although a comprehensive study has yet to be completed, we can say on the basis of our technicians' observations that all over Europe there is has a similar problem. Obviously, these problems are more serious with documents, as they usually do not have any binding which, in some degree, protects book paper.

TARGETS

1 – Paper weakening

Various methods can be used to solve the problem of paper weakening. These methods include crosslinking with crosslinking agents, grafting with functional polymers and finally, coating with functional polymers. Many polymers applied as a coating can improve the strength of paper, although, over time, micro-organisms can still damage materials treated in this fashion. There are some products, however, that are both effective for sizing and resistant to fungi attack. For example, polyethylene-coated paper shows no evidence of micro-organism growth, and parylene has been shown to protect paper and improve its bio stability (Dobroussina et al. 1996). A multitude of studies have revealed a variety of

efficacious materials. Cellulose ethers have been widely studied as consolidating agents for paper (Feller and Wilt 1990), obviating the need to describe their advantages and disadvantages in this article, though it is noteworthy that cellulose ether–treated papers can be prone to fungi attack, depending on storage conditions. All additives applied as sizing agents become a structural and irreversible part of paper, including cellulose ethers. Still, cellulose ethers are acceptable for conservation works, owing to their similarity to and compatibility with cellulose. Chitosan is a biodegradable copolymer, consisting of 13–17% units of monomeric N-acetyl-glucosamine and 83–87% glucosamine units. It is environmentally and technologically acceptable in the repulping and recycling of paper, since structurally it is essentially cellulose with the 2-hydroxyl group replaced by a primary amino function (Allan et al. 1977). Chitosan has been shown to be even more compatible with cellulose because the differences in chemical structure between cellulose and chitosan are minimal. Because cellulose usually has a negative charge due to the presence of some carboxylate groups, it strongly interacts with the positive charges in chitosan (Allan et al. 1977). Allan et al. (1977) studied the effects of chitosan on the mechanical and optical properties of paper. They observed that in paper the best wet resistance and best dry resistance were obtained by spraying a chitosan solution on dry paper. They also did tests depositing chitosan in pulp slurries at pH 5, and then bringing them to pH 10 to precipitate the polymer on the fibers. However, paper treated with chitosan is suitable for repulping and recycling (Allan et al. 1977). Recently, investigations of its application to ancient papers conservation have been performed through PAPERTECH (FP6 project 2004-2007). The treated samples with chitosan show enhancement of the mechanical properties, tensile strength and tear factor, improving of the thermal properties, reduction of the water vapor permeability and uptake, increase resistance to hydrolytic enzyme degradation. In addition, experiments have been done to determine whether chitosan applied to paper is reversible.

Modification of chitosan structure to increase its solubility in the neutral medium and at the same time immobilized with silver ions to induce additional antibacterial activity presenting a new materials for the consolidation and conservation of ancient paper items. Different modification routes such grafting, carboxylation and amination will be used. Characterization of the modified chitosan through FT-IR, TGA, TMA, SEM, mechanical analysis and solubility test will be essential. Water permeability and oxygen permeability in addition to tear factor and folding character will be further investigated.

This problem is especially serious for material which was produced in the past two centuries, because paper used in these last two hundred years, compared to that produced in other periods, has a higher degree of acidity, which causes its very quick ageing and brittleness.

Obviously, these problems are more serious with documents, as they usually do not have any binding which, in some degree, protects book paper.

The objective of this Area is to study and test new methods in order to distinguish the physical and chemical characteristics of non acidic paper and

preservation of paper medium in books and documents.

2 – Other documents

Documents are not only produced on paper; there are documents in non traditional media as well: from the most ancient, like parchment and papyrus up to the present ones, as for ex. magnetic and optical media, and also photographic films and plates and thus the audio-visual products in general.

There is a pressing need to find an effective preservation of these nontraditional media and their related experiments.

It is evident that there is an urgent need for concrete and well-timed treatments that will arrest or at least reduce the progressive damage to our documents; because of the great quantity of material which is badly preserved, these treatments will probably be done en masse.

The quick degeneration of paper material produced in the past two centuries is certainly caused by the high degree of acidity which is present in modern paper since its production.

Thus, it is advisable to begin a study on mass intervention treatments, as proposed above, and, at the same time, to research other different techniques of de-acidification which employ less hazardous materials and safeguard the operators' health. This kind of research would not be separate from other studies which are also individuating new and more suitable methods of preservation.

Another unsolved problem today is connected to disinfesting techniques which are normally carried out with ethylene oxide. It is necessary to know the resulting alterations in the media's composition (i.e. what changes have occurred because ethylene oxide has been introduced); it is also necessary to encourage further research into less hazardous, alternative methods. Likewise, studies should be done on the chemical and physical characteristics of paper damaged by various environmental agents.

The above mentioned research areas related to preservation of documents on paper have much in common from a methodological point of view with the study for preservation of documents on non paper media.

The problems related to (photographic) glass plates, (photographic and motion picture) films, photographic positives and so on are not so different from those related to paper material; thus, the list for proper intervention already presented for paper medium can be proposed for these media as well, even if with some necessary modification. As studies in this field are not advanced, it would be necessary a comprehensive historical research concerning preservation conditions and methods for audiovisuals and magnetic media, for organic materials, such as papyrus and parchment as well as digital media, obsolete databases and software, as well as hardware to read them.

At last, it is of great importance to develop preservation methods and techniques for obsolete software and hardware so as to assure their utilization, also for what concerns images and data bases produced in these last decades.

3 – Ageing, de-acidification and de-infesting treatments

a) The accelerated ageing of modern paper media

A study on artificially accelerating the age of paper in order to assess the quality and the chemical stability of modern paper that would be the physical medium for cultural treasure.

b) Optimizing de-acidification techniques for mass preservation

A study on optimizing de-acidification techniques for large preservation projects.

Definition and employment of reinforcement and consolidating agents

Definition and/or employment on a large scale basis reinforcing agents which, will not affect the cellulose material nor that which has been deposited on it (inks, writings, drawings, etc.); these agents will make the paper, even controlled use paper, resistant to bending and twisting, which cannot be entirely avoided. The aim is to stop the paper media from turning into powder, as sometimes happens after de-acidification or even during the de-acidifying process itself.

c) Compositional alterations caused by de-infesting chemical agents

The study of alterations of media caused by use of de-infesting chemicals and possible alternate technique.

d) Definition of methods for a concerted campaign against insects

The study and definition of chemical substances for a concerted campaign against insects which feed on paper, wood etc., at least in some phases of their development (as for ex. Larvae); these insects are one of the main causes of degeneration for cultural treasures that is more difficult to fight.

Similar studies are meant to be carried out against degeneration caused by every sort of biological agent.

4 - Electronic restoration and retrieval of information on documents

The reproduction of historically important documents to preserve the originals from the risks inherent to physical manipulation and to enable an easier exploitation by scholars and other users is now an established practice. Recently, analog recording media (such as microfilms) are being complemented by newly developed digital techniques. Indeed, the latter are rapidly substituting the former, and an extensive translation process has also been started, at least for the most valuable documents. The advantages of digital preservation are manifold: 1) Digital media are easier to exploit, more versatile, and can be reproduced, stored and shared much more easily than the traditional ones; 2) Digital images can include and represent properly all the possible specialized measurements performed on physical objects; 3) Any kind of additional, contextual, information on the physical objects can easily be incorporated into the related digital objects; 4) Digital image restoration is much more effective and versatile than any analog (e.g. photographic) restoration technique; 5) Modern mathematical image analysis tools, which can only be applied on digital objects, are capable of disentangling,

processing and storing information that is otherwise hidden in analog images. Digital information, along with modern processing and analysis techniques, is thus becoming an essential tool to help physical restoration and conservation of documents. Although scientific imaging and digital data analysis and processing are now actively researched areas, much work is still to be done as far as procedures specifically dedicated to document restoration and conservation are concerned. As an example, a deep insight into the physical properties of the different media can both help an improvement of hardware systems for specialized image capture and the development of mathematical models for the description of the appearance of a document. Both these tasks entail a huge theoretical, experimental, and computer programming effort. Image processing and analysis also require a great deal of computing research. Establishing dedicated methodologies to ensure an efficient management of digital data is also extremely important to allow a secure exploitation of the documents by the various kinds of users. Another problem that is not completely solved is the definition of a set of standards dedicated to the construction and maintenance of the digital objects, as is being done for the restoration and conservation of the physical documents.

The study will be devoted to identify a number of best practices and to explore new research avenues to define and realize integrated systems where, depending on the particular documents treated, the most suitable diagnostic and imaging techniques are complemented by effective software tools to process and analyze the data and to build, classify, and store sets of digital objects that contain all the relevant information. Attention will also be paid to effective and secure data management systems that both ensure the integrity of the original information and deal with possible digital rights management issues. All these activities will take into account the existence of established standards, and will also be able to contribute to new or extended standards at the European level.

1. Samples of paper and parchment should be collected from different conditions and analysis and investigations for the effectiveness properties should be applied in order to identify the nature of raw materials, Explain causes of deterioration, describe the deterioration forms and explain the deterioration mechanisms;
2. New paper and parchment should be prepared according to ancient recipes. The samples prepared should be used in the experimental study.
3. Different accelerated ageing will be used to prepare new samples in advanced state of deterioration similar to the historical samples (from the point No.

and parchment should be evaluated;

7. New pastes and materials should be evaluated for gap filling and completion of missed parts of parchment documents;
8. Advanced and non-destructive techniques of analyses and investigations 1);
4. The aged samples from the previous point will be used for the evaluation of materials and techniques of the conservation treatments;

5. For paper the techniques and materials of deacidification should be evaluated;

6. The use of new natural materials should be applied in the disinfection of paper should be used; (Gomaa abdel-maksoud)

EXPECTED RESULTS

- To define on a national and international level the physical and chemical characteristics of "permanent" (or non-acidic) paper destined to be the medium of cultural treasure.

- To define de-acidification techniques that are not hazardous to material and to operators' health.

To define suitable methodologies and preservation techniques of documents and book material on paper relating to environmental conditions, substitution reproduction techniques, electronic restoration, ink and pictorial films reinforcement.

- To define adequate de-infesting methods.

- A historical survey on preservation conditions and methodologies of audiovisuals and magnetic media up to the present day.

- To define a correct methodology and preservation techniques for audiovisuals relating to environmental conditions, their restoration and transferring (digitizing) on more lasting media.

- A set of correct techniques and methodologies to preserve and manage the information contained into documents through their digitization and storage in the most suitable media.

- A help to establish complete European standards on specialized image capture, data processing, analysis and management procedures, and a complete set of metadata to describe all the textual and contextual information associated to historical documents.

Area X.2.7 – Nanotechnologies in preservation of Cultural Heritage

PROBLEMS

Over a period of years several innovations in the Conservation field mainly based on the application of Nanoscience showed that they can be applied with consistent advantages over “traditional” restoration methods, providing clear evidence of the huge potential of this emerging Science for Cultural Heritage

Conservation. Basically efforts have been successfully addressed transferring to the Conservation Field tools typical of Nanoscience.

Nano particles are known since longtime, considering that the first scientific paper on nanoparticles dates back to Faraday. Lustre is one of the most relevant decoration techniques of Middle Ages and Renaissance ceramic of the Mediterranean basin based on nanotechnology. It is characterized by glazes of different colors (in general, yellow or red but with several variations) with metallic reflections and iridescence. The singular optical properties derive from the luster composition and structure, consisting of a thin layer of a colloidal dispersion of silver and copper metal nanoparticles within the more external surface of the glaze.

Furthermore, the production of melt-glass colored by the dispersion of small amounts of metal nanoparticles is historically remote and the singular case of the optical behavior of the Roman Lycurgus Cup (4th century AD), exhibited at the British Museum, is well known. Lustre is characterized by nanoparticles of sizes generally comprised from 5 to 200 nm, not dispersed in the glaze bulk, but instead collected at much higher density in close proximity to the glaze surface. Nanoparticles display a quasi-spherical shape and are distributed in single or multiple layers of thickness generally between 100 nm to 1 pm. These features result in a decoration displaying a wide range of colors and characterized by surprising dichroic effects when the glaze surface is observed at different angles.

Modern and contemporary arts, ranging from objects and paintings to building heritage, lacks at the moment of innovative methodologies for the conservation of their "modern materials", such as concretes, steel, polymers and related composites. Similarly, conservation treatments performed on stone with modern products, i.e. polymers, showed during time lack of performance and a novel approach is urgently needed to preserve the established hybrid inorganic-organic system. In addition to the current efforts Cultural Heritage, research projects must be developed regarding the following topics.

The nano-structured systems, are characterized by a size of the constituent “objects” that ranges in the interval 2-100 nm. Indeed, the exact definition of a nanometric structure is that referring to an `object' which has got at least one of the three dimensions less than 100 nm. Therefore, solid particles sized in this regime, nanodroplets of a liquid dispersed in a suitable medium [immiscible liquid (microemulsions), gas (aerosols)], nano-domains of a liquid entrapped in polymeric architectures (gels), nano-bubbles of a gas in a liquid medium (foams), supramolecular aggregates of amphiphilc molecules (micelles, vesicles, membranes, etc.) represent systems of great interest either speculative or technological and applicative.

TARGETS

1 – Diagnosis by nano or molecular deterioration markers

High performance new facilities and nondestructive and/or nanoinvasive methods to be used especially in situ (spectroscopic, spectrometric, diffractometric, electron microscopy techniques) capable to identify qualitatively and quantitatively at nanometric or molecular level the morphology, structure and composition of the different materials, together with their compatibility with the substrate, their stability and reactivity, the mechanical and thermal properties, etc. and to detect suitable nano- or molecular deterioration markers to be used in fast and inexpensive determination of the state of conservation and of incipient decay processes.

2 – Intervention by nano-systems for restoration

- clearing procedures based on micelles and nanoemulsions or other nanosystems as nanostructural gels.
- -calcium alkoxides- Tailored nanoproducts as consolidants and coatings, especially for the conservation of building heritage. Some examples are nanodispersions as $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$, $Sr(OH)_2$), as consolidants of suitable carbonatic substrates (marbles, etc.).
- -Silane/syloxane, acrylic and silica nanodispersions, using inorganic, organic and mixed consolidant products (for example Nanorep 10: 30%silane/25%syloxane nanodispersion, diameter of particles 50-80 nm); Nanorep 21: silane/syloxane microemulsion; 3) Nanosil 30: silica nanodispersions, diameter of particles 20-30 nm; 4) silica/acrylic nanoproducts, diameter of particles 20-100 nm; 5) Acryl 22: acrylic dispersion; 6) Atomo: acrylic microemulsion, diameter of particles 20-40 nm.
- Nanosilica injected in the substrate of wall paintings could be alternative to nanolime actually used while zirconia and/or alumina nanoparticles can improve mechanical resistance of artwork surface layer and go deeper in the body of piece.
- polymeric nanosilicate nanocomposite (nanofillers into a polymeric matrix)
- photocatalytic cement-based materials
- bio deterioration restoration based or nano biocatalysts
- functionalized alkoxy silane for deacidification and consolidation of paper.
- plasma technology for SiOx (≈100nm.) deposition on papers or antibacterical properties of Ag particles.
- carbon nanotubes for mechanical improvement of timber structures.

3 – Protection by nano – systems for conservation

- Organic resins used in latest fifty years demonstrated poor time and weather resistance, in some cases worsen the appearance and the conditions of

the artwork. The use of inorganic coating can override these problems, because of their long term stability; moreover, it can improve the "self-conservation" of the artwork, for example in the case of titanium dioxide (fig. 1), that give self-cleaning (super-hydrophilicity) and antimicrobial effect to the treated surface.

- Organic inhibitors, such as 4-methyl-imidazole, 2-mercaptobenzothiazole, 1-phenyl-tetrazole-5-thiol, 3-amino-1,2,4-triazole and 3-ethyl-4-methyl-5-imidazole-caboxylate, and thin protective nano-structured films produced via environmentally friendly plasma based techniques have been selected on the base of their potential activity on a nano-scale dimension to inhibit the cyclic copper corrosion.

4 – Protection by nano – systems for conservation

Some colors of the current palette used in painting integration showed a degradation and/or hue modification during the time: examples are artificial ultramarine blue and the brown-yellow named "terra d'ombra", that, used in important restorations like Giotto's Scrovegni Chapel in Padova changed in short time. Gold nanoparticles (fig.2), for example, give a red color similar to Lacca di Garanza and the cobalt ferrite gives a black color with a quite good covering power. The use of pure nano pigments or mix of them can lead to colors physically and chemically stable in the time.

5 - Monitoring and maintenance by nano devices

New nano devices and sensors based on selective-recognition (for humidity, presence of salt, aggressive atmospheric agents and pollutants, fast and cheap detection of decay markers, sensors of mechanical or thermal performances, etc.

EXPECTED RESULTS

The exploitation of nanotechnology for the safeguard and conservation of cultural heritage is rather recent and deals with some of the above mentioned systems developed ad hoc as innovative materials to be used in the conservation of many artifacts, as wall paintings, archaeological objects, buildings easel paintings, wood, ancient papers and manuscripts, concrete, steels, polymers and related composites, etc. Thus, materials and devices at the nano scale hold vast promise for innovation in virtually every sector of Cultural Heritage, i.e. archaeometry, diagnostics, monitoring and maintenance materials and technologies for conservation.

THE EACH PROJECT

KEY ACTION X.3 – BIOLOGICAL DIVERSITY

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AREA X.3.1 – Analysis and preservation of biological diversity

TARGETS:

1 - Achaeosurfaces and natural environments
2 - Man and populations
3 - Ancient bone preservation
4 - Documenting and analyzing productive cycles and traditional ritual forms by graphic and audiovisual technologies.
5 - Biomechanical analyses of long bones

AREA X.3.2 – Ethno anthropological testimonies

TARGETS:

1 - Techniques in cataloguing and processing linguistic, iconic, musical, choreutic, etc. representations
2 - Documenting and analyzing productive cycles and traditional ritual forms by graphic and audiovisual technologies
3- Thematic automatized cartography for the reading and the interpretation of the material culture and the forms of the territorial organization
4 - Environmental biodiversity

ACTIVITY X.3 - BIOLOGICAL DIVERSITY

INTRODUCTION

The "Biological Archive" is important for past times when lacking of written documents oblige to turn to other testimony; but it is essential also for present every time that study of human remains and of the use man made of natural resources are important to explain quality of life since prehistory until times of the industrial revolution. Research in paleoanthropology, paleopathology, paleobotanic and paleozoology thus must be systematically included in all studies on cultural heritage, as they allow to basic answers in connection with the strong demand of identity of present societies.

Since recent times the mean of biological remains in contributing to increase knowledge on mankind' history has been widely disregarded, as interaction between humanistic and naturalistic sciences had been traditionally very poor. The present reevaluation of natural and biological sciences as a tool in reconstructing the dynamics of the biological events, may allow to strong answers in documenting processes that might seem definitively lost when life stops.

In order to be exhaustive the botanical, zoological and anthropological archive have to include not only ancient materials but also the present one, such as biotypes of special interest, cell cultures, animal and vegetal genomes and data on the biological diversity and the genetic structure of populations. All these information have to be seen as "markers" in the history of man. Therefore they give a cultural testimony of great significance in reconstructing and interpreting manufacts, environment, territory and cultural expressions improving, meantime, new methodological approaches and technologies finalized to set up a panorama including past and present.

In this frame, appreciating the multiplicity and variety of existing natural forms (biodiversity) and recognizing that at present animal and vegetal genetic variability is threatened by wide introduction of highly selected species, it's urgent to recover and improve native genetic types as unique and priceless expression of different genetic diversity which represent the link between past and developing becoming of living beings.

Deep analysis of forecast researches with application of advanced methods specific of biological sciences as well as of archeological ones, could allow to a new wide and promising research stream of interdisciplinary studies characterized by strong interaction among students of different cultural and professional background.

AREA X.3.1 – Analysis and preservation of biological Diversity

PROBLEMS

Since early times, history of man and its style of life appear to be strongly influenced by the natural environment. Factors as climate, land's orography, environmental resources and productive potentialities played a major role in stimulating and shaping the biological and cultural adaptive responses of man to its habitat.

From this this point of view man's history may be considered as the history of the achievements obtained by mankind in its effort to reach the best living conditions in relation to the potentialities allowed by the physical environment.

In order to outline the whole of the relationships which played a prominent role in the becoming of these proceedings, wide basic knowledge is needed on ancient natural environments, their evolution and biotic variability in relation to human biological and cultural adaptation.

This Area deals with the identification and description of a variety of biotic components of natural environments where man settled in early and most recent past in order to clarify the relationships among them as to explore their influence on human biological and cultural variability, tools production and technology as well as on the social and economic organization. The analysis of the effects of human activities on the dynamics of the environmental modifications and their feedback on human being is also of topical interest.

In order to achieve significant results it seems imperative to overcome constraints imposed by traditional specialist approach improving new approaches based on wide interaction among complimentary disciplines as well on renewal of technical approaches and to experiment with advanced technologies.

As the main purpose of this Area deals with how since early times man used natural resources and developed specific behavioral and cultural patterns, the analysis of past environments and the reconstruction of human habitats through time must provide the basic outline to this. Under this perspective the use of a biological archive is needed to complete knowledge on the history of man being manufactures and other cultural remain to be viewed as an expression of the use man did of natural resources including available animals. Furthermore man's remains themselves are the prominent testimony of living conditions of human populations as well as of their food resources and their performance on work and in all activities essential to guarantee survival, wellbeing and culture's production.

A variety of methodological strategies and advanced technological approaches can be envisaged to be successfully used together with or in alternative to classical optical microscope: bone mineral scanning and Allen Boyde's tandem microscopy,

electron scanning microscopy, photo acoustic spectroscopy and other techniques allowing to third dimension view and surface structures; confocal microscopy, fluorescence microscopy, cyto- fluorimetric techniques and cathode luminescence techniques, etc. All these microscopic techniques may be applied to ancient materials (pollen, wood fragments inorganic remains, teeth crows lytic manufacts, etc.) as well as to the present ones. Furthermore techniques based on radiation emission may be fruitfully used, such as analysis based on directionally originated X rays flow, computerized axial tomography, image analysis methods especially useful to the comparative morphometric and to the video graphic morphologic reconstruction of structures (CAD techniques).

Many other techniques can be used other than that, which belong to biochemistry and molecular biology from which researches are waiting sophisticate answers to be used in verifying and confirming data from humanistic studies; many efforts are made at present to make molecular analysis methods more and more powerful and trustful on this subject.

From all the above it is evident that researches on botanical, zoological and ethno anthropological archive are very promising for the improvement of new technologies. New approaches in population paleo-biology may be developed, the main aim being the "rebuilding" of ancient populations structure and bio cultural processes through the analysis of present populations' DNA and other genetic markers in comparison with data from ancient remains. In this context the application of molecular biology to archaeology emerge as a a new tool which can be named "molecular bio archaeology" more and more used to explore the past and to confirm or reject previous archaeological and anthropological hypothesis. Furthermore studies on "tracing animals" can offer valuable information on man quality of life, changing environment and man's economic activities and commercial exchanges.

TARGETS

1 - Achaeosurfaces and natural environments

Researches include several multidisciplinary studies aiming to characterize and reconstruct the evolution of the cultural landscape which is at the base of the comprehension of modern human impact and land sustainability; life conditions and nutritional status, domestic and wild plants and animals exploitation and environmental modifications and cultural patterns due to human settlements. Trace elements determination and paleo toxicological analysis are a necessary support for all the researches in this context. Environmental traits and their modifications will be settled by advanced methods in palynology and archaeobotany in general, mycology, lichenology and dendrochronology; meantime fauna and flora reconstruction, both of environmental and economic interest, may help to settle the history of natural resources affected by continuous or seasonal drawing in connection of human living activities.

Furthermore in some specific places these studies could be basic to elaborate peopling models, traditionally based on paleontology, paleogeography and

paleoclimatology being these models useful to be considered a valuable "reading key" for peopling processes of geographical areas which suffered complexes paleo climatic events, as the Mediterranean area.

All these researches will be enriched by specific studies dealing with recovering and storing animal and plant, genomes of species collected, domesticated and sometimes cultivated, and of species threatened by extinction due to the rash man pressure and un replaceable parts of the earth ecosystem.

2 - Man and populations

This research line mainly deals with the application of a variety of instrumental diagnosis on bones and dental remains in order to reconstruct the biological events lost with the end of life. Among them paleogenetics, paleoserology and paleopathology shall be stressed as well as paleophisiology and paleo epidemiology and their relationships with environmental, nutritional and working stresses.

Furthermore, taking into account that classical archaeology often give ambiguous answers and can not pursue true typing of ancient human remains, the development of molecular bio archaeology will be pursued in order to contribute to clarify controversial questions. On this respect, amplification and analysis of DNA obtained from ancient bones plays a prominent role. By these technologies data on migrations of prehistoric populations can be depicted which represent the basic background to understand the biological history of present populations.

The studies on the DNA of ancient populations could play also a prominent role in clarifying the origin of some diseases widely distributed in present populations among which developed as earth problems of social value, i.e.: haemo globinopathies and enzyme's deficit in the Mediterranean area, This studies will be performed on samples showing morphological evidence of pathology and belonging to well defined habitats. As a whole these researches aim to contribute to clarify the evolutionary dynamics of human populations and their interactions with the environment.

From the methodological and technological point of view, the following should be stressed: statistical biometric analysis of intra and inter-population variation, multivariate statistics, discriminant analysis, “bootstrapping" techniques, biologic and genetic distances among populations; morphometric and allometrics image analysis, non cartographic photogrammetry, iconography. .Identification and standardization of techniques in "molecular bio archaeology" useful to obtain, amplifying and analyzing ancient DNA from pre historical human remains. Testing of new technologies for recovering, restoration and conservation of the remains of the biological archive; taxonomic investigations on the reconstruction of pre and post depositional skeletal and dental remains.

3 - Ancient bone preservation

The diagenesis of bones is mediated by microorganisms, the presence of which has a profound influence on the bone preservation potential. Local groundwater, oxygen availability, pH and temperature will not only influence what kinds of microorganisms are present, but also how quickly they multiply. Acidic soils and/or

the acidic microenvironment, caused by micro-organisms living in the soil, contribute to the degradation of bone. Neutral soils produce bones with little or no bacterial attack and a high residual collagen content. Water provides a medium for the transport of ions to and from bone and contributes in a major way to the chemical degradation of osteological materials. Histology is a relatively easily applied technique that allows several degradation phenomena to become visible in a qualitative or semi-quantitative way. Relation between histological preservation and the ability to extract intact bio-molecules has been reported. Scanning electron microscope gives a three-dimensional overview of spatial arrangement of bone tissue and demonstrates the structure of bone surfaces. Total amino-acid and collagen concentration as well as crystallinity indices appear to follow a common pattern and to be positively (although imprecisely) correlated with the quantitative preservation of DNA.

In particular studies will be carried out for bones and teeth:

DNA analysis

Amino-acid racemization analysis

Scanning electron microscope

EDAX elemental analysis

Histomorphometry (quantitative histology)

Computerized tomography (CT) imaging

1. Historical samples from different locations and excavation should be collected in order to analyze and investigate to prepare new bone samples similar to the archaeological samples by application different accelerated ageing;
2. Study the corrosion phenomena of bone;
3. Physical, chemical and biological properties of organic and inorganic compounds of bone should be studied by using the advanced techniques of analysis;
4. Evaluation of new consolidants for the weakened bones;
5. Experimental studies on the removal of soluble and insoluble salts should be done;
6. Experimental studies on the cleaning materials and techniques of bone should be done;
7. The effect on microorganisms on historical bone should be studied and the materials and techniques of disinfection should be evaluated.

4 - Documenting and analyzing productive cycles and traditional ritual forms by graphic and audiovisual technologies.

This is the application field of visual anthropology which during last decades experienced wide development both at national and international level. Graphic and audiovisual documenting techniques became more and more necessary as they are extraordinarily effective in giving back documents as well as in making easer the fruition of the scientific results. They are also valuable heuristic tools in order to better understand the deep meaning of the observed phenomena.

5 - Biomechanical analyses of long bones

Biomechanics represent how engineering concepts could be applied to human archaeological samples, to reconstruct past behavioural patterns. Robusticity, in its most general definition, refers to the strengthening of a skeletal element through the addition of bone tissue. Long bone robusticity can be quantified by applying beam theory to the biomechanical analysis of cross-sectional geometric properties of long bone diaphyses. Postcranial robusticity, the massiveness of the skeleton, is an important aspect of human skeletal variability. Anthropologists use postcranial robusticity to infer the activity levels of prehistoric populations. The robusticity of human long bone diaphyses can provide information about habitual behavior among humans in the past. The changes in robusticity over time provide crucial support for scenarios that describe shifts in activity patterns. Mechanical bone stress and strain developed under loading increase the amount of cortical bone and change its distribution in cross sections of long bones. Both body shape and behavior may influence mechanical loadings on the limbs, and thus bone shape. Both kinds of effects appear to be specific to the mechanically most relevant regions. Diaphyseal size and shape are highly responsive to changes in the habitual mechanical loads placed upon them. This provides the justification for using measures of the quantity and distribution of bone as a reflection of those habitual loads, and hence of relative activity levels and patterns between relevant samples and specimens.

Computed tomographic scanning (CT) is an excellent noninvasive technique for acquiring image data. Cross-sectional images will be obtained in the transverse plane of each bone, perpendicular to both coronal and saggital planes, e.g. at the mid-shaft point of the femur and tibia, and at the 40% from the distal end of the humerus. Antro-posterior and mid-lateral breadths of both subperiosteal and endosteal areas will be measured at the two planes and theta (θ) the angle from M-L axis counterclockwise to major axis. In addition, cortical bone thickness at anterior, posterior, medial, and lateral parts of the bone section will be measured. The biomechanical properties of the bone will be determined by applying the equations for calculation of cross-sectional geometric properties.

EXPECTED RESULTS

The final aim of the research described above is the construction of a thesaurus of organized studies which can become data bases, annotated bibliographies, experimental and applicative protocols and procedures, test studies on a series of fields, feasibility tests on particular reconstructive analyses and procedural norms.

This same data, once organized, will be in agreement with the elaboration of a series of general answers to historical questions an to archaeological problems, other than those of recovery, protection and conservation of the biocultural patrimony.

The product of similar studies will continue to permit the calibration and adaptation of general instrumental technologies applied to materials of historic and museum interest, the actualization of constructed models departing from past events,

the retrospective chronological control of models of protection, such as demographic transition.

AREA X.3.2 – Ethno anthropological testimonies

PROBLEMS

The main aim of this section of the research is to contextualize the cultural objects and to integrate them into proper social economical, historical and cultural contexts by mean of suitable analytical methods. On this basis interactive regional archives will be set up in which, through informatics and audiovisual technologies, digital data, written documents, pictures and sounds will be integrate.

Essays, leading articles, papers of every type (historical, topographic and thematic), photographic documentaries and movies will be entered on informatics tapes as well as numerical and statistical data, tables, graphs, and so on. Single topics and localities could be recalled, consulted and scrutinized by proper software with the possibility to associate qualitative and quantitative information, images and verbal documents on the fundaments of the artificial intelligence.

Furthermore, all this documentation can be used as a tool to set up and to test monitoring and control of localities and contexts of special interest in order to prevent demoting risk situations.

TARGETS

1 -Techniques in cataloguing and processing linguistic, iconic, musical, choreutic, etc. representations

Ethno anthropological subjects, to be catalogued and properly represented, need the application of specific and diversified techniques. An ethno anthropological archive, or museum, deals with subjects whom structure and function are extremely heterogeneous: from the agricultural tool to the traditional singing, from the ritual practices to the productive techniques and to the forms of association, etc. As consequence in this field, the collection, classification and elaboration of the data, require to settle models and methodologies more and more advanced but oriented to formalization which avoid eliminating the complexity and the variability of the cultural reality.

2 - Documenting and analyzing productive cycles and traditional ritual forms by graphic and audiovisual technologies

. This is the application field of visual anthropology which during last decades experienced wide development both at national and international level.Graphic and audiovisual documenting techniques became more and more necessary as they are extraordinarily effective in giving back documents as well as in making easer the fruition of the scientific results. They are also valuable heuristic tools in order to better understand the deep meaning of the observed phenomena.

3- Thematic automatized cartography for the reading and the interpretation of the material culture and the forms of the territorial organization

Thematic automatized cartography already showed interesting applications in the domain of Cultural and Environmental Heritage offering a variety of opportunities to students of the material culture to deepen their researches. The techniques and the subjects which fall into this field in fact can be satisfactorily studied only if correctly contextualized. Reading of the interpretation of the relationships between the material culture and the social economic and socio territorial contexts represents the natural development of all the ethno anthropological studies oriented to the documentation and to the analysis of the productive and festive cycles.

Characterization and definition of regions, places and territorial contexts. The institution of an ethno anthropological and linguistic regional atlas need preliminarily the definition and the characterization of social environments as well as territorial contexts with special historical and cultural mean. This study appear to be very difficult as imply the application of field research oriented to single out places significant for the historical memory and the cultural identity of the settled human communities. Interactive and multimedia models of regional archives. Often, the application of the automatic cartography to Cultural Heritage had been limited to show the geographic distribution of the observed phenomena; in spite important, this application can be seen reductive and greatly below the potentialities offered by modern computing systems. Building and experimenting models of regional archives is mainly oriented to explore the potentialities of new technologies in give interactive and multimedia representation of the cultural systems stratified along the national territory.

Monitoring and controlling territorial contexts and environmental systems of special ethno anthropological value. In a steady changing society, establishment of regional archives is mainly oriented to make stronger the historical memory but also to improve monitoring and control of cultural parameters and territorial realities that human activities and changing environments expose to wasting and extinction risk. In this field also, when localities and environments of special interest are recognized, it's necessary to settle proper evaluation methods on the environmental impact as well as the deriving action for protection and safeguard.

4 - Environmental biodiversity

It is becoming more and more explicit the concept that human economy is a subset of the surrounding ecology. Socioeconomic systems strictly depend on the capacity of natural systems to ensure “Goods” and “Services” necessary to support life and well-being. Goods and services are the products of ecosystem processes and functions which, in turn, are generated by complex interactions between abiotic and biotic (biodiversity) components. Generally, the services produced by natural systems and their values (natural capital) are not considered by the classical approach of the market economy. This implies that they are rarely included in policy decision-making processes and cost-benefit analysis and explain the actual levels of “unsustainable development” which characterize the economy of many countries and the human overexploitation of natural resources worldwide.

In this context, it appears of fundamental importance to assess the economic value of non marketable “natural services” (Costanza et al. 1997; Millennium Ecosystem Assessment, MA 2005) with a clear understanding of the linkage between biodiversity and ecosystem functioning (BEF – Loreau et al. 2002).

The recent “Economics of Ecosystems and Biodiversity” project (TEEB 2009) includes an assessment and evaluation of the role of Biodiversity in sustaining Ecosystem Services (ES) and human well-being, with the main objective directed to improve policy decision-making. This project identifies five dimensions of biodiversity necessary to provide supporting, regulating, provisioning and cultural ecosystem services for human well-being: 1) species richness, 2) species rarity, 3) biomass density, 4) primary productivity and 5) genetic diversity.

Our proposal is to investigate aquatic and terrestrial biodiversity of selected taxonomic groups and habitats in countries surrounding the Mediterranean Sea. Although the Mediterranean basin has been indicated as one of the main hot spots of global Biodiversity (Myers et al. 2000) very little is known about species richness and distribution of some “minor” living organisms, as invertebrates, fungi and others. The research will be mainly conducted in habitats which are of fundamental importance for the ES they provide to society, as wetlands, freshwater springs, agroecosystems, forests, and so on.

Because of the intrinsic difficulties to explore all dimensions of biodiversity (see above), the project will be focused to assess the first two dimensions: species richness and species rarity.

Information from bibliographic references, databases, check-lists and other sources will be organized and digitalized in a georeferenced system using GIS technologies. Field samples will be scheduled to cover less explored geographic areas. Sampling procedures, sorting and identification of the material will be conducted following the standard protocols characteristic for each taxonomic group. Molecular methods and DNA analysis will also be employed. The distribution of data will be statistically analyzed by applying univariate and multivariate methods of spatial analysis to produce replicable patterns useful for analogous future researches.

The final aim of this research described above is the individuation of any biogeographical model, including endemism areas, represents a basic instrument that biogeography provides to conservation biology.

Nevertheless, preliminary to any elaboration is the actual knowledge of biodiversity, both in terms of species richness and of their distribution into the biogeographical selected unit.

The so-called Linnean shortfall (referred to all taxa still undescribed) and Wallacean shortfall (referred to the incomplete knowledge of the species distributions) are, in fact, among the main challenges that conservation biology is facing today. The decline of taxonomy, considered a ‘dead branch' in the environmental research, is dramatically reflected in a profound gap of knowledge to which all the research fields in ‘applied' biology, as ecology, biogeography and conservation, are paying heavy consequences.

In preliminary phase of this proposed study, a number of typologies of terrestrial and aquatic environments in the Mediterranean area will be sampled. On the basis of the existing competences within our research team, reference-areas will be selected that for ecological and historical features (e.g., palaeogeography, palaeoecology and palaeoclimatology) have the potentiality to host (1) elevate biodiversity; (2) high incidence of UNIQUES (Vane-Wright et al., 1991) and (3) of ESUs (Evolutionary Significant Units); (4) high rate of rare species; (5) high rate of endemic species; (6) high phylogenetic dispersion of the diversity. Moreover, areas for which the past knowledge is missing or incomplete will be sampled with the aim to amend the cognitive indetermination that reflects into the Steyskal effect that still strongly affects the knowledge of the Mediterranean biodiversity.

Moreover, the construction of a thesaurus of organized studies, such as data-bases, annotated bibliographies, experimental and applicative protocols and procedures, can facilitate test studies in different fields, tests on particular reconstructive analyses and procedural norms.

These same data, when organized, will be in agreement with the elaboration of a series of general answers to different questions in many scientific fields, other than those of recovery, protection and conservation of the biocultural heritage.

Finally, the product of similar studies will permit the calibration and adaptation of general instrumental technologies applied to historical and museal biological materials.

EXPECTED RESULTS

Analytical models and returning techniques for the ethno anthropological information as a tool aimed to improve knowledge on the research experience developed in Europe during next decades.

Application of innovative scientific and techniques methodologies to the study and preservation of a cultural heritage greatly variable at a regional level and exposed to a fast wasting risk due to a society oriented to a continuous changing of values and cultural models. Processing and testing models and techniques in settling ethno anthropological and linguistic atlas based on regional interactive and multimedia archives. Settling up and testing monitoring and checking systems in localities and territorial contexts of special ethno anthropological context.

THE EACH PROJECT

KEY ACTION X.4 – MUSEUMS PROJECTS & BENEFITS

KEY ACTION X.4 – MUSEUMS PROJECTS & BENEFITS

AREA X.4.1 – Museum management models

TARGETS:

1 - Microclimatic conditions
2 - Air-conditioning systems
3 - Sensor-systems to monitor museum microclimate

AREA X.4.2 – Museum cultural Project

TARGETS:

1 - Sciences of man and material culture
2 - Natural sciences: collections
3 - Historical gardens, botanical gardens, natural history
4 – Science museums and botanical gardens
5 - Collections, galleries and pPicture galleries
6 - Analysis of models of economic management

AREA X.4.3 – Museum Systems

***TARGETS*:**

1 - Multimedia regional systems
2 - Virtual reality, coding methods and applications
3 - Study of typologies
4 - Study of techniques to guarantee information integrity and Intellectual property rights
5 - Mediterranean civilisations: cultural relationships and their fruition for North African migrants in Europe

AREA X.4.4 – Tourism & economic outcome

TARGETS:

1 - Analysis of models of economic management
2 – Quality tourism

KEY ACTION X.4 – MUSEUMS PROJECTS & BENEFITS

INTRODUCTION

The concept, organization and operation of museums are areas in need of profound innovation in order to adequately meet the current social demand for access to cultural resources.

This Activity focuses on the central question of conservation and promotion, that is methods and ways by which the results of cognitive research are made available to the public by means of the most suitable presentation of duly preserved and restored materials. It therefore consists of a first stage devoted to the development of cultural projects with the aim of conveying the interpretation and historical re-creation of the "context" the different works belong to and significantly highlight.

A project is needed for the presentation of works to the public to organize the terms of reference of the cultural framework the public must acquire to play an active role in the information process.

In practical terms, the project will define and realize didactic aids, mainly of an interactive nature which will provide information on any work presented both directly and induced on public demand.

We purposely used the term "works" as the previous considerations apply to museums and galleries in the traditional sense of the term as well as to monuments which have survived to our day and are still in use, archeological sites, natural parks, museums of natural sciences, ethno-anthropology, technique and science.

Once the cultural project has been defined, the above mentioned most suitable presentation of materials requires an architectural scheme, its realization and the setting up of the exhibition structure where practical solutions are adopted to meet the public's demand and the best layout of didactic aids is sought. Here a fundamental role is played by the systems to control state of conservation and microclimatic conditions and to guarantee safeguard from any possible risk to both visitors and exhibits.

The conservation and promotion of the cultural heritage should not be limited to single sites and collections, even if they bear great historical significance: the complete recovery of our predecessors' experiences is only possible if we consider physically and historically defined areas: a geographic area, a region often supports the spatial organization of culture. That's why museum systems covering whole regions should be organized around historical museums, which represent pieces of evidence of museum historiography.

The concept of “museum system” also applies to scientific museums which provide an integrated supply of works illustrating the history of science and of technique as the fundamental components of cultural complexity.

Such systems should include a central pole presenting an effective synthesis with regard to a specific theme and covering the whole area under consideration as well as some peripheral poles linked to sites and monuments of particular relevance.

The third level of the system consists of distributed units which essentially contain didactic aids for special collections that do not require any expensive air-conditioning and security system. Through these didactic aids it will be possible to create a computer network whereby information and indications on the access to the cultural heritage will be available at any place in the area under consideration.

It should be pointed out that there is a vast stock of instruments and findings that constitute an extraordinary documentation of the role played by scientific research and technical applications throughout the history of civilization.

So far all attempts to guarantee the conservation and public accessibility of such wide cultural resources have failed to produce any appreciable result. In the country of museums by antonomasia, the numerous institutions that preserve significant pieces of evidence of the history of science and technique are in precarious conditions: many of them are completely run down , whilst those that are still active find difficulties surviving.

AREA X.4.1 – Museum management models

PROBLEMS

The processes causing the deterioration of the surfaces of items belonging to the cultural heritage are being investigated with great attention as even extremely low deterioration rates can produce irreparable damages in time.

The negative impact of air pollution and microclimate on items exhibited both outdoor and within museums is by now unanimously recognized.

The term “microclimate” is generally used to describe the typical climatic conditions of interiors, but in this context it can also be used to define local weather conditions affecting outdoor structures.

The assessment of the real efficiency of air purification systems inside museums has only recently attracted the attention and concern of those responsible for the cultural heritage.

Therefore it will be necessary to study and analyze the micro-environmental conditions and their interactions with the cultural heritage by means of suitable instruments, and to identify the most effective systems to monitor environmental

parameters and possibly reduce the risks of deterioration. In addition to environmental monitoring systems, other systems are needed to guarantee a safe display of exhibits: in designing electrical, heating, lighting systems etc. we must consider the peculiar nature of museums, rather than treating them just like any other office or residential building. Solutions must be sought to ensure comfort and security to visitors, museum-staff and exhibits.

Definition of procedures to “map” the distribution of microclimatic conditions in time and space in order to acquire information about the required characteristics of air-conditioning systems. The latter should be designed to guarantee optimal conservation conditions for the exhibits as well as maximum comfort for visitors and staff members.

Proposals for the realization of electrical, lighting and security systems, tailored to the specific characteristics of premises.

Creation of sensor networks connected to “feedback” devices, allowing for corrective measures in the event of critical situations.

TARGETS

1 - Microclimatic conditions

This research line will deal with the characteristics of microclimate and their impact on the cultural heritage in different exhibition situations. Physical-chemical parameters and their variability in time and space will be considered in order to develop effective models to assess and possibly foresee risk situations.

2 - Air-conditioning systems

Their purpose is to guarantee optimal conservation conditions for exhibits as well as comfort for visitors and staff members particularly at times of very high public attendance. Different devices and procedures can be adopted to meet these two kinds of requirements: a number of functional sectors can be identified according to the nature of exhibits and of museum premises.

3 - Sensor-systems to monitor museum microclimate

In order to study the museum microclimate and introduce adequate regulating systems, as described above, permanent monitoring is required of the physical and chemical parameters in exhibition premises. Such a system will monitor temperature, relative humidity, light intensity and, in particular, it will record the presence of harmful radiations and polluting agents, such as ozone, sulphur and nitrogen oxides, carbon dioxide and organic vapors.

Special sensors will be designed for this purpose (piezoelectric, optical fiber, semiconductor sensors etc.) to minimize their esthetic impact on the environment. It should be recommended that the design of sensors or groups of sensors should allow for the simultaneous monitoring of various parameters within the network and for their connection to a central control unit for emergency intervention in case of critical situations.

EXPECTED RESULTS

Definition of procedures to “map” the distribution of microclimatic conditions in time and space in order to acquire information about the required characteristics of air-conditioning systems. The latter should be designed to guarantee optimal conservation conditions for the exhibits as well as maximum comfort for visitors and staff members.

Proposals for the realization of electrical, lighting and security systems, tailored to the specific characteristics of premises.

Creation of sensor networks connected to “feedback” devices, allowing for corrective measures in the event of critical situations.

AREA X.4.2 – Museum cultural Project

PROBLEMS

This subject focuses on the definition of “cultural projects” designed to become documents and vehicles of communication in an interactive network of history, art, science and nature etc.

Cultural resources become documents and vehicles of communication with people faraway from us in time and often in space too, but whose accomplished experiences have somehow affected our way of being.

The research work will consider the typology of materials and will prepare models from which indications, rules and procedures will be drawn: different examples will be provided for each typology of items to be presented to the public.

With regard to scientific museums it is necessary to systematically relate instruments, technical-scientific equipment, production systems of special innovative significance (to the present time) to the general issues and theories they historically referred to , as they constituted the tools to verify and measure as well as the basis to develop hypotheses and theories. Historiography of science has not in fact produced the cognitive instruments to identify and highlight this documentation of fundamental relevance.

In particular we lack systematic research on manufacturers and manufacturing methods of instruments, devices and machines, on handwritten and printed manuals describing their use (including Renaissance machine theatres), on precision standards and on the lexicon of instruments, on their trade at international level, on the transition from instruments used in research to collection pieces. It is furthermore time to start serious studies on scientific collections to identify its main personalities, its trends and purposes in different geographic areas and historical times.

Similar attention should be devoted to such relevant and yet not fully highlighted sectors as botanical gardens, parks and historical gardens. The studies on historical gardens have so far concentrated only on a few extremely famous examples and have mainly considered their strictly architectural features, without providing complementary information on their vegetation and on their agronomic and cultural traits.

Re-located into the cultural, social and productive context they once belonged to, the instruments and products of scientific research will finally be regarded as legitimate components of the cultural heritage. It will thus be possible to start and culturally assist the process of building a national system of scientific and historical-scientific museums and centers, where such documents will be exhibited and will hopefully contribute to the dissemination of basic scientific knowledge.

TARGETS

1 - Sciences of man and material culture

These museums present ethno-anthropological findings as well as items illustrating the evolution of man and helping to understand man's living conditions in the past. An important aspect is constituted by man's activities such as farming and manufacturing handicrafts and tools: apparently humble yet essential documents to recreate the complete picture of man's presence in the past, something we usually term as material culture. Studies will be carried out on eco-museums, open-air museums.

2 - Natural sciences: collections

These are the many public and private collections existing which can increasingly play an important socio-cultural role, one that is strongly related to the knowledge of the natural environment and therefore to its management. The basic concept in planning and improving this typology of museums is that of effectively illustrating the natural environment and its formation and evolution in time.

Museums belonging to this category, with their wealth of historical collections, must get over the stage of mere collections and become systems documenting the past and therefore playing a crucial role for present knowledge; they must be research and training centers where present knowledge and modern technical aids are utilized with scientific exactitude to properly illustrate the evolution and modifications of the environment due to natural causes and those induced by man, as well as the evolution of its mechanisms.

Priority will be given to studies : a) aiming at the recovery, conservation and promotion of collections with special didactic or naturalistic value or rare ones as they were made by means of ancient and no longer known techniques which therefore deserve special attention; b) allowing for extensive and articulated didactic interactive relations between museum's "users" and nature, observed and interpreted through the analysis of past and present environments, of the structure, functions and evolutionary "history" of living beings.

3 - Historical gardens, botanical gardens, natural history

One of the primary objectives of this research is to achieve complete and in-depth knowledge of historical gardens and botanical gardens existing over the whole Euro-Mediterranean area. This will be possible by combining a number of skills and competences, including botanic and vegetation notions as well as architectural, artistic and archeological ones. The study of botanic-vegetation aspects will aim at preparing a number of cards to set up an electronic archive, including data on vegetable, tree, shrub and fruit species, present in the sites under study.

Through this stage of investigation and understanding the next objectives will be achieved, i.e. the safeguarding and improvement of historical gardens and botanical gardens.

As to their safeguard the presence and amount of air and water pollution and its impact on vegetation will be studied as well as pedologic and physical-chemical characteristics of the soil and state of health of trees and shrubs; an electronic archive will be created to collect computerized surveying cards.

The project should also produce a multimedia information system containing data on the legal status of gardens, historical parks and botanical gardens.

4 – Science museums and botanical gardens

The aim of the project is to deepen the linkages between the cultural tourism and the science museums; the study wants to highlight the relationships between the museums commitment toward public understanding and public participation of science and the activities related to the entertainment, in the light of the valorisation of the cultural tourism of the Mediterranean basin. The analysis is focused on the Botanical Gardens as good example of science museums with a high tourist attraction.

The project adopts a case study methodology with a comparative perspective. It intends to develop few significant cases of Botanical Gardens located in four big countries in the Mediterranean area. More specifically, the cases selected are the botanical gardens of Italy (Palermo), Spain (Valencia), Tunisia (Tunis) and Egypt (Elephantine). The analysis considers the organisation and the functionalities of the Botanical Gardens, as well as the local socio-economic characteristics, the presence in the area of infrastructures for the admittance and the reception, and the existence of dedicated schemes of incentives aimed at sustaining and favouring the cultural tourism.

5 - Collections, galleries and picture galleries

This research line will tackle the specific need of those “museum-like” places which are closer to permanent exhibitions aiming to illustrate periods of time and their main personalities as well as cultural and methodological subjects.

It is also necessary to consider the specific requirements of small and often monothematic or, conversely, excessively poly-thematic collections which, despite their cultural significance, have never been fully highlighted.

Architectural works, still in use or belonging to museums, require suitable projects and specific programmes for their architectural and historical significance to be fully perceived and appreciated by the public.

This research line will also cover the restoration and conservation of music instruments belonging to the cultural heritage.

It is worth noting that modern artists use synthetic pigments like acrylic products and create art works made of different materials: these materials often react with consequent problems for the conservation. It seems useful to spread a better knowledge on the characteristics of the materials employed.

6 - Analysis of models of economic management

Such analyses, utilized by several European museums, must be further developed, both by examining existing research works and by carrying out ad hoc ones. An analysis should also be made to assess the professional skills of museum-staff at various levels, training and awareness-rising of museum and public entities staff.

Attention will also be devoted to European monuments and archeological parks; models will be developed for the organization of functions and staff and for the supply of facilities, taking into account the different typologies of museums and their sizes, in relation to public attendance.

Finally a special survey will be made to investigate the management problems of those containers that are not specifically or mainly intended for the public to have access to them (in particular churches and historical residences); suitable interventions will be sought for their management, including fiscal measures.

EXPECTED RESULTS

The creation of museum projects that will promote the generalized application of methodologies, procedures, and organizational patterns, providing a fundamental contribution to the conservation and promotion of our cultural heritage. The museum project is in fact the scientifically creative element that justifies the structures built and organized to become places producing culture rather than mere containers for conservation and storage as most museums, rather ineffectively, tend to be today.

In the case of technical-scientific museums of historical interest and considering the backwardness of this sector, some preliminary research work will be carried out to acquire the information needed to organize such museums: biographies of instrument manufacturers, bibliographies of scientific findings of particular historical significance, systematic reconstruction of the relations of theories with experimental equipment, of scientific principles with historical subjects of vulgarization and of the transformation of application techniques with the renovation of manufacturing plants.

Gardens and botanical gardens represent the privileged subject for different experiences and competences to meet as their study involves researchers and professionals such as agronomists, botanists, architects, historians, archeologists,

chemists and legislators. The result expected from this research line, through the collaboration of all these disciplines, is the definition of innovative methodologies, (surveys, graphical representations etc.), to study historical gardens and botanical gardens.

Science museums and botanical gardens is supposed to produce new knowledge on the reciprocal influences of the entertainment and the public understanding/public participation of science activities. It also addresses how such relationships influence the attraction of different types of tourists (children, schools, families, communities from abroad, etc.).

AREA X.4.3 - Museum Systems

PROBLEMS

The necessary relation with the region that constitutes the support of the spatial organization of culture, on the one hand, and the complexity of subjects to be illustrated, on the other, require exhibition facilities to be organized in such a way as to create museum systems. This also emerges from the on-going definition of a national museum system including all museums, both state-run and non state-run. It consists of the planning and operational interpretation of the subjects illustrated with the aim of highlighting dwelling patterns and cultural events of a physically and historically significant area with regard to different themes.

Museum systems within the framework of research and experimentation can develop from museum projects capable, on the one hand, of meeting canonical and traditional problems linked to the physical space of museums and , on the other hand, of applying access methodologies based on the latest developments of information science and engineering.

Only such a profound and full interaction, involving the most technological features of computer science, such as multimedia and networks, can fully guarantee and express the communication potentials of the system.

Of particular relevance will be the creation of so called third level museum structures, destined to contain a limited number of items, but provided with advanced technology equipment and information programmes, in order to extend the use of the system to a vast part of the region and to provide the possibility of gradually expanding the scope of facilities.

TARGETS

1 - Multimedia regional systems

In this case the system illustrates some broad chronological or thematic contexts of the region by means of a central pole presenting the global and general framework of events relating to a specific context in that area, and some peripheral poles, linked to particularly important findings and having the function of further illustrating specific cases.

The network configuration and associated infrastructures will have to take several factors into account such as geographic distribution, typology and number of users, expected quality of information and amount of information provided.

The projects will identify suitable instruments and methods to create multi- and hyper-media archives and data indexing systems by means of graphical describers and their geographic location; they will also allow for consultation by identified categories of users as well as access to the system with different levels of interaction and data quality.

The projects will also identify the required professional skills that will include information expertise, knowledge of the cultural sector suggested as well as of museography and museology.

2 - Virtual reality, coding methods and applications

Regional systems should be supplemented by theme-oriented systems or systems aiming to illustrate a particularly vast and complex subject more extensively than a single museum can do. Also in this case, the central pole will be supported by a number of peripheral poles describing, with greater details and examples, the cultural Programme of the systems.

In order to meet such requirements, the systems will utilize advanced technologies of three dimensional imaging and animation as well as graphical tools to organize conducted tours, reconstruct missing parts of exhibits and simulate environments.

The systems suggested should also create a number of distributed multimedia archives that will enable the public to get to know and investigate a cultural subject that would not be otherwise available in such an organized and coordinated way.

The subjects selected should be such as to allow the planning and realization of virtual exhibitions and visits based on data contained in various archives, logically integrated along itineraries. The system will allow for differentiated consultation according to users' location.

In order to develop such systems, and especially their imaging requirements which may significantly vary according to specific applications and therefore range from geometric details to whole paintings, it is essential to study advanced coding techniques.

In this sector typical examples can already be found in the field of telecommunications. Therefore, on the basis of existing solutions, the complete integration of applications to the cultural heritage should be achieved.

3 - Study of typologies

Museum typologies must be perceived as well-balanced and interconnected subsystems. We also need to establish central poles providing qualified services to local agencies. In particular, in the field of restoration, cataloguing, documentation and research, such centers will have an evident coordination function.

In these cases of “professional use” the applications of the previous research line require ad hoc techniques.

The issue of networks connecting the different poles in a subsystem appears to be extremely important as well as the production of exhibits and itinerant exhibitions to be circulated within a subsystem.

By this definition we mean all the minor structures distributed over the region which contain items of relatively limited value. These would be linked to the area they come from through the provision of advanced computer equipment connected to regional museum systems and offering information through interactive programmes, on visitors demand.

The suggested systems must firstly discover techniques and solutions to the problems of existing museums which often lack efficient connection with other museums and are therefore unable to present exhibits as part of a broader system and secondly provide clear references to their historical, artistic and geographic contexts.

For each selected theme, the projects will also point out one or more cognitive approaches based on real materials as well as on documents illustrating faraway items. They will develop following pre-feasibility studies according to clear requirements expressed by selected categories of users.

4 - Study of techniques to guarantee information integrity and Intellectual property rights

With the introduction of telematics to exchange and send information, it is essential to study and develop methodologies to guarantee confidentiality, at various levels, and integrity of information exchanged. In fact the protection of copy-rights on data and images is of paramount importance for institutions owning them.

The European Community funded several projects on this issue; the most important, (CITED), defined a general model of copy-right protection and management.

Another project, IMPRIMATUR Intellectual Multimedia Property Rights Model and Terminology for Universal Reference, was recently started with the aim of univocally associating each item with its owner’s identity.

Furthermore several mechanisms are presently in use for the payment of copy-rights on international networks.

The projects will also analyze a number of protection systems, select the most suitable ones and test them on real applications introducing modifications and adjustments whenever necessary.

5 - Mediterranean civilisations: cultural relationships and their fruition for North African migrants in Europe

-To set up a relationship on a new basis it is fundamental to know and understand the history that unites all the people who populate the Mediterranean basin and recognise the mutual advantageous relationship that exists among them and which, though often hostile, has, nonetheless, succeeded in creating in “mare nostrum” what is now considered the cradle of world culture.

-To make the migrants aware of the importance of their cultural identity by showing them evidence of their culture of origin with the aim of establishing a programme of recognition of their cultural roots also outside their own country of origin.

- To re-evaluate ancient relationships through the study of archaeological and literary evidence.

- To form collections of antiques as a demonstration of interest in cultural diversity and for use in multicultural workshops.

The setting up of specific multicultural visual itineraries inside museums, documentary videos, books, media, and didactic resource material suitable for children of school age.

Cultural itineraries to the archaeological sites in the area, where artefacts relevant to North Africa were excavated, and museums, where such objects are kept, should be proposed and organised in Europe.

EXPECTED RESULTS

Museum systems will constitute an extremely functional organization pattern destined to develop the full potential of the cultural heritage.

We expect to produce the complete project of a thematic regional system with a modular structure through which the associated information system will be developed.

Furthermore demonstrations of individual modules for special applications will also be needed with regard to specific subjects.

We furthermore expect to develop indexing methods and methods to retrieve distributed data as well as to complete the operational project of a regional system dealing with chronological periods or thematic sections of the same region.

AREA X.4.4 –Tourism & economic outcome

PROBLEMS

Tourism is a key component of cultural heritage in terms of economic activity benefiting local people who can be attracted to protest and preserve cultural heritage because it is a source of income besides strengthening their cultural identity.

The importance gained by the high mobility of tourists raises new cultural, environmental, social and economic problems.

The reorganization of tourism – oriented towards selective demand and differentiation of supply – should be framed within a cultural strategy for Mediterranean integration, with the more ambitious aims than the pure and simple "sustainable mobility".

Mediterranean Basin has natural, environmental and cultural factors that are essential elements for the motivation of the tourists who travel there. In recent years, tourism flows in Mediterranean countries are characterized by a large increase of tourists choosing short to medium range destinations for their holidays. The Mediterranean area represents a safe harbour for European tourists who book these places for their vacations.

TARGETS

1 - Analysis of models of economic management

Such analyses, utilized by several European museums, must be further developed, both by examining existing research works and by carrying out ad hoc ones. An analysis should also be made to assess the professional skills of museum-staff at various levels.

Attention will also be devoted to monuments and archeological parks; models will be developed for the organization of functions and staff and for the supply of facilities, taking into account the different typologies of museums and their sizes in relation to public attendance.

Finally a special survey will be made to investigate the management problems of those containers that are not specifically or mainly intended for the public to have access to them (in particular churches and historical residences); suitable interventions will be sought for their management, including fiscal measures.

2 – Quality Tourism

A significant improvement in the economic and social benefits derived by the influx of foreign tourists in the Mediterranean can only be achieved through

"quality tourism". In this strategy, the market should be planned and segmented in order to keep the distinction between different types of tourists. On the one hand there are tourists who are willing to pay high figures for luxury services and claim privileged channels for access to transportation facilities, museums, cultural events and sports. On the other hand, the "mass tourists" – that are also recipients of "quality tourism", but in different lanes – that could overcrowd and pollute the segments reserved to tourists of high spending capacity.

EXPECTED RESULTS

The new model of “European lifestyle” differs from the present trend of cultural mass tourism, and at the same time meets the needs of society expressed via leisure and professional goals.

This process needs the application of “relational tourism” approach for involving the tourists to solve the environmental, economic and social problems of local communities.

In this way tourist sector can give an important an important contribute to the goal of preserving cultural heritage for future generation.

The hypothesis of our research - that will be checked with an interdisciplinary approach - is that the growth of “relational tourism" can contribute to overcome the social tensions and the environment costs caused by traditional mass tourism.

THE EACH PROJECT

KEY ACTION X.5 - ROBOTICS & CULTURAL HERITAGE: DISTRIBUTED SENSOR NETWORK

KEY ACTION X.5 - ROBOTICS & CULTURAL HERITAGE: DISTRIBUTED SENSOR NETWORK

AREA X.5.1 – Signal Processing Advances

TARGETS:

1 - Data separation to solve multi-target scenarios
2 - Data fusion for multi-sensor applications
3 – Situationally aware target tracking
4 – Track-before-detect to fully exploit data

AREA X.5.2 – Distributed Sensor Networks

TARGETS:

1 - Data driven control schemes
2 - Decision making on which data to be exchanged when there is only limited communication bandwidth between assets available
3 - Assessment of specific sensor performance

AREA X.5.3 – Robots and Autonomy

TARGETS:

1 – Autonomous navigation
2 – Path planning
3 - Exploration

AREA X.5.4 - Distributed Sensor Network Based Robots

TARGETS:

1 - Underwater methodologies & robotics
2 – Seismic early warning & robotics
3 – Touristic events & robotics

KEY ACTION X.5 - ROBOTICS & CULTURAL HERITAGE: DISTRIBUTED SENSOR NETWORK

INTRODUCTION

The UN Secretary-General stated (UN General Assembly, Fifty-third session, Item 67 of the provisional agenda, Role of science and technology in the context of international, security and disarmament, Report of the Secretary-General, Distr.: General, 28 July 1998.

"***Advances in information technology have enabled an escalation in both commercial and military intelligence and surveillance information-gathering. Already, there is a 24-hour collection of intelligence, assisted by Internet connectivity and improvements in positioning, sensing and monitoring devices. These devices have benefited from a combination of innovations in active and passive sensor technologies, in the processing infrastructure and in sophisticated processing algorithms that rely on complex models of the environment and the sensor."***

"Miniaturization, coupled with developments in sensor technologies, will continue to reduce the cost and size of sensors, just as it has with processors. Coordinated networks of small smart sensors offer enhanced low-cost capabilities intelligence gathering, surveillance and reconnaissance."

"As well, improved computing resources and better sensor and environmental modeling will continue to increase the usefulness of fused data – for example, electro-optic, infrared, acoustic and seismic data collected by sensors, or infra-red and radar data in aerial surveillance systems. Such data can be processed on-site, compressed, transmitted, analysed and eventually stored in data warehouses to enable low-cost monitoring and tracking for civilian, military and peacekeeping purposes including weapons tracking and disposal monitoring."

"Evolutionary enhancements in transport technologies occurring alongside the miniaturization of sensors has fostered the development of smaller, more autonomous, more mobile monitoring units. The trend will lead to cheap sub-centimeter 'micro robots' which can team to perform complex tasks. With intelligent control and communications, smarter sensing devices allow the development of more capable unmanned autonomous vehicles, which are only starting to play the significant military and commercial roles that have been forecast for several decades. The potential exists for relatively cheap drones or autonomous vehicles to be redeployed for military or terrorist use. Generally, the increased capability

of autonomous vehicles opens up the potential for acts of warfare to be conducted by nations without the constraint of their people's response to loss of human life. A related concern is the accessibility to such technology as costs decline. The convergence of sensing, processing and actuation technologies is being applied to the development of autonomous weapons and weapons systems."

Recent journal literature and patent applications can be listed as evidence that the forecasted trend has really been followed.

There is an evident overlap between the needs for future research as described in Key Actions X.1-X.4 and the capabilities outlines in the just repeated outline of the trends in signal processing, distributed sensor networks, robots and autonomy and finally distributed sensor network based robots. The main idea of this Key-Action X.5 is to exploit this overlap in order to:

a) find an application field for the new technological tools,

b) help to improve the quality of systems to register and protect cultural heritage.

After describing these areas in more detail by dividing them into a number of Targets, the concluding remark is that Distributed Sensor Network Based Robots are the tool-of-choice for the development of systems that register and protect cultural heritage sites. Furthermore, in the sections "Expected Results" concluding each Area description detailed links are given to Activities X.1-X.4, described previously.

AREA X.5.1 –Signal Processing Advances

PROBLEMS

The sensors for gathering data from the sites can be the same used in Air and Ground Surveillance or Maritime Surveillance applications, plus geological measurement devices for underground data gathering.

These domains continue to be important for our society. Significant investments continue to be made to increase our knowledge about what "happens" at specific sites at land, underground, underwater, whether at or near the sea surface, within the water column, at the seabed, or below it. The latest geophysical, archaeological, and oceanographical surveys deliver more accurate knowledge at increased resolutions. Surveillance applications allow dynamic systems, such as security/intruder scenarios, to be accurately characterized.

The exploration is fundamentally reliant on the effective processing of sensor signal data. The miniaturization and power efficiency of modern microprocessor technology have facilitated applications using sophisticated and complex

algorithms, for example ‘synthetic aperture sonar’. The distributed sensing and fusion of data have become technically feasible, and the teaming of multiple autonomous sensor platforms will, in the future, provide enhanced capabilities, for example, multi-pass classification techniques for objects on the sea bottom. For such multiplatform applications, signal processing algorithms exists but have to be extended with intelligent control procedures.

All these applications face the same difficult operating environment: fading channels, rapidly changing environmental conditions, high noise levels at sensors, sparse coverage of the measurement area, limited reliability of communication channels, and the need for robustness and low energy consumption, just to name a few. There are obvious technical similarities in the signal processing that have been applied to different measurement equipment:

- Sonar applications for surveillance and reconnaissance
- Radar applications for measuring physical parameters of the surface and surface objects
- Non-acoustic data processing and sensor fusion for improved target tracking and situational awareness
- Underwater and high-resolution imaging for automatic classification
- Signal processing for distributed sensing and networking including underwater communication
- Signal processing to enable autonomy and intelligent control

The success story of robots and autonomy partly depends on advances in signal processing which provide appropriate and efficient analysis of sensor data and enable autonomy. In the following topics, the recent advances in four signal processing areas are summarized: data separation to solve multi-target scenarios, data fusion for multi-sensor applications, situationally aware target tracking, Track-before-Detect to fully exploit measured data. The combination of these recent advances is following the trends in sensing, described in subsection the introduction of Activity X.5.

The applications of these techniques have to be explored for registration and protection of cultural heritage.

TARGETS

1 - Data separation to solve multi-target scenarios

Almost every multichannel measurement includes mixtures of signals from several underlying sources. While the structure of the mixing process may be known to some degree, other unknown parameters are necessary to demix the measured sensor data. The time courses of the source signals and/or their locations in the source space are often unknown a priori and can only be estimated by statistical means. In the analysis of such measurements, it is essential to separate the mixed signals before beginning postprocessing. Blind source separation techniques then allow separation of the source signals from the measured mixtures.

2 - Data fusion for multi-sensor applications

When aiming at a higher level of situational awareness, physically independent (and desirably quasi complementary) sensor types are used. On a large spatial scale, multistatic sonar and multistatic radar have already demonstrated the added-value of spatially separated sensors which exploit the different aspect angles on hypothetic targets, leading (among other advantages) to a drastically increased detection performance.

3 – Situationally aware target tracking

The fusion of measurements is a prerequisite for extracting and maintaining target tracks. The inherent ambiguity of the data makes the use of adequate algorithms, such as multiple hypothesis tracking, inevitable. For their design, the residual clutter, the sensor resolution, and the characteristic impact of the propagation medium are important. Their understanding leads to precise sensor models which are able to determine the performance of the surveillance team. Incorporating these models in multihypothesis tracking leads to a situationally aware data fusion and tracking algorithm. Incorporating model knowledge leads to increased performance, but only if the model is in line with the physical reality: making incorrect model assumptions can easily lead to worse performance. Furthermore, to implement the model, which is inherently nonlinear for multistatic sonar, approximations have to be made. When engineering a multi-sensor tracking system, sensitivity studies help to tune model assumptions and approximations.

4 – Track-before-Detect to fully exploit data

Seamless detection and tracking schemes are able to integrate unthresholded (or below target detection threshold) multiple sensor responses over time to detect and track targets in low signal-to-noise ratio (SNR) and high clutter scenarios. These schemes, also called “track-before-detect (TBD)” algorithms are especially suitable for tracking weak targets that would only very rarely cross a standard detection threshold as applied at the sensor level. Thresholding sensor responses result in a loss of information. Keeping this information allows some TBD approaches to deal with the classical data association problem effectively in high clutter and low SNR situations. For example, in detection scenarios with simultaneous activation/illumination from different signal sources this feature allows the application of triangulation techniques, where in the case of contact tracking approaches essential information about weak targets would often be lost because these targets did not produce signals that cross the normal detection threshold. Extending this example to a multi-sensor network scenario, a TBD algorithm that can use unthresholded (or below threshold) data has the potential to show improved performance compared to an algorithm that relies on thresholded data. In low SNR situations, this can substantially increase performance particularly in the case of a dense multi-target scenario. This leads to collaboration (naturally) between assets. To further explain this, the results

obtained in TBD work suggest a possible application of the TBD approach specifically in a multistatic sonar system.

Classical multistatic systems perform the data fusion by detection- or contact-based tracking algorithms, e.g., by applying the Multiple-Hypothesis Tracking scheme. Relying on detections being made first, these techniques do not exploit all the potential of a multistatic system. This is where new TBD algorithms could enter the scene. However, the high computational power needed for TBD algorithms leads to a restriction on the amount of data presented to the TBD algorithm, i.e., the TBD can only serve as a magnifying glass. This magnifying glass can be automatically positioned on received bistatic data where detections have been found for other geometries. As being demonstrated in the TBD algorithm can find tracks even for patches of data in which the single-ping detection probability is low. Interoperable systems are able to collaborate as just described and improve the overall surveillance quality.

EXPECTED RESULTS

With reference to the problems and targets discussed under Key Action X.1, Area X.1.1, the systematic acquisition of information regarding the physical and cultural aspects of a territory is essential to a complete identification of its cultural resources.

Within this framework, the necessity for consistency gives first consideration to the acquisition, processing and interpretation of multi-temporal and multi-spectral images from satellites and low or very-low altitude aeroplanes, the latter employed for obtaining data with an increasingly higher resolution

With reference to the problems and targets discussed under Key Action X.1, Area X1.2, seismic methods, used for the most part in mineral exploration, have not been used due to methodological difficulties. Interesting results are emerging as regards electromagnetic induction methods, georadar and acoustic impulses and the study of the phenomena of induced or spontaneous electric polarization

AREA X.5.2 – Distributed Sensor Networks

PROBLEMS

The performance of distributed multisensor/multi-agent systems highly depends on how the collaboration, interoperability, and interplay between individual networked sensor and signal processing nodes are organized in architecture, protocols, and control algorithms.

For distributed sensor networks, the advances in signal processing techniques, as described in Area X.5.1, have to be incorporated in algorithms for sampling, filtering, compression, detection, estimation, and tracking in scenarios where the sensors provide input to multiple and spatially separated actors/actuators that follow joint goals.

TARGETS

1 - Data driven control schemes

When distributed sensor networks are used, the quality of the overall system should be also kept at a high level. The measurement settings for the sensors should be arranged to gain as much information from the measurement as possible.

2 - Decision making on which data to be exchanged when there is only limited communication bandwidth between assets available

When distributed sensor networks are used for surveillance, the communication between sensors becomes extremely important: In case multiple potential targets occur, the communication scheme has to allow important target information to be exchanged while less important information should be buffered or canceled.

3 - Assessment of specific sensor performance

When it comes to data fusion, the quality of each fusion input has to be evaluated. Only when knowing which sensor is good (under which conditions) or poor it is possible to always gain by data fusion. In case incorrect model assumptions are made in the fusion process, the fused result can have decrease quality, which should clearly be avoided

EXPECTED RESULTS

With reference to the problems and targets discussed under Key Action X.1, Area X.1.1 the product of the interpretation must be interfaced with photogrammetric data in order to exactly geo-referencing all the data acquired and to compare them with geophysical, mechanical and other field observations.

Also relevant with these problems is the study of specific sensors for specialised applications in the visible wavelength: the study of the optimal environmental filming conditions for data acquisition and of the techniques for controlling and guaranteeing the stability of the acquired data and the repeatability of the measurements. Lastly, attention is given to the digitalisation procedure of the signal, with the aim of reducing conversion noise to a tolerable minimum.

With reference to the problems and targets discussed under Key Action X.1, Area X.4, once the cultural project has been defined, the above mentioned most

suitable presentation of materials requires an architectural scheme, its realization and the setting up of the exhibition structure where practical solutions are adopted to meet the public's demand and the best layout of didactic aids is sought. Here a fundamental role is played by the systems to control state of conservation and microclimatic conditions and to guarantee safeguard from any possible risk to both visitors and exhibits.

AREA X.5.3 - Robots and Autonomy

INTRODUCTION

A key element of the transition of signal processing output to its exploitation inside robots and autonomous systems is the way uncertainty is managed: uncertainty originating from insufficient sensor data, uncertainty about effects of future autonomous actions and, in the case of distributed sensors and actuators (like for a team of robots), uncertainty about communication lines.

Especially necessary for applications in registration and protection of cultural heritage are probabilistic approaches and setups of distributed sensors and actuators. Autonomous sensor platforms can be under water, on the surface, ground based, or airborne, plus geological measurement devices for underground data gathering. In-door transferred to hazardous environments in caves or ruins.

TARGETS

1 – Autonomous navigation
outdoor navigation using geo-information
collision avoidance/sense and avoid
dynamic feature maps
simultaneous localization and mapping

2 – Path planning
proactive, based on open-loop optimization
reactive, based on adaptive control
model predictive control (MPC)
probabilistic approaches for maximizing the expected future information

3 - Exploration
networked teams of robots
sensor networks which mix static sensors with autonomous moving ones

distributed algorithms and communication aspects

EXPECTED RESULTS

With reference to the problems and targets discussed under Key Action X.1, Area X.1.1, the basic research problem for cultural resources is to optimise the remote-sensig procedures for images from existing orbital or aerial platforms and to develop new suitable platforms for shots from low and very low altitudes (between 300 and 50 m), as well as the most appropriate equipment and methods for the purpose, while taking into consideration the environmental conditions for filming and the possibilities for correlating thermal images with those in the visible wavelength.

Optimisation of the use of satellite positioners for the survey of cultural resources.

The research will have to develop, and orient towards the specific objective, the methodologies that are operative in the field for the specific requirements of the cultural heritage, and study programs for recording and graphically display while respecting the greatest accuracy of the survey.

Passivity. It must not act physically on the source and on its environmental conditions.

With reference to Area X.1.2, another area where geophysical exploration is ever more applied is in the underwater environment. Artefacts of historical and artistic interest are very frequently found by chance by amateur enthusiasts during underwater activities. However, there is no continuous and systematic scheme of exploration of the sea bottom based on essentially geophysical methods, which would give a relatively complete picture of underwater finds.

AREA X.5.4 –Distributed Sensor Network Based Robots

INTRODUCTION

As we have seen up to now how well both toolboxes of 'Distributed sensor networks' and 'Robots and Autonomy' fit to the demands of registration and protection of cultural heritage, the logical follow-on is the combination of these two toolboxes. However, this combined tool, we call it DSNBR, has to overcome the following hurdles:

- the a-priori information for an initial distribution is sparse,
- the initial spatial distribution of the sensors themselves is sparse,

• a collaborative behavior is necessary to keep the overall probability of detection high,

• a collective classification of potential targets is necessary to decrease the false alarm rate,

• evasive actions of targets have to be answered,

• communication between team members might only happen on a limited basis.

• the necessity to address the topics related to security and trustworthiness of robotic platforms, which have to defend themselves against interception of their transmitted intelligence or hostile take-over of their controls

• Trust in Robots and Unmanned Platforms

• Cyber-physical systems security

• Robotic Immune Systems

• Robot protection and countermeasures against intercepts and attacks

• Self-test and self-repair

• Security of Robot-facilitated ad-hoc networks

• Miniature robots for surveillance applications

TARGETS

1 - Underwater methodologies & Robotics

Methodologies for underwater explorations are almost completely based upon acoustic waves because electromagnetic waves are drastically absorbed in water. Acoustic techniques for explorations into deep sea sub bottom had a remarkable development from oil-research, mainly concerning acoustical signal processing, while no substantial contribution has been given to the improvement of resolution which is an indispensable requirement in shallow exploration. Actually, oil-research is interested to large-scale anomalies connected with the profitable big oil-fields, for which resolution is not an important requirement. On the contrary, the exploration of shallow sea sub bottom,- namely a range from a few to tens of meters,- needs high resolution in order to reveal small anomalies and objects. This is the case of marine archaeology, where high-resolution is a compulsory requirement in order to reveal also small anomalies and antique objects. Detecting sea sub bottom sediment structures and archaeological objects is a very important topic, especially for the Mediterranean Sea Basin. Actually, in this area, the succession of manifold geological events, which caused submersion of secular strata of various civilization man-made structures, and thousands of shipwrecks from the ancient age to today, render the top layers of the sea bottom particularly interesting. The presence of archaeological remains on the sea sub bottom is often correlated to particular marine environment situations, so their detection and unearthing also help to investigate the geological characteristics of the submersed sites, as well as to enrich the historical heritage of the neighbouring countries.

Today the objective of the underwater archaeology is the recovery and conservation of the objects and their study after recovery. The conservation of the objects where they were found would constitute the presupposition for the constitution of underwater archaeological sites which could be visited by lovers of underwater activity.

The realization of such an idea needs to study how to preserve the underwater site and how to facilitate its availability. A great field of research would be open.

2 – Seismic Early Warning & Robotics

One of the most effective systems for the movable and semi-movable objects' protection from earthquake damage is represented by the "seismic early protection". This is a strategy that can be planned through a system called Early Protection system, which is based on some key concepts, which have to guarantee no invasivity, no contact, early detection and identification of the risk. The main system consists of three sub-systems:

a) A dedicated Seismic Early Warning (SEW) on-site network, which can also be nested within the regional seismic networks (when available); e.g., in Italy, within the National Geophysics and Volcanology seismic network.

b) A number of reliable and efficient non-intrusive devices (e.g. anti-seismic devices, air bags, elastic net etc.) for the preventive conservation of an object or item, or a group of object or items in display cases, during the earthquake excitation aimed at avoiding and minimizing their deterioration or loss.

3 – Touristic events & Robotics

The importance gained by the high mobility of tourists rises new cultural, environmental, social and economic problems.

Especially the safety and security of touristic events have to be maintained. From an economical perspective the potential for a persistent surveillance which systems of robots offer, seems to be a viable way ahead.

EXPECTED RESULTS

To address these issues, it is appropriate to further work with mathematical formulations of the nonlinear stochastic dynamic game with distributed agents where state estimates are subject to noisy measurements. It is important to note that the observation model in these formulations includes also the possibility for manipulation of measurements of the surveillance system made by the targets.

These mathematical formulations have to lead then to applicable algorithms where the sensor data is applied in a distributed manner to reasonable combinations of sampling, filtering, compression, detection, estimation, and tracking before providing input to multiple and spatially separated actors/actuators that follow joint goals.

A distributive sensor network of robots is the tool of choice as a concept for surveillance tasks in the protection of cultural heritage. Towards an implementation, the concept can be realized by a chain of already available tools, found in the toolboxes of modern signal processing, data fusion, sequential filtering, and control and decision theory. So far, less attention has been given to incorporate an appropriate evasive target motion model and to incorporate that the quality of the measurement can be actively decreased by the target. Furthermore, due to the networking approach, the trustworthiness of network participants has to be adequately maintained.

The Scientists

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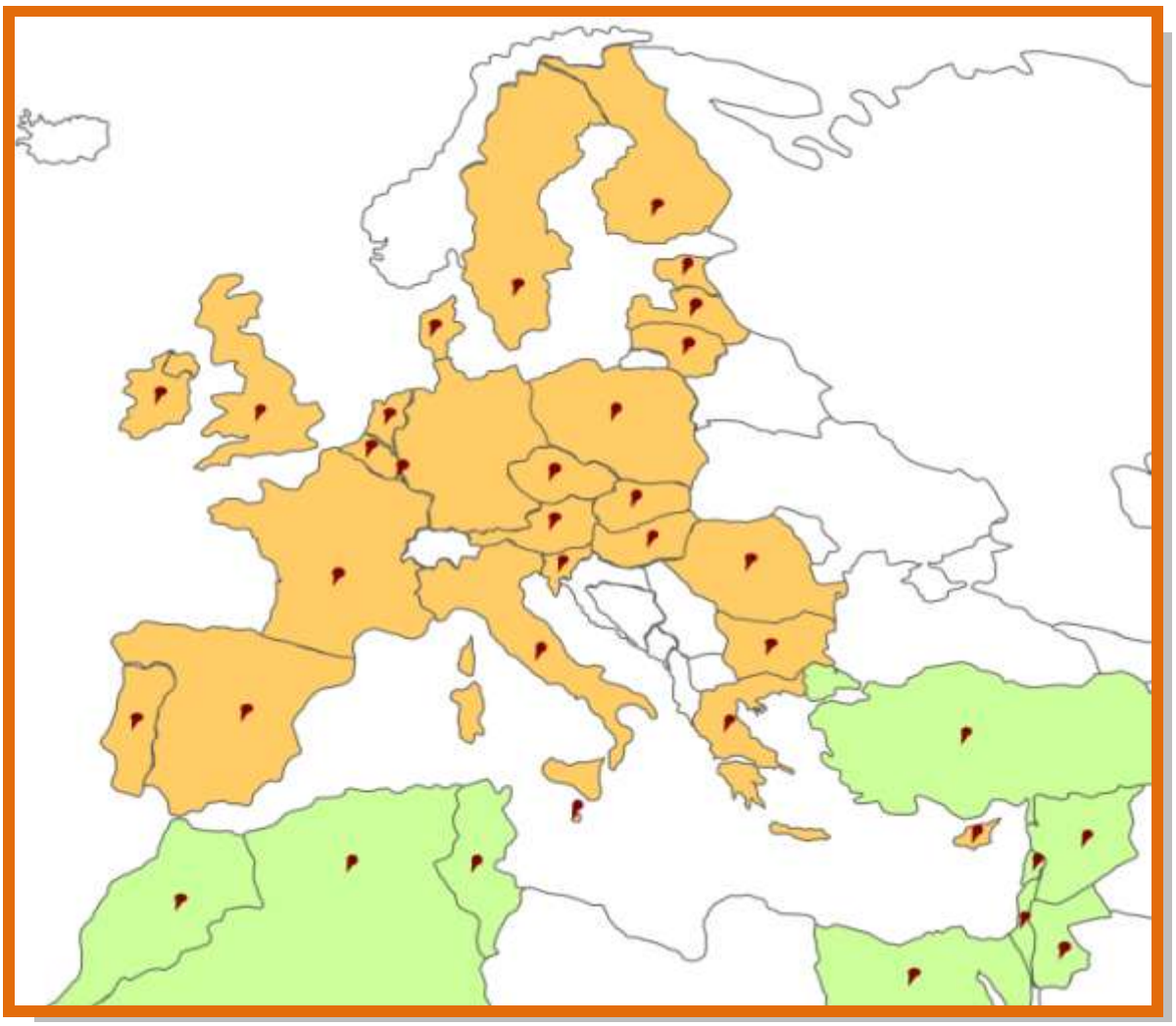
5 - Previous activity of the Organizing Team ….. page 171

1 – Project diffusion



The Project has been submitted to the attention of scientists belonging to:

***a) All the 27 Member States of the European Union*:**

Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

b) All the 9 States European Union Mediterranean Partners:

Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Syria, Tunisia, and Turkey

The Project has been submitted also to the attention of scientists belonging to other European Countries as well as to scientists working outside Europe; in many

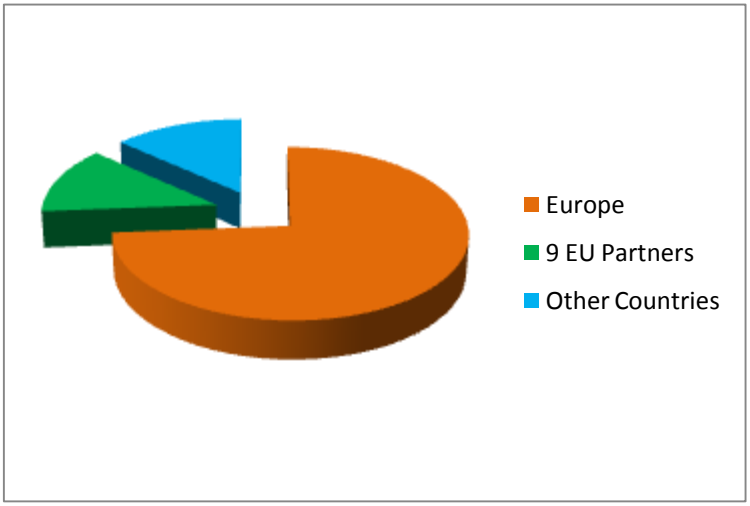
cases, we received requests by collegues living in other continents. It is worth observing that the European Commission Framework Programmes often involve scientists belonging to countries outside Europe.

c) Other Countries

Albania, Argentina, Armenia, Australi, Brazil, Canada, China, Croatia, Ecuador, India,, Iran, Iraq, Israel, Japan, Kenya, Kuwait, Macedonia, Nigeria, Norway, Pakistan, Peru, Puerto Rico, Qatar, Russia, Saudi Arabia, Serbia, South Africa , South Korea, Switzerland, Thailand, United Arab Emirates, Uruguay, USA, Vatican City,Vietnam.

The contacted scientists during 2010 were over 3.600. The provisional lists reported in this Report refer to about 2.300 scientists. We are still waiting answers, controlling wrong emails, leave of absences, out of office, etc. We will adjourn these lists every month on the web site of the Project www.eachproject.eu starting from February 2011.

The overall reported contacts refer to scientists working in 74 Countries.



2 - Provisional list of contacted scientists

The EACH Project has been submitted to the attention of the following scientists throughout year 2010.

The following list will be adjourned on the Project web site www.eachproject.eu every month, starting from February 2011.

A

A.Al-Harbi Omar
Abadi-Reiss Yael
Abate Glenda
Abay Esref
Abd El Kader Zeinab Farghaly
Abd el Zaher Abd el Sattar
Abd el Aal Shaaban
Abd el Ateef Waleed
Abd el Hakboua
Abd el Moeiz Abber
Abd el Salam Zienab
Abd el Tawab Ayman
Abd el Toti
Abd el Hady Khaled
Abd el Kareem Omar
Abd el Latif Jgounni
Abd el Rahim Shehata
Abd el Rahim Slaouihakim
Abd ol Ahi Mostafa
Abdou Mahaman Dango
Abd ul Ahad Emad
Abd ul Lah S. Al Hobaib
Abd ul Rahman Abu Ajamieh
Abd el Raouf
Abraham Bruce
Abu Bakr Mohamed
Abu Azizeh Wael
Accati Garibaldi Elena
Aceto Maurizio
Achille Cristiana
Achilli Vladimiro Adamo Marianna
Abd el Rahman el Sorogy
Aderhold Jochen
Adnane S. Moulla
Afifi Hala
Agai Lule
Agostino Angelo
Agresti Juri
Agrimi M
Aguilera Ureña María Jesús
Ahmad Ahmad
Ahmed Boukdir
Ahmed Fekri
Ahmed M.R. Khater
Ahrens Alexander
Aissata Boubakar Hassane
Akar Murat
Akasheh Khaled
Akeb Fatiha
Akyuz S.
Al Ani Marwan
Al Karaimeh Sufyan
Al Mutawalli Mahmoud Nawala
Al Saad Ziad
Alaimo Rosario
Albani Francesca
Albergoni Roberto
Alberini Anna
Alberotanza Luigi
Albertano Patrizia Beatrice
Alberti Angelo
Albertini Roberto
Albrecht Robin
Alcalà Francisco J.
Alcocer Alex
Aleffi Michele
Alessi Paolo
Aliotta Giovanni
Allasia Walter
Allinger-Csollich Wilfrid
Al Saleh Raed
Al Salloum Ataa

Al Shorman Abdulla
Altay Gülay
Altieri Antonella
Altuntas Cihan
Alvarez De Buergo Monica
Amadasi Maria Giulia
Amal Djerrari
Amani Abd el Hafez
Amany M. Bakr
Amato Giuseppe
Ambrosini Dario
Ambrosini Laura
Amer Germaine
Amin Khalil
Anastasi Valentina
Anceschi Maurizio
Ancona Massimo
Ancona Nicola
Andersson Eva
Andreani Carla
Andre-Salvini Beatrice
Angel Munoz Vicente
Angelini Andrea
Angelini Emma
Angelini Giancarlo
Angelini Ivana
Angioni Giulio
Anglos D.
Angus Best
Anheuser Kilian
Añón Carmen
Antonelli Fabrizio
Anwar el Fikry
Aomar Akerraz
Aomar Iben Brahim
Apicella Eugenia
Apollonia Lorenzo
Apollonio Dario
Aranburu Arantxa
Aranda Miguel A.G.
Arayici Yusuf
Arcidiacono Claudia
Arduini Iduna
Aref Yasser
Arena Grazia
Arevalo Alicia
Argentieri Arturo
Armelle Anthoine
Aronne Giovanna
Arroyo Ana
Arroyo Fátima
Arwa Rawan
Ashkenazi Haim
Ashley-Smith Jonathan
Ashrafi Khosro
Asmaa Fathy
Asmus John
Asouti Eleni
Atef A. Brania
Atef Abd el Latif
Athanassas Kostas
Attanasio Donato
Attolico Giovanni
Atwa Mohamed
Aucouturier Marc
Augenti Nicola
Auras Michael
Auricchio Teodoro
Aurisicchio Carlo
Ausset Patrick
Avanzato Damiano
Avdan Uğur
Avdelidis Nico P.
Avella Maurizio
Avolio Francesco
Awad Yasser Hassan
Awbi Hazim B.
Aydin Elif Ozlem
Aydingun Sengul
Aytek Ozlem

B

Babacan Nilüfer
Bacchetta Gianluigi
Bacci Mauro
Bachelot Luc
Bachmann Balint
Bagdzeviciene Jurga
Bagella Simonetta
Baglioni Piero

Bahain Jean-Jacques
Baillie Mike
Baird Douglas
Bakasis Ilias
Bakhoum Dina
Bakhshi Ali
Bakr Amanym
Balan Etienne
Balaras Costantinos
Balboni Laura
Balci Semra
Baldacci Alberto
Baldin Alice
Baldini Carlotta
Balkan-Atli Nur
Ballero Mauro
Balletti Caterina
Balocco Carla
Baluc Claire Angèle
Baluci Claire
Bandis Stavros
Banfill Phil
Bannasch Rudolf
Barabasz Wislaw
Barakat Wislaw Heba Nayel
Barazzetti Luigi
Barca Donatella
Barocci Stefano
Baronio Giulia
Barrie Marylin
Bartelheim Martin
Bartl Peter
Bartoll Jens
Basaran Tahsin
Basile Corrado
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Bassirou Diagana
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Beckers Benoit
Beeckman Hans
Beg Darko
Begum Zareena
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Ben-Ami Doron
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Bencs László
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Betrouni Mourad
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Bienert Andreas
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Bini Marco
Bioletts
Biondi Edoardo
Biron Isabelle
Birouk Abdelouahed
Bischoff James L.
Biscontin Guido
Bishopp John
Bison Paolo
Bizzarri Carmen
Blanchette Robert
Blanke Louise
Blanquez Juan

Blasi Carlo
Blocken Bert
Blondel Philippe
Boano Rosa
Boccaletti Mario
Bocchi Emanuele
Bocchi Francesca
Bogaard Amy
Bogdan Constantinescu
Bokan-Bosiljkov Violeta
Bolivar-Gagliano Fernando
Bomboi Mingarro Maria Teresa
Bonaduce Ilaria
Bonazzi Achille
Bondioli Federica
Bondioli Luca
Bonfil Ruhama
Boon Jaap
Boqvist Marianne
Bordogna Gloria
Borgatti Lisa
Borghi Alessandro
Boroumand Alireza
Boschetti Mirco
Boscolo Marco
Bosi Giovanna
Bosiljkov Vlatko
Bottiroli Giovanni
Bouâbid el Mansouri
Bouchage Geraldine
Bouchaou Lhoussaine
Bouchnaki Mounir
Bourdeu Alexandre
Bourke Stephen J.
Boustany Hareth
Bouteflika Mourad
Bozer Ali
Bozzato Simone
Bozzi Andrea
Bracci Susanna
Bradbury Jennie Nicole
Brahim Ben Kabbour
Brando Giuseppe
Braovac Susan
Brasili Patricia
Brauns E.B.
Breitkopf Susan
Breuckmann Bernd
Brezova Vlasta
Brignola Anna
Brimblecombe Peter
Brivio Pietro Alessandro
Brooks Mary
Brostrom Tor
Brown Keith
Bruce Arnold
Brunetti Brunetto
Bruni Vittoria
Bruno Fabio
Bruschi Piero
Btissam Alami
Buffarini Giacomo
Burgio Lucia
Burke Aaron A.
Burri Ezio
Bustamante Alvarez Macarena
Busuttil Christopher
Bouteflika Mourad

C

Cabeddu Maria Eugenia
Cagnoni Stefano
Caiti Andrea
Calatayud Guillem
Calcagno Maniglio Annalisa
Calliari Irene
Calligaro Alberto
Camaiti Mara
Cannelli Giovanni Bosco
Camangi Fabiano
Camarda Ignazio
Campitiello Francesco
Campos Juan Manuel
Camuffo Dario
Canazza Sergio
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Candilio Francesca
Canepa Gaetano
Caneva Claudio

Caneva Giulia
Caneva Isabella
Canter Megan E.
Cantone R
Canuti Paolo
Capasso Luigi
Capilleri Paola
Capitani Donatella
Capitelli Mario
Caponero Michele
Caponetti Eugenio
Cappelletti Piergiulio
Cappellini Vito
Cappitelli Francesca
Capus Chris
Carafa Annamaria
Caramelli David
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Caŕ Federico
Carranza-Cañadas Mª Pilar
Carraro Carlo
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Carter Elizabeth
Carter Robert
Carter David
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Carvalho Rosário
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Casagrande Gaelle
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Casini Andrea
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Casoria Paolo
Cassar Jo Ann
Cassar May
Castel Corinne
Castellano Maria Gabriella
Castellano Mario
Castelli Daniele
Castelli Francesco
Casti Mauro
Castiglioni Piero
Castillejo Marta
Castro Fabio Luciano
Castro-García Miguel
Catalano Paola
Catara Stefania
Cather Sharon
Catoni Francesca
Cattani Maurizio
Cavallaro Antonio
Cavallini Mauro
Çayir Böyukülusoy Ümit
Cazacova Liudmila
Cazacova Natalia
Ceccaroni Francesca
Ceccuti E.
Cederholm Alex
Cédric Gervaise
Cefai Shirley
Cennamo Claudia
Cennamo Gerardo Maria
Cennamo Paola
Ceppan Michal
Ceraudo Giuseppe
Ceregioli Piergiovanni
Cerichelli Giorgio
Ceschin Simona
Cessari Luciano
Chadwick Alan
Chakib Ke
Champion Erik Malcom
Chang Wen Shao
Charalampos Alexakis
Charola A. Elena
Chen Bixia
Cheradame Hervé
Chesson Meredith S.
Chiabrando Filiberto
Chiaia Bernardino

Chiancone Pedro
Chiantore Oscar
Chiarelli Brunetto
Chiocchini Maurizio
Chiodi Silvia
Chircop Joseph
Cho Hun Hee
Choi Soyeon
Christensen Mikkel
Cialone Giovanni
Ciarallo Annamaria
Ciardelli Francesco
Ciccarello Domenico
Ciccioli Paolo
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Cicerchia Annalisa
Cicirelli Grazia
Cifani Giandomenico
Ciliberto Enrico
Cilingiroglu Altan
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Ciniglia Claudia
Cipollaro Marilena
Clark Robin
Clarke Joanne
Clausi Marina
Clemens Reichel
Clemente Pietro Luigi
Clorennec Dominique
Clottes Jean
Cnudde Veerle
Cocchi Alessandro
Cöcen Öget Nevin
Colao Francesco
Colbow Gudrun
Collepardi Mario
Colomban Philippe
Colombini Maria Perla
Comelli Daniela
Condemi Silvana
Conoir Jean-Marc
Consejo Y Chapela Carolina
Consoli Vito
Coppa Alfredo
Coqueugniot Eric
Corbeil Marie Claude
Cordini Giovanni
Córdoba Joaquín María
Core Manuela
Corgnati Stefano Paolo
Cornara Laura
Corns Anthony
Corradini Paolo
Cortelazzo Guido Maria
Cossu Rossella
Costa Virginia
Costacurta Stefano
Costantini Lorenzo
Coulton James J.
Coupry Claude
Coza Radiana
Craig Erasmus
Cremaschi Mauro
Cremonini Stefano
Cresti Mauro
Crewe Lindy
Crisci Gino Mirocle
Cristaudo Antonia
Croci Giorgio
Cromhout Marzanne
Cucarzi Mauro
Čufar Katarina
Cultrone Giuseppe
Cuzman Oana Adriana
Cywinski Zbigiew

D

D' Agostino Nicola
D'Amicone Elvira
D'Orazio Tiziana
Dahlin Elin Marie
Dahlin Elin Marie
Dalla Negra Riccardo
Dallari Fiorella
Daly Rose
Damiani Maria Luisa
D'Andria Francesco
Danese Maria
Danieli Moshe
Danielli Cristina

D'Aniello Mario
Danin Avinoam
D'Annunzio E.
D'Aponte Tullio
Dasiou Maria-Eleni
Davari Vahid
De Angelis Flavio
De Backer Fabrice
De Caro Stefano
De Decker-Szaybo Klara
De Felice Fabio
De Feo Vincenzo
De Franco Roberto
De Gennaro Maurizio
De Gregorio Daniela
De Groot Suzan
De Jong Christ
De La Quintana Jesùs Angel
De Leo Giacomo
De Luca Antonio
De Madariaga Juan Manuel
De Mico Antonella
De Miroschedji Pierre
De Natale Antonino
De Phillips Henry A.
De Ridder Maaike
De Rosa Ennio
De Simone Elina
De Simone Girolamo Ferdinando
De Stefano Gianfranco
De Toni Giovanni
De Vries-Melein Martine
De Witte Eddy
De Bouw Michael
De Bustamante Gutiérrez Irene
De Francesco Anna Maria
De' Gennaro Maurizio
De Luca Livio
De Meo Anna
De Mico Antonella
De Tagle Alberto
Dean E. Arnold
Debiasi G. B.
Decultot Dominique
Degrigny Christian
Dei Luigi
Dekeling René
Del Mastro Gianluca
Del Prete Carlo
Del Favero Michela
Del Hoyo-Meléndez Julio
Dell'Erba Ramiro
Delli Santi Maurizio
Demkowicz Jerzy
Denaeyer Andre
Derieux Agnes
Deriu Antonio
Dessouky Elshaimaa
Detalle Vincent
Devaux Mylène
Di Fiore Marco
Di Maio Amedeo
Di Natale Anna
Di Somma Andrea
Di Fiore Marco
Di Giulio Giuseppe
Di Lorenzo Antonio
Di Pietro Giovanna
Diaz Josè Juan
Dibiase Carolina
Dickinson D.
Dierick Manuel
Dierna Salvatore
Dietemann Patrick
Dimitrokali Elisavet
Distante Arcangelo
Dogariu Adrian Ioan
Dominguez Salvador
Domingo Concha
Domínguez Cuesta María José
Dong Shao Chun
Donnelly Paul Francis
Donnini Domizia
D'Orazio Loredana
D'Orazio Marco
Doré Annette
Doris Milkert
Dornemann Rudolph H.
Dos Santos Guimarăe A. Sofia
Dos Santos Monteiro Fernando

Dotsika Elissavet
D'Ottavi Enrico
Doubravova Katerina
Down Jane
Dragoni Giorgio
Drdacky Milos
Drewello Rainer
Drioli Enrico
Drizis Théodore J.
Drusini Andrea
Dubina Dan
Dubois Marie-Claude
Dubus Michel
Duistermaat Kim
Dumovajovanoska Elena
Dupont Anne-Laurence
Duran Benito Adrian

E

Ebrahimi Saeed
Ecklin Sabine
Eddine El Amrani
Ehlers Frank
Einwag Berthold
El Amrani el Hassani Iz-Eddine
El Arbi Toto
El Azhari Hamid
El Basri Mohamed
El Feky Osama
El Hakim Sabry F.
El Hammoumi Abdallah
El Hassani El Amrani
El Kahlawey Mohamed
El Mouraouah
El Neshily Khaled
El Shaer Mohamed
El Bana Sally
El Banna Abd el Fattah
El Garhi Noorah
El Hassan Asmaa
El Mitwalli Hemdan
El oueldrhiri Anas
El Sayed A. Abd el Aal
El Sayed Yones
El Shaimaa Mohammad
Emam Nahla
Emblemsvåg Jan
Emiliani Giovanni
Emmi Salvatore
Epossi Ntah Zoila Luz
Equini Schneider Eugenia
Erdal Omur Dilek
Erdal Yilmaz Selim
Erdem Aylin
Erdem Deniz
Eres Zeynep
Eriksen Line
Erkan Yonca Kosebay
Erkilic- Bayar Mualla
Ertűrk Nevra
Ervan Garrison
Erwan Josse
Erzin Engin
Escribano Martin Fernando
Eslam Nofal
Esmaeily Jelodar Mohamad
Esposito Eliana
Esposito Salvatore
Esposto Matteo
Essahlaoui Ali
Essam E. F. el Sayed
Essam Heshmt
Estrada Maria Rita
Evershed Richard

F

Fabbri Bruno
Fabbricatti Katia
Facchini Fiorenzo
Faeta Francesco
Faggiano Beatrice
Fahimi Monzari Seyed Hamid
Fahmy Ahmed G.
Falciai Riccardo
Faleri Alberto
Falini Giuseppe
Falivene Maria Rosaria
Famoso Fabio
Famoso Nunzio
Fanelli Corrado

Fanfoni Giuseppe
Fanfoni Luigi
Fanfoni Sara
Fantar Mhamed Hassine
Fantazzini Paola
Fantoni Roberta
Farid Chati
Fassi Francesco
Fassina Vasco
Fassino Mauro
Fathi Bejaoui
Fathi Salloum
Fathy Basem Gehad
Fathy el Shaimaa
Favaro Monica
Fayed Injy
Fazeli Hassan
Fenzi Federica
Fermo P.
Fernand Leon
Ferrari Valentina
Ferraro Antonio
Ferrero Elena
Ferretti Marco
Ferro Daniela
Fetouh Mohamed Roko
Fico Gelsomina
Filippaki Liana
Filippi Marco
Finlayson Clive
Fiora Laura
Fiorani Luca
Fiori Cesare
Fiorino Luigi
Fischer Peter Michael
Fischer-Genz Bettina
Fletcher Alexandra
Floreal Daniel
Florio Giuliano Gilda
Fonti Roberta
Foote Rebecca
Forest Jean Daniel
Formaggia Luca
Formisano Antonio
Formosa Michael
Fornaciari Marco
Forst Alexandra
Forti Gianluca
Fortini Paola
Fossati Fabrizio
Fotakis Costas
Fouad Amraoui
Fourmont Martine
Frade José Carlos
Franceschi Enrico
Franchi Roberto
Frangipane Marcella
Fraser James
Fratini Fabio
Fratini Matteo
Frazier Catherine
Frediani Manuela
Frediani Piero
Freestone Ian C.
Frenguelli Emanuele
Frigo Manlio
Fuad Mona
Fuentes Pardo José María
Fugazzola Delpino M. Antonietta
Fulcheri Ezio
Fumagalli Fabio

G

Gabellone Francesco
Gabrielli Roberto
Gaffney Vince
Galán Emilio
Galán Huerto Emilio
Galea Mario. P.
Gallipoli Maria Rosaria
Galluzzi Paolo
Gambaro Andrea
Gambini Annastella
Garagnani Gian Luca
García Gayo Dolores
García José Francisco
García Ventura Agnès
García Bueno Ana
García-Diego Fernando-Juan
García-Gutiérrez Mosteiro Javier

Garcia-Talegon Jacinta
Garraffo Salvatore
Gascoigne Alison
Gattesco Natalino
Gattuso Giovanna
Gaudenzio Paola
Gaudiano Cosimo
Gazzano Claudia
Gehad Fathy Basem
Geigl Eva-Maria
Gentile Gennaro
Genz Herman
Gerasimou Stefanos
Gerdes Frank
Gernez Guillaume
Gerrit De Bruin
Gershuny Lilly
Geyer Bernard
Ghaffarian Hoseini Amirhosein
Ghannad Mohammad Ali
Ghany N. A.
Ghayamghamian M. Reza
Ghoneim M. Abo el Fetouh
Giacobini Giacomo
Giacovazzo Carmelo
Gianfrotta Piero Alfredo
Giani Elisabetta
Giannossa Lorena Carla
Giardini Marco
Giardino Claudio
Giarratana Carmelinda
Giavarini Carlo
Gibson Lorraine
Gigli Stefania
Gigliarelli Elena
Gil Francisco
Gillespie Alexander Mathew
Gillot Laurence
Gioncu Victor
Giorgi Rodorico
Giovannini Peter
Girardi Maria
Giraud Jessica
Giumlia-Mair Alessandra
Gizzi Fabrizio Terenzio
Gjelstrup Bjordal Charlotte
Glatz Claudia
Glavcheva Rumiana
Gliozzo Elisabetta
Godsill Simon
Goidanich Sara
Golani Amir
Goldfus Haim
Golliard Joachim
Gomaa Abd el Maksoud
Gombia Mirko
Gomez Stella Maris Viviana
Gomez Auxiliadora
Gómez De Cózar Juan Carlos
Gómez Bolea Antonio
Gontz Allen
González Fernandez Carla
Gonzalez Juan M.
Gonzalez Garcia De Velasco .C.
Goodhue Robbie
Gorbushina Anna
Gorny Ronald
Gorska Hab Natalia
Gorzalczany Amir
Grabner Michael
Graham Beamiss
Graham Brian
Gralińska Aleksandra
Gramatikov Kiril
Grampce Orhideja
Grassi Francesco
Grassini Sabrina
Grasso Rosario
Grasso Salvatore
Grau Almero Elena
Gravagnuolo Antonio
Grazuleviciute Vileniske Indre
Green Jack John D.M.
Greenberg Raphael
Greenblatt Chuck
Greffe Xavier
Gregory David John
Griesser Martina
Grinzato Ermanno
Grippa Maria Rosaria

Grøntoft Terje
Gross Dieter
Grove Matt
Gruppioni Giorgio
Grussenmeyer Pierre
Guaitoli Marcello
Guariglia A.
Guarino Riccardo
Guarrera Paolo Maria
Guasparri Giovanni
Guattari Giorgio
Guccio Calogero
Guerra Carlos Ranz
Guerra Maria Filomena
Guerriero Paolo
Guglielminetti Maria
Guidazzoli Antonella
Guiducci Bonanni Carla
Guilaine Jean
Gulcur Sevil
Güleç Ahmet
Gülker Gerd
Guney Caner
Gunneweg Jan
Guralnick Eleanor
Gutiérrez Santolalla Francisco
Guttmann Marta

H

Hadipriono Tan Fabian
Hahn Oliver
Hailu Solomon
Hala A.M. Afifi
Haldimann Marc-Andre
Hall George
Hamad A.Rahman S Al Saad
Hamadoun Bokar
Hamarneh Basema
Hamdan Khalil Mahmoud
Hamid Elghayam
Hamilton Andrea
Hampikian Nairy
Handizi Kamal
Haneca Kristof
Hanke Klaus
Hanna Monica
Hanus Jozef
Hanzlicek Thomas
Harby Ezzeldeen Ahmed
Hardy Matthew
Harith Mohamed Abd el
Harmsen Carmen
Harris Rupert
Hartnell Tobin
Hasan Aktarakci
Hasanein Amira Ezzat
Hassan Sayed
Hatchfield Pamela
Hatipoglu Murat
Haus Goffredo
Hausleiter Arnulf
Havermans John
Hawari Mahmoud
Hayman Gary
Heady Teresa
Heald Gary
Heinsch Sandra
Hektor Thomas
Helal Ali
Helal Mohamed
Helmy Fatma
Helwing Barbara
Hemdan el Mitwalli
Hemeda Sayed Mohamed
Henneberg Maciej
Henriksen Agnes
Heras Verónica Cristina
Herchenb M.
Herchenbach Michael
Hermand Jean-Pierre
Hermo Benita Silva
Hernando Josè
Herrmann Georgina
Hessni Mehdi
Heussner Uwe
Higgitt Catherine
Hilal Rifaat Hassan
Hole Frank
Holger Militz
Holger Schmaljohann

Holicky Milan
Holm Andreas
Homem Paola Menino
Hook Duncan
Horn Joëlle
Horrocks Richard
House Pilar
Hradil David
Huang Xin
Hubert Vera
Huerta Santiago
Huguet Esperanca
Hussein Abd el Shafy
Hussein Hassan Marey H. M.
Hussein Heba
Hussein Idris
Hussein Mahmoud
Hyman Jacqui

I

Iain Shepherd
Iben Brahim Aomar
Iborra M.Pilar Eres
Ignatakis Christos
Ilan David
Iman Saca
Imposa Sebastiano
Incarnato Loredana
Inches Antonio
Indirli Maurizio
Ingo Gabriel Maria
Iniguez Gonzales Guillermo
Innocenti Roberto
Innocenti Anna Maria
Invernizzi Stefano
Ion Rodica Mariana
Ionescu Corina
Iordanidis Andreas
Irbe Ilze
Iriarte Eneko
Isikli Mehmet
Iskandar Ariffin
Issini Giovanni
Ivakin Anatoliy
Ivansson Sven

J

Jackson Caroline
Jacobs Jessica
Jančovičová Jana Viera
Janković Ivor
Janssens Koen
Jaouad Sefrioui
Jasienko Jerzy
Jáuregui David
Jeffra Caroline
Jensen Eric
Jensen Paul
Jeronimidis G
Jezewska Elzbieta
Jinane Labo
Jing Zhao
Joachimski Michael
Jones Glynis
Jorissen Andre
Jouvenel Aurelie
Juàrez Arias Marta Estela
Jun Wu
Jung Michael
Jung Jason
Jütte Ton

K

Kaan Iren
Kadiri S. Mariam
Kadmon Ronen
Kafafi Zeidan
Kaimaris Dimitris
Kakali Atanasia
Kallaf Mohamad
Kalle Pilt
Kałużna-Czaplińska Joanna
Kamal Bichoy
Kamran Ahmadi
Kappos Andreas
Kaptijn Eva
Karakul Ozlem
Karami G. Hossein
Karapanagiotis Yiannis

Karaveziroglou-Weber Maria
Karik Sàndor
Karlsson Lars
Karydas A.
Kastenmeier Pia
Kazim Oz Ali
Kecskemeti Istvan
Keheyan Yeghis
Kellogg James
Kenai S.
Khenchaf Ali
Kepinski Christine
Keskin Levent
Keune Katrien
Khakzad Sorna
Khalidi Lamya
Khalil Essam E.
Khedr Amal
Khermane Lamia
Khosrowzadeh Alireza
Kidd Fiona
Kim Dong Soo
Kim Hyon Sob
Kircher Marco
Kiriatzi Evangelia
Kirreh Rania
Kislev Mordechai
Klaas.Jan Vd. Berg
Klaassen Rene
Klenz Larsen Poul
Knuutinen Ulla
Kokkori Maria
Kolar Jana
Kolbadinejad Maryam
Kolinski Rafal
Konkol N.
Kontoyannis Christos
Korn Lorenz
Kornienko Tatiana
Korosec Paola
Koubaa Ahmed
Kouris Homel
Kouris Leonidas Alexandros
Kouris Spyridon
Kourkoulis Stavros
Koutsoudis Anestis
Kovacheva Mary
Kovachovska Liljana
Kozaczka Eugeniusz
Kozal Ekin
Kozbe Gülriz
Kozlowski N.C. Roman
Kralj-Cigic Irena.
Kristensen Age
Krizmanic Jelena
Kröner Stephan
Krumbein Wolfgang E.
Kubik Maria
Kucerova Irena
Kühne Hartmut
Kulakoglu Fikri
Kuniholm Peter Ian
Kuntner Walter
Kuroiwa Keiko
Kurtz Donna
Kurzawski Piotr
Kuzucuoglu Alpaslan Hamdi

L

La Russa Mauro Francesco
La Niece Susan
Labarga Cristina Martinez
Labella Anna
Lacambre Denis
Lafli Erguen
Laftouhi Nour Eddine
Lago Luciano
Lagostena Jose
Laguzzi Giuseppe
Lahcen Aitssi
Lahcen Asebriy
Lahcen Zouhri
Lam Frank
Langella Alessio
Lanos Philippe
Lanzarone Giorgia
Lapenna Vincenzo
Larsen René
Lasaponara Rosa
Laserna Javier

Lattuati-Derieux Agnès
Lavier Catherine
Lazaridis Michael
Lazzari Maurizio
Lazzarini Lorenzo
Le Dosseur Gaëlle
Le Mière Marie
Lecervoisier Bertrand
Lee Chan Hee
Legrenzi Paolo
Lehmann Eberhard
Lehtaru Jaan
Lehtinen Jorma
Leissner Johanna
Leito Ivo
Leman Marc
Lenci Stefano
Lendl Bernard
Lenth Chris
Lentini Francesca
Lentini Valentina
Leo Marco
Leporatti Maria Lucia
Lepore Giuseppe
Letardi Paola
Letourneux Jean Pierre
Levialdi Stefano
Lewartowski Kazimierz
Ljaljevic Grbic Milica
Li Jonathan
Liarokapis Fotis
Licchelli Maurizio
Ligterink Frank
Lindsay William
Liotta Giovanni
Liu Xiao Fang
Ljaljevic Grbic Milica Vukasin
Ljiang Liben
Lo Giudice Roberto
Lo Monaco Angela
Lofli Erguen
Logleby Cliff
Lojewski Tomasz
Lollini Federica
Lomax Suzanne
Lombardi Gianni
Lombardi Tiziana
Lone Ross Gobakken
Löndqvist Minna Angelina
Lord Barry
Lorentz Kirsi
Lotti Franco
Lourenço Paulo B.
Lovell Jaimie
Lucchesi Massimiliano
Lugo Vega Johnny
Lurton Xavier
Luvidi Loredana
Luxán Gómez Del Campillo Pilar
Lyesse Laloui
Lynch Rod
Lyonnet Bertille

M

Macarena Lara
Macchia Andrea
Macchiarelli Roberto
Madricardo Fantina
Maggi Oriana
Magnaghi Agostino
Magnenat-Thalmann Nadia
Magness Jodi
Magni Mariapia Viola
Magnus Sandström
Magrane Bouchaib
Mahfroozi Ali
Mahmoud Abd el Hafez.
Mahmoud Abd el Jawad
Mahmoud Youssif A.
Mai Mohamed
Maierhofer Christiane
Maines Christopher
Maino Giuseppe
Majolino Domenico
Makhoud Nisrine
Malaga Katarina
Malagodi M.
Malalanirina S. Rakotonirainy
Mallik Azim U.
Malmberg Simon

Manacorda Daniele
Mandara Alberto
Mando' Pierandrea
Mandrone Giuseppe
Manetti Piero
Manfredi Gennaro
Manfredi Lorenza Ilia
Manganaro Marina
Mango Furnari Mario
Mangone Annarosa
Mann Samuel
Mannering Ulla
Manuelvargas Jose
Manzi Aurelio
Manzi Giorgio
Mar Ricardo
Marcolongo A.
Marcozzi Giordana
Marcuccio Chiara
Mariani Costantini Renato
Mariani Tullio
Marino Carlo Maria
Marinovic Doro Norma
Mariotti Matteo
Mariotti Mauro
Maritan Lara
Markatos Nikolas
Marletta Giulia
Marlin Petra
Marocchi Marta
Marouf Mohamed
Marras Susanna
Marrese Giovanna
Marro Catherine
Marrocchino Elena
Martelli Alessandro
Martello Stefano
Martin Harriet
Martin Manuel
Martin Valérie
Martinez Antonio
Martinez Kirk
Martínez Valle
Martini I. Peter
Martini Marco
Màrton Zsuzsannaa
Marzi Tanja
Mascari Gianfranco
Mascelloni Marialaura
Masetti-Rouault Maria Grazia
Masi Alessia
Masini Nicola
Massa Michele
Masserey Catherine
Massimino Rossella
Mastrantonio Maria
Matamala Mellin Juan Carlos
Mateiciucová Inna
Matova Margarita
Matsuda Mayumi
Matteini Mauro
Matteoli Ugo
Maugeri Michele
Maurin Emmanuel
Mautone Maria
May Eric
Mazar Amihai
Maze Gérard
Mazzanti Marta
Mazzei Mauro
Mazzeo Rocco
Mazzoleni Paolo
Mazzolini Renato
Mc Guire Gibson
Mc Kenzie Judith
Mc Leod Rory
Mc Nab Hamish
Mc Phillips Stephen
Mecchi Annamaria
Mecella Girolamo
Medhat Saber
Megahed Mohamed
Megna Bartolomeo
Mehmood Khalid
Meijer Diederik J. W.
Mele Giuliana
Mele Maria Grazia
Meli Guido
Melis Enrico
Meloni Paola

Menci Luca
Meninoh P.
Menozzi Maria Ilde
Mercuri Anna Maria
Mercuri Fulvio
Merone Olindo
Mertz Jean Didier
Messiga Bruno
Mhisen Nebal
Micallef Grimaud Jacqueline
Michalski Stefan
Middendorf Bernhard
Middleton Andrew
Milan Andreina
Milella Annalisa
Milevski Ianir
Miliani Costanza
Miller David A.
Minoofam Seyed Amir Hadi
Mirabaud Sigrid
Mirti Piero
Misk Hamid
Miyajima Masakatsu
Miyake Yutaka
Moatamed Mohamed
Modena Claudio
Modenesi Paolo
Modrzewska Pianetti Iwona
Modugno Francesca
Moggi Guido
Mohamed Abdo Abd el bar
Mohamed Belkhayat
Mohamed Benammi
Mohamed Civile
Mohamed Ejja
Mohamed Hafid
Mohamed Mohamed
Mohammadi M. R.
Mohammed A Bahattab
Mohammed Mahmoud Youssif
Mohammed Marafi
Mohie Mostafa
Mohy el Din Mohamed Samir
Molik S.
Mona Ali
Mona Khouzam,
Monamy Elisabeth
Montanari Carlo
Montaruli Nadine Edi
Monti Lorenzo
Morales Clara
Morando Mariagrazia
Morel Jean-Paul
Moreno Mateos Miguel
Morer Paz
Moretti Sandro
Morǧs Andràs
Moropoulou Antonia
Morselli Luciano
Mortara Giovanni
Morten Hjorslev Hansen
Mortezaei Alireza
Moscatelli M.C.
Moscati Paola
Mosquera Díaz María Jesús
Mossa Luigi
Mossetto Gianfranco
Mossotti Raffaella
Mostafa Attia
Mostafa Oujidi
Mosteiro Javier Garcia-Gutierrez
Motta Ernesto
Moulay Idriss Hassani
Moussa Abubakr
Mohamed Abubakr
Mozetic Miran
Mque Wei Min
Muller Margueron Béatrice
Munafo' Paola Franca
Musinguzi Dan

N

Nabeel Said
Nabil Chabour
Naesborg Maria Reese
Nagel Alexander
Nagla Ali
Nardi Florina
Nashwa Solieman M. Saied
Navrud Stale

Negro Paolo
Nelle O.
Nerlich Andreas
Nesrin El Haddidi.
Neubauer Wolfgang
Ngoma Athuman Mwedad
Ni Enzhi
Niazy Mostafa
Nicola Ludwig
Nicola Macchioni
Nicoletti Marcello
Nicoletti Viviana Elisa
Niculescu Gheorghe
Nielsen Kurt
Nigro Lorenzo
Nilsson Thomas
Nimis Pierluigi
Nishiyama Shin'ichi
Niskanen Paula
Nofal Eslam Mahmoud Hassan
Nogueira Monteiro Yara
Noldt Uwe
Northedge Alastair
Northover Peter
Nosch Marie-Louise
Nour el Din Gaaloul
Novo Alexandre
Novotny Friedrike
Ntanos Kostas
Nuccio Lucrezia
Nugari Maria Pia
Nunes Lina
Nur el Din Hani
Nuria Ferrer
Nyabade Gordon
Nymann Hanne

O

Oddo Elisabetta
Oddone Massimo
Oddy William Andrew
Odlyha Marianne
Ogleby Clifford Leslie
Ögüt Birgül
Onofri Silvano
Ooghe Bart
Opielinski Krzysztof
Orazi Roberto
Orchard Jocelyn
Orchard Jeffery
Ordóñez Celestino
Oren Eliezer D.
Orimoogunje Oladele
Orlandi Fabio
Ormsby Bronwyn
Ortega-Monasterio María-Teresa
Ortiz Calderon Del Pilar
Oshima Takayoshi
Ossman Mouheyddine
Ossola Franco
Otto Adelhaide
Ottosen Lisbeth
Oujja M.
Oujli Lamyaa
Ozcan Koray
Özdemir Kameray
Özdoğan Eylem
Özfirat Aynur
Ozkut Deniz
Öztan Öncel

P

Pacault Anne
Pacciani Elsa
Pace Anthony
Pace Loretta
Paci Maria Augusta
Pacini Alessandro
Pacini Ettore
Padeletti Giuseppina
Pagliolico Simonetta
Pagounis Vassilios
Palazón Julio Navarro
Pallecchi Pasquino
Palleschi Vincenzo
Pamir Hatice
Panagiotou Konstantinos
Panayotis Carydis
Pandolfi Anna Maria
Panitz-Cohen Nava

Panou-Pomonis Evgenia
Pantano Eleonora
Panza Giuliano
Paoloni Giovanni
Papadakis Vassilis
Papadopoulos Georgios
Papageorgopoulou Christina
Papagiannakis George
Papliaka Zoe-Eirini
Paquet Eric
Paradisi Alessandra
Parante J.
Paraskevopoulos Konstantinos M.
Parastates Elias
Pardi Luca
Pardini Carla
Parenti Roberto
Pareschi Maria Teresa
Parfait Noele
Park Heon Joon
Parker Bradley J.
Partyka Andrzej
Parvis Marco
Pascoal António
Pasi Gabriella
Pasqua Recchia Antonia
Pasuto Alessandro
Paterň Fabio
Patias Petros
Patrier Julia
Patumi Maurizio
Pavlidis George
Paz Yitzhak
Pearce Geoff
Pearson Jessica A.
Pecchioli Laura
Pecchioni Elena
Pedde Brigitte
Pedde Friedhelm
Peilstöcker Martin
Pel Leo
Pellegrino Margot
Pelosi Claudia
Peltenburg Edgar
Peng Li
Pennisi Maria Laura
Pereira Da Cunha Costa M. Filipe
Pereira Roders Gomez Ana Rita
Peresani Marco
Peretto Carlo
Pereyra María Violeta
Pérez Aranteguei Josephine
Perez Jordà
Perez Juan
Perez Rosanna
Perez Zoloza Natalia Antonia
Perez-Miralles Juan
Peri Arina Laura
Perna Maria Anna
Pernice Alessandro
Perrone Angela
Persi Peris
Persia Franca
Persiani Anna Maria
Perugini Raynaldo
Peruzzo Luca
Pescarin Sofia
Pescatore Tullio Secondo
Pesce Delfino Vittorio
Pescetto Alessandro
Pestana Barros Carlos
Petit Lucas
Petraskovic Zoran
Petrescu St. Joan
Pettener Davide
Petteň Piero
Peyronel Luca
Pezzati Luca
Pfälzner Peter
Pfeiffer Kristina
Phenix Alan
Piattoni Quintilio
Piazza Maurizio
Picchi Eugenio
Picollo Marcello
Piervittori Rosanna
Piga Giampaolo
Pigott Vincent C.
Pilar Ortiz Maria
Pini Roberto

Pinna Daniela
Pinnock Frances
Pinto Gabriele
Pintucchi Barbara
Pinzari Flavia
Piovesan Rebecca
Pipan Michele
Piper David
Piquè Francesca
Pires Cruz Helena Maria
Pires Margarida Calejo
Piro Salvatore
Pirotti Francesco
Pisano Marilene
Pistarino Annalaura
Pitas Ioannis
Pitthard Vaclav
Pizzi Antonio
Plaza Beatriz
Podany Jerry
Podestà Stefano
Pohleven Franc
Poldini Livio
Poli Paola
Poli Emilia
Poli Giampiero
Polikreti Kyriaki
Polizzi Maria Domenica
Pollio Antonino
Polona Ropret
Pompoli Roberto
Ponzi Federica
Pouli P.
Pournou Anastasia
Pozzi Massimiliana
Prada Claire
Pradell Trinitat
Preciado Quiroz Adolfo
Pretzel Boris
Price Clifford
Principe Claudia
Privitera Silvia
Proietti Noemi
Provis John L.
Psycharis Ioannis
Pucci Marina
Pulhan Gül
Pullen Derek
Pulvirenti Emanuela
Puppi Gigliola
Puturidze Marina
Pyšek Petr

Q

Quagliarini Enrico
Querini Giulio

R

Rababeh Shaher Mah'd
Rabin Ira
Rabino Massa Emma
Rachid Omira
Raciti Erminia
Radvan Roxana
Rafael Fort.
Ragni Pietro
Rahsaz Hasan
Rainone Mario Luigi
Raissouni B.
Ramilo Alejandro
Ramírez Jose María Martín
Ramos Jose
Ranfa Aldo
Rania Khaled
Rasmussen Kaare Lund
Rattanawong Phuttachart
Ravera Sonia
Reale Emanuela
Realini Marco
Reda el Wakil
Regert Martine
Rehor Miriam
Reiche Andrzej
Reina Giuseppe
Reinprecht Ladislav
Remondino Fabio
Remzi Ya Ciğ
Renard Francois
Renna Floriana

Residori Luciano
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Ribera Albert
Ribera Lacomba
Riccardi Maria Pia
Riccio Giuseppe
Richard Suzanne
Richard Petit
Richards Vicky
Richardson Ken
Rickards Olga
Ridolfi Stefano
Rifaat Hilal
Rigano Laura
Rinaldi Maria Donata
Rinaudo Fulvio
Risan Thomas
Rissanen Sirkka
Ristić Slavica
Ristvet Laureen
Rivas Brea Teresa
Riveiro Belen
Rives Vicente
Rivoal Marion
Rizza Giovanni
Rizzo Gianfranco
Rizzo Giovanni
Rmili Ahmed
Robert Beatrice
Robinson Darren
Robinson Mark
Robinson Stephen
Robles-Marin Pedro
Roca Pere
Roccardi A.
Rocio Ortiz Calderón
Rode Carsten
Rodriguez Navarro Carlos
Rodriguez-Maribona Isabel
Roemich Hannelore
Roig Picazo Pilar
Rojas-Sola José Ignacio
Roldan Lourdes
Rolla Giancarlo
Romagnoli Manuela
Romano Bruno
Romano Daniela
Romero-Noguera Julio
Rooijakkers Tineke
Rook Lorenzo
Rospi Gianluca
Rossi Renzo
Rossi Walter
Rosso Ana Maria
Rostirolla Pietro
Rota Michela
Rota Sabrina
Roter-Blagojevic Mirjana
Rouault Olivier
Rousset Marie-Odile
Roustaei Kourosh
Roux Valentine
Rovira Leticia
Rudan Pavao
Ruffolo Silvestro Antonio
Ruggeri Roberto
Ruijgrok Elisabeth
Ruiz-Agudo Encarnación
Ruiz-Moreno Sergio
Rumor Massimo
Rushmeier Holly
Russell Joanna
Russo Saverio
Ryhl-Svendsen Morten

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Sabbatini Luigia
Sabbioni Cristina
Saber Mahmoud
Sablatnig Robert
Sabry Mishael
Sader Helene
Sadori Laura
Saez Antonio
Safae Zahri
Sahin Mustafa
Sahin Nuran
Said Boutaleb

Saisi Antonella
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Sala Elisa
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Salerno Emanuele
Salerno Giovanni
Sales Ibiza Palacios
Salib Sabet Mervat
Salimbeni Renzo
Salje Beate
Sallam Ahmed
Salmon Sabrina
Salonia Paolo
Salthammer Tunga
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Savo Valentina
Sawastyanowicz S.
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Sayed Deyab
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Schäfer Irmhild
Schalm Oliver
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Schilling Andreas
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Schmidt-Ott Katharina
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Schreiner Manfred
Schulz Arne
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Scott David Andrea
Scucka Jiri
Scuderi Gianfranco
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Sertok Kemal
Severi Marco
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Siano Salvatore
Siart Christoph
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Simons Dick G.
Singer Christiane
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Soria Teresa
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Sorour Mohamed
Sorror Charles
Spampinato Giovanni
Spaň Antonia
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Stege Heike
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Tatarek Agnieszka
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Tomasi Tongiorgi Lucia
Tomasin Patrizia
Tone Marie Olstad
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Torge Manfred
Tornari Vivi
Torrini Maurizio
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Trentelman Karen
Triboulot Pascal
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Tronchin Lamberto
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Trupiano Gaetana
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Tsurugi Masato

Tucci Pasquale
Tucci Patrizia
Tufanio Massimo
Tülek Füsun
Tuniz Claudio
Turbon Daniel
Turchiano Maria
Turki Saud Mohammed al-Saud
Tutkun Murat
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Urż Clara Enza
Ussishkin David
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Uzquiano Paloma

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Vaggelli Gloria
Vagnetti Lucia
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Valbusa U.
Valcuvia Mariagrazia
Valdés Pereiro Carmen
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Valentini Massimo
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Van Acker Jorisr
Van de Zande Dianne
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Van der Werf Inez Dorothé
Van Exel Vincent
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Vaz Fatima
Vázquez González M. Auxiliadora
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Vegas López-Manzanares F.
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Vellinga Marcel
Vendl Alfred
Vendrell Mario
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Verges-Belmin Véronique
Vergnieux Robert
Verhaeghe Gus
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Vermeulen Tony
Viana-Baptista Maria Ana
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Vigato Pietro Alessandro
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Walmsley Alan
Walzer Michael
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Wasserman Irina
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Weber Gerhard
Weber Martina
Wei Min W.
Wei Shuya
Wendel Van der Sluis
Wheatley Paul
Whelan Caroline
Whincop Matthew Raymond
Whitcomb Donald
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Whitmore Paul
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Wilson Alicia
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Wouters Jan
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Wygnanska Zuzanna

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Yakar Murat
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Yang Guifang
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Yener Aslihan
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Zammit Gabrielle
Zampolli Mario
Zani Nicola
Zanier Katharina
Zanini Alessandro
Zanotti Annaletizia
Zanutta Antonio
Zanuttigh Pietro
Zappalà Antonio
Zarif Nahed
Zarnic Roko
Zarza Alonso Ana Maria
Zaslavskiy Gennadi
Zeigler Margee
Zendri Elisabetta
Zeraouli Mustapha
Zezza Fulvio
Zhang Rouran
Zhou Xiao Meng
Ziad Al-Saad
Ziaei Majid
Zignale Maurizio
Zink Albert
Zoppi Marco
Zouain Georges S.
Zouraris Georgios
Zsolt Kajcsos

Zsolt Simon
Zucchi Fabrizio
Zuckerman Sharon
Zuparnic Zvonka

3 - Provisional list of contributing Scientists

Many thousands of scientists contributed with comments, suggestions and adjournements to the EACH Project text throughout year 2010.

The following scientists joined lately to the Association *"Investing in Culture"* and Partners of the EACH Project. (the free subscription membership form is available on the same web site).

Afifi Hala
Albertini Roberto
Anheuser Kilian
Arayici Yusuf
Attolico Giovanni
Calliari Irene
Cavallini Mauro
Colomban Philippe
Dimitrokoli Elisavet
Dubina Den
Emam Nahla
Erdem Otman Aylin Umit
Guttmann Marta
Ion Rodica Mariana
Khakzad Soma
Kuzucuoglu Alpaslan Hamdi
Leftouhi Nour Eddine
Madariaga Juan
Marrese Giovanna
Martin Jose Maria
Montaruli Nadine
Moretti Sandro
Ortiz Pilar
Ortiz Rocio
Piazza Maurizio
Pires Margarida
Reinprecht Ladislav
Sabry Mishael
Smolik Jiri
Styliadis Athanasios
Tanacseren Mine
Tiano Piero
Tucci Patrizia
Yakar Murat

The Project text will be adjourned during 2011 up to the Istanbul Congress of next November 2011; adjournements will be reported on the web site www.eachproject.eu.

The following scientists suggested new texts which were inserted into the EACH Project during 2010.

Aydin Elif Özlem	**Key Action X.2 – Area X.2.5 – Target 1**
Ambrosini Laura	**Key Action X.2 - Area X.2.3 – Target 7**
Bertani Duilio	**Key Action X.2 - Area X.2.4 – Target 4**
Burri Ezio	**Key Action X.1 - Area X.1.1 – Target 6**
Cannelli Giovanni Bosco	**Key Action X.1 - Area X.1.2 – Target 4**
Capitani Donatella	**Key Action X.2 - Area X.2.3 – Target 7**
Cennamo Claudia	**Key Action X.2 - Area X.2.5 – Target 1**
Chiaia Bernardino	**Key Action X.2 - Area X.2.5 – Target 1**

Ehlers Frank	**Key Action X.5 - The whole Key Action X.5**
Fabbri Bruno	**Key Action X.2 - Area X.2.2 – Target 3**
Fantoni Roberta	**Key Action X.2 - Area X.2.2 – Target 2**
Ferrari Angelo	**Key Action X.1- Area X.1.1 – Target 6**
Ferro Daniela	**Key Action X.2 - Area X.2.2 – Targets 3 & 4**
Ferro Daniela	**Key Action X.2 - Area X.2.3 – Target 7**
Frediani Piero	**Key Action X.2 - Area X.2.2 – Target 3**
Frediani Piero	**Key Action X.2 - Area X.2.4 – Target 3**
Gomaa Abd el Maksoud	**Key Action X.2 - Area X.2.6 - Target 3**
Gomaa Abd el Maksoud	**Key Action X.3 - Area X.3.1 – Target 3**
Harith Mohamed Abd el	**Key Action X.2 - Area X.2.2 – Target 4**
Harith Mohamed Abd el	**Key Action X.4 - Area X.4.4 – Target 2**
Hussein Mahmoud	**Key Action X.2 - Area X.2.4 – Target 2**
Khedr Amal	**Key Action X.2 - Area X.2.2 – Target 4**
Khedir Amal	**Key Action X.4 - Area X.4.4 – Target 2**
Lucchesi Massimiliano	**Key Action X.2 - Area X.2.4 – Target 4**
Lugo Vega Johnny	**Key Action X.1 - Area X.1.1 – Target 2**
Lugo Vega Johnny	**Key Action X.2 - Area X.2.1 – Target 4**
Luvidi Loredana	**Key Action X.2 - Area X.2.3 – Target 4**
Manfredi Lorenza Ilia	**Key Action X.4 - Area X.4.3 – Target 5**
Mazzolani Federico	**Key Action X.2 – Area X.2.5 – Target 1**
Mercuri Anna Maria	**Key Action X.3 - Area X.3.1 – Target 1**
Milan A./Magnaghi.A.	**Key Action X.2 - Area X.2.4 – Target 5**
Mohy el Din Mohamed	**Key Action X.2 – Area X.2.6 – Target 4**
Piervittori Rosanna	**Key Action X.2 - Area X.2.4 – Target 3**
Pipan Michele	**Key Action X.1 – Area X.1.2 – Target 4**

Pipan Michele	**Key Action X.2 - Area X.2.2 – Target 4**
Querini Giulio	**Key Action X.4 - Area X.4.4 – Target 2**
Reale Emanuela	**Key Action X.4 - Area X.4.2 – Target 4**
Rinaldi Maria Donata	**Key Action X.2 - Area X.2.1 – Target 1**
Rinaldi Maria Donata	**Key Action X.4 - Area X.4.4 - *passim***
Rossi Valter	**Key Action X.3 - Area X.3.2 – Target 4**
Sadori Laura	**Key Action X.3 - Area X.3.1 – Target 1**
Salerno Emanuele	**Key Action X.2 - Area X.2.1 – Target 2**
Salerno Emanuele	**Key Action X.2 - Area X.2.6 – Target 4**
Sciarretta Francesca	**Key Action X.2 – Area X.2.4 - *passim***
Sykora Miroslav	**Key Action X.2 - Area X.2.4 – Target 4**
Tidblad Johan	**Key Action X.2 - Area X.2.4 – Target 3 & 4**
Trupiano Gaetana	**Key Action X.4 - Area X.4.2 – Target 4**
Tuniz Claudio	**Key Action X.1 - Area X.1.2 – Target 4**
Tuniz Claudio	**Key Action X.2 - Area X.2.2 – Target 4**
Vafeidis Antonios	**Key Action X.1 - Area X.1.2 – Target 4**
Vigato Pietro Alessandro	**Key Action X.2 - Area X.2.7 – All Targets**
Zaki Moushira	**Key Action X.3 - Area X.3.1 – Targets 3 & 5**

The following scientists contributed with comments and suggestions.

This list of contributing scientists will be adjourned on the Project web site www.eachproject.eu every month, starting from February 2011.

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Abraham Bruce
Aceto Maurizio
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Blocken Bert
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Mehmood Khalid
Meli Guido
Moatamed Mohamed
Modrzewska Pianetti Iwona
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We deeply thank all the colleagues for their fundamental help making this document more exhaustive and legitimate to be submitted to the attention of the European Commissioner Mrs. Máire Geoghegan-Quinn.

4 – Project Organizing Team

The Organizing Team of the EACH Project has been working for years on the before mentioned initiatives, (see Annex). Nowadays it is formed by a full time Team, i. e. Dr. A. Ferrari, Dr. E. Sirugo, and Mr. S. Tardiola of the "*Institute of Chemical Methodology"* belonging to the National Research Council of Italy (CNR), under the auspices of the "*Department of Cultural Patrimony"*, and by the "*Association "Investing in Culture*", AIC, prof. A. Guarino, president, prof. M. Guaitoli, Secrertariat Dr. E. Possagno, Mrs. M. Manfredi..

The Association *"Investing in Culture"* is an international non profit Association which deals with activities concerning science applied to Cultural Heritage. Anybody all over the world is working in this field may adhere with no obligation and no fee. Whoever is interested being a member of the Association may fill the form contained on the web site www.eachproject.eu.

Hundreds of associates, belonging to universities and public and private scientific Institutions of the 27 Member States of the European Union and of North Africa and Middle East are giving their significant contribution to this Project.

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5 - Previous activity of the Organizing Team

1 - Special Project "CULTURAL HERITAGE"

An important national Project was financed and carried out in Italy between 1997 and 2005, unique in Europe for extension and financial support, regarding science and technology applied to Cultural Heritage. Total funding was more than 30 million Euro from the Ministry of Research. The Project was led, inside the National Research Council (CNR), by a staff of scientists who mainly correspond to the actual Organizing Group.

The Project concerned about 320 Research Units that worked for about five years, avoiding research fragmentation, with significant exchange of information. The results of these activities were reported in scientific Journals like the *Journal of Cultural Heritage* and were presented during events like the International Congresses on *"Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin*" held in Paris in 1999 and in Madrid (Alcala') in 2001.

2 – International Congresses

Three important Congresses were held in Europe between 1995 and 2009 promoted and organized by the staff of the Special Project ***"Cultural Heritage".***

The first Congress was held in Catania, to assess the "state of art" of scientific applications to the safeguard of Cultural Heritage.

1ST International Congress on "SCIENCE AND TECHNOLOGY FOR THE SAFEGUARD OF CULTURAL HERITAGE OF THE MEDITERRANEAN BASIN"

Participants: 380
Oral Presentations: 280
Poster Presentations: 120
Proceedings of the Congress: 2 Volumes

The second Congress was held in Paris, opening section inside the Louvre Museum, in collaboration with the ***"Centre national de la recherche scientifique", (CNRS)*** and the University of Nanterre.

2nd International Congress on "SCIENCE AND TECHNOLOGY FOR THE SAFEGUARD OF CULTURAL HERITAGE OF THE MEDITERRANEAN BASIN"

Participants: 500.
Oral Presentations: 201
Poster Presentations: 163
Proceedings of the Congress: 2 Volumes

The third Congress was held in Spain, in collaboration with the ***"Consejo Superior de Investigaciones Cientificas"***, ***(CSIC),*** and the University of Alcala' de Henares.

3nd International Congress on "SCIENCE AND TECHNOLOGY FOR THE SAFEGUARD OF CULTURAL HERITAGE OF THE MEDITERRANEAN BASIN"

Participants: 480.
Oral Presentations: 303
Poster Presentations: 96
Proceedings of the Congress: 2 Volumes

The fourth Congress was held in Cairo, in collaboration with the ***Supreme Council of Antiquities of Egypt.***

4th International Congress on "SCIENCE AND TECHNOLOGY FOR THE SAFEGUARD OF CULTURAL HERITAGE OF THE MEDITERRANEAN BASIN"

Participants: 350.
Oral Presentations: 240
Poster Presentations: 46
Proceedings of the Congress: 2 Volumes

5th International Congress on "SCIENCE AND TECHNOLOGY FOR THE SAFEGUARD OF CULTURAL HERITAGE OF THE MEDITERRANEAN BASIN"

The 5th Congress will be held in Istanbul, next November 2011.

3 - European Projects Eureka – Eurocare

The same Group of scientists organized and directed from 2000 until 2005, the Umbrella Programme on Cultural Heritage named ***"EUROCARE"*** of the European Projects "***EUREKA".*** Board president of the "*Eurocare Programme*": A. Guarino. Six specific Programmes on science and technology for the safeguard of Cultural Heritage were approved and financed on European basis for about 10 million Euros.

4- Journal of Cultural Heritage – Elsevier – Paris

Starting from 2000, an international Journal in English concerning scientific papers on Cultural Heritage was founded in Paris and directed as Editor in Chief by. A. Guarino in collaboration with the Publisher Elsevier up to 2007.

The *Journal of Cultural Heritage* receives yearly hundreds of scientific papers from all over the world and possesses a significant impact factor.

5- A. Guarino: a short profile

University of Rome: degree in chemistry and PhD in Radiation Chemistry.

Associate professor, University of Camerino,(1969-1970).

Brookhaven National Laboratory, BNL, New York, USA: Staff Member of the Chemistry Department (1966-1967).

National Research Council, CNR, Italy, senior scientist and director of the "*Institute of Nuclear Chemistry*", CNR, Rome up to year 1987.

President of the CNR National Committee *"Science and Technology for Cultural Heritage*" from 1995 up to 1999; Organizer and President of the Special Project "*Cultural Heritage*", from 1997 up to its end in 2005.

President of the Board of the European Umbrella Programme "*Eurocare*" , of the EUREKA Projects for the years 1998-2001.

Founder and Editor in Chief since 2000 up to 2007 of the "*Journal of Cultural Heritage"* published in Paris by Elsevier.

Co-founder of the "*Journal of Labeled Molecules and Radiopharmaceuticals*"; Brussels.

Founder and President of the AIC Association in 2004. Member of the Italian Government delegation of the Research Ministry in Dublin, Brussels, Cologne and Moscow, years 1997 - 1998.

Organizer of the first European Conference on "*Research for the protection of Cultural Heritage: opportunities for European Enterprises*" in association with the European Commission DG X (Director Dr. C. Patermann) held in Rome, 1997.

For the years 1990 - 2010, invited guest to International conferences and congresses on Cultural Heritage held in Amman, Athens, Brussels, Caceres, Cairo,

Cologne, Graz, Florence, Lisbon, Madrid, Malaga, Nice, Paris, Rome, Tripoli, Toledo, Venice, Vienna, etc

85 full papers in international Journals, patents and books in Nuclear Chemistry and Radiochemistry.