

*Pollution and Cultural Heritage:  
an Italian Case Study*

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This theme is related not only to the exchange  
and consequent integration of the various teachings of different  
scientific areas

– that is of various cultural extractions,

*experimental experiences*

and *acquired competences* –

because the

but also to the reciprocal and the same aim:

**“the good of cultural goods”.**

ions.

Consequently the complete study is *directed* at the

**“system: artifact-environment-biota”**

with one common objective,

that is the protection and valorization of Cultural  
Heritage

together

with the quality of life and work.

A complete and correct methodological path is very important for this aim. It includes, in relation to any historical artifact that is: painting, statue, book, codex, archival report, architectural-monumental complex, etc..., this sequence of study:

- the preliminary on the spot investigation and the subjective evaluation of artifact and collocation site:

- the specific research concerning the library and archival documentation on the history and the various previous conservative interventions;

- the diagnostic-analytical examination in relation to characterization of the material composing the object and evaluation of the state of conservation;

- the consequent intervention – if necessary – of restoration with appropriate materials, products and techniques;

*which are also important.*

- the parallel monitoring of collocation site: container, structure and environmental conditions;

- the monitoring of these conditions to prevent possible interactions with environmental factors and agents;

- the promotion, planning and valorization of the site with artistic and cultural events.

I indicate some topics inherent to cultural and environmental heritage

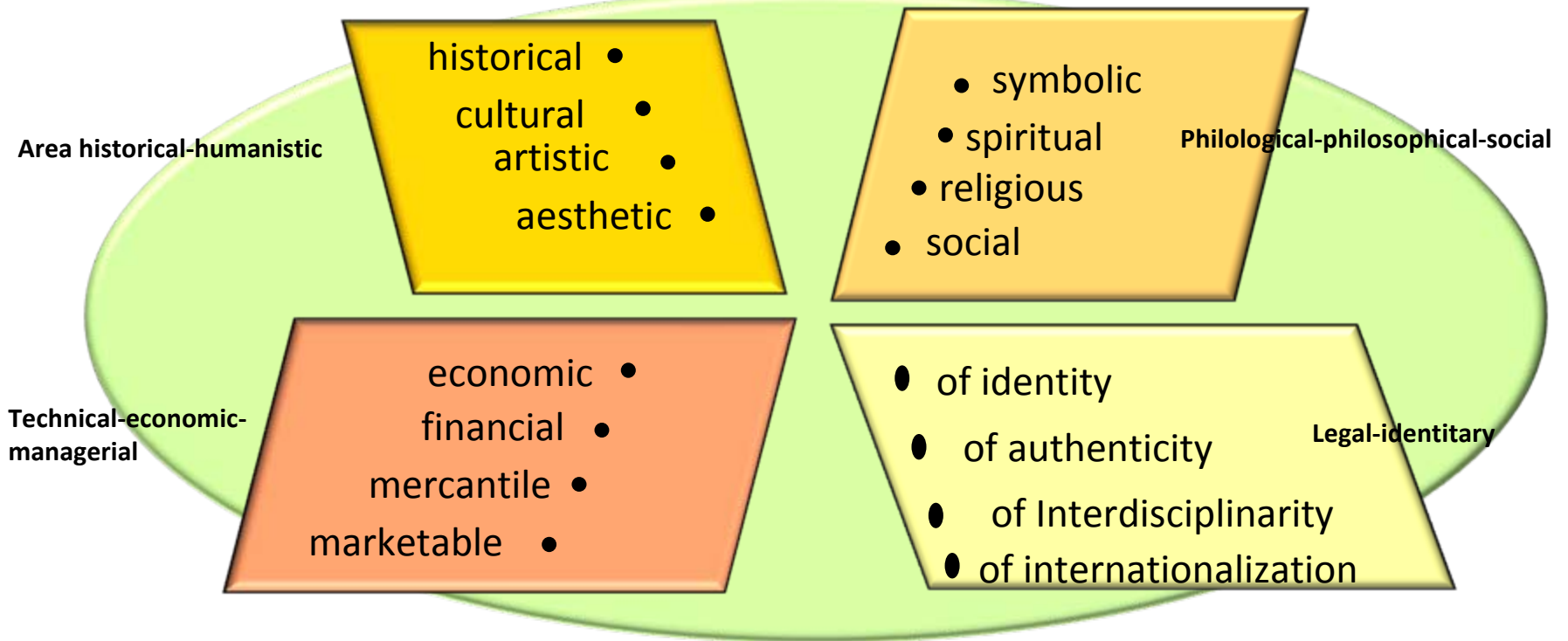
## 1. The study of cultural heritage

A)

The introduction concerns the fundamental aspects of different and important competences and experiences related to the study and research of environmental and cultural heritage, that is **“interdisciplinarity”**.

This initial point represents a real need, which determines the **union of art and science**, formally and historically two different words, but realistically and correctly one common manner to **“read” a work of art**.

A work of art is ultimately characterized by a holistic value or rather by a set of values that relate to different areas of research:  
**THE HOLISTIC VALUE OF CULTURAL HERITAGE**



**B)**

*The second point is the description of my educational and scientific activity.*

This includes:

- **the Diagnostic Laboratory for Cultural Heritage** with the various diagnostic-analytical techniques for monitoring environments and artifacts;

- **the book series:**  
“The environment and cultural heritage”  
and “Education and research in the sector of Cultural Heritage”;

- **the historical-technical Journal**  
“Conservation Science in Cultural Heritage”;

- **the Master**  
“Planning and Promotion of Artistic and Cultural Events”.

# Training and research in the cultural heritage sector: this slide briefly shows my did+sci act

## Training

### Two Book series



Some volumes are in Italian and English edition

On the base of the book series there are two conceptual terms: Interdisciplinarity and Internationalization.

I mention in particular:

- the first book series with 11 volumes about various topics related to works of art;
- the second book series with 3 volumes:
  - ✓ one on the various interventions in several conferences and study days;
  - ✓ another with the problematic theme on “Risk management in confined areas”;
  - ✓ another is dedicated to the Master

## Research

### Diagnostic Laboratory for Cultural Heritage

This Laboratory has:

- the purpose of carrying out study and experimentation on the system: artifact-environment-biota
- non-destructive, non-invasive, non-manipulative technologies
- been indicated as an “Institute of excellence of the System Italy”

### The Master:

“Planning and promotion of artistic and cultural events”

is related to my didactic and managerial activity and to interdisciplinarity and internationalization: the main themes covered by the various teachers in their teaching

All occurring in the area of traditional lessons and internships/job placements



The historical-technical journal “Conservation Science in Cultural Heritage” represents my scientific heart and:

- includes International Universities, Research Centers, Institutions
- has obtained various quality certifications and platforms
- is available in print and online (open access) and is present on numerous international websites of Western and Eastern scientific communities.
- Has an international and interdisciplinary Scientific Board

## 2. "The art market and auction houses".

The second topic concerns the art market and auction houses with their **particular and polyhedric aspects** and actors: their endogenous and exogenous presences and interventions determine the movements of this market, which can be predictable but also unpredictable in relation to the **various economic-financial situations** and conditions of the national and international sphere.

*works of art and **different factors and agents present***

In particular the aim of this topic is related to the importance and the need for a subjective and, at the same time, objective evaluation of artwork, to decide the price on the art market: some case studies underline this current and problematic theme.



### **3. Art and environment as media for *ecosustainability*, ethics and aesthetics.**

The ethic and aesthetic issues concerning **ecosustainability** are the next arguments, which represent the fundamental aspects related to the education of the operator and/or historian in the sector of Cultural Heritage for the study of the "system: environment-artifact-biota".

But another aspect, according to experts, is consequently the importance of social-media and changes in the course of time. It underlines that social media have become sentimental and profound, because they are the open expression and interaction of emotions, intentions, ideas, relations and interrelations between different persons in life and in research.

#### **4. The activity of research and case studies in indoor and outdoor environments**

The various case studies on the experimentation concerning confined and external environments

**In the subsequent** and the interaction with artifacts.

... ..

the problems of alteration and degradation of these artifacts and consequent evaluation of their conservation state, with the possibility of interventions of **restoration,**

**conservation,**

**maintenance**

**and prevention,**

represent the numerous case studies which include the corresponding causes of these modifications.

## 5. *Traditional and non traditional , innovative, ephemeral materials and techniques in contemporary art*

Study and experimental application is related to contemporary art

This is a particular sector which presents new problems

Some case studies explain this new and difficult vision, which poses new and difficult problems for intervention and application, which are not always accepted and/or employed and/or standardized.

but also new considerations in relation

to basic and consecrated conceptions, which derive from

the principles connected to

**RESTORATION,**

**CONSERVATION,**

**MAINTENANCE**

and

**PREVENTION**

## **6. Industrial and educational research project “BluArcheosys “. Innovative technologies and advanced systems in underwater archeology**

This recently concluded project includes

**In particular this project is related not only to underwater archaeology, but also to other sectors, that is:**

*land-sea informative system,*

*monitoring of oil rigs,*

*research of new raw materials,*

*monitoring of underwater pipes, etc...*

## 7. A case study :“Atmospheric pollution and degradation of monuments and historical-artistic environments”



Basilica of Santa Maria Maggiore, Rome



Theatre of Marcellus, Rome



Cloister of the Villa d'Este, Tivoli

The **first objective** was to detect and measure volatile **POLLUTANTS** ( $\text{NO}_x$  - nitrogen oxides,  $\text{SO}_x$  – sulphur oxides, TSP – Total Suspended Particulate) with automatic analyzers classified as reference methods by the Environmental Protection Agency EPA-USA). These analyzers follow over time an **INDEX OF DEGRADATION** for the exposed material that indicates the extent of the degradation:

### Characteristics of the chosen research points:

| Point | Site                             | Traffic              | Index of methanisation |
|-------|----------------------------------|----------------------|------------------------|
| 1     | Basilica of Santa Maria Maggiore | Intense and fast     | 81%                    |
| 2     | Theatre of Marcellus             | Intense and fast     | 48%                    |
| 3     | Cloister of the Villa d'Este     | Intense and stagnant | 100%                   |
| 4     | Villa Adriana                    | Null                 | 100%                   |



Villa Adriana, Tivoli



*Mobile laboratory equipped with automatic analyzers complying with EPA standards for air-borne pollutants*

***A representative day in the course of routine city life.***

***Analysis of atmospheric pollutants (mobile laboratory)***

Readings taken at intervals of 20-30 days for each of the 4 seasons – they include:

**SULFUR DIOXIDE (SO<sub>2</sub>)**

with automatic detector (UV fluorescence)

**NITROGEN OXIDE (NO)**

**NITROGEN DIOXIDE (NO<sub>2</sub>)**

with automatic detector (chemiluminescence)

**TOTAL SUSPENDED PARTICULATE MATTER (TSP)**

with automatic detector TEOM continuous ambient air monitor/microgravimetry

## Characterization of the material constituting the artifacts

- ❖ sampling
- ❖ preparation of stratigraphic sections
- ❖ observation by mineralogical microscope

For this purpose non-destructive, non-invasive, non-manipulative methodologies were chosen and,

as a parameter to follow over time, the greying-fouling index of:

- selected portions of travertine artifacts ;
- horizontal surfaces of travertine slabs (reference)
- horizontal travertine discs



After cleaning selected portions of surfaces, reliable functional techniques were used to measure brightness (% reflectance)

namely

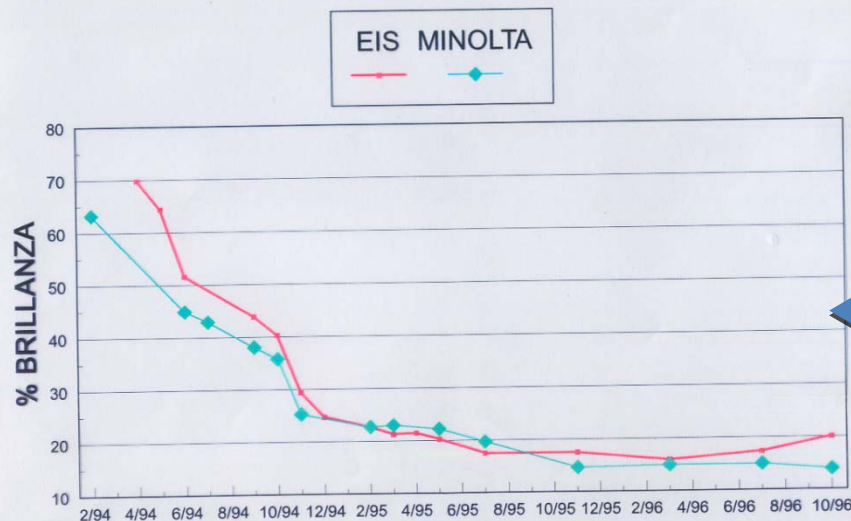
**colorimeter-spectrophotometer  
prototype instrument  
videomicroscope with image analysis**

Analysis of the type of damage caused by the deposition of pollutants

Determination of degree of greying (% reflectance) by:

- 1) **COLORIMETER-SPECTROPHOTOMETER** (portable)
  - on standardized travertine slabs and exposed to pollutants (reference)
  - on the artifact surface (selected portions)
- 2) **PROTOTYPE FOR CONTINUOUS MEASURING**
  - on samples of travertine (reference samples)
  - determination of micro-maps of degraded areas of reference slabs by:
- 3) **VIDEOMICROSCOPE WITH IMAGE ANALYSIS**
  - on standardized travertine slabs and exposed to pollutants (reference)
  - on the artifact surface (selected portions)

TEATRO DI MARCELLO - Roma  
Misure di ingrigimento con colorimetro spettrofotometrico (Minolta) sulla lastra orizzontale di riferimento e con prototipo (EIS) sui dischetti orizzontali:  
confronto di andamenti



**Theatre of Marcellus – Rome**

Measurements for greying made using colorimeter-spectrophotometer (Minolta) on horizontal slab (reference) and using prototype (EIS) on horizontal discs: comparison of trends

## RESULTS

From the results obtained over the 4 seasons in the 4 sites in Rome and Tivoli it was found that:

**NO<sub>x</sub>** and **TSP**: average recorded values are high in both the Basilica of Santa Maria Maggiore (NO<sub>x</sub>: 122 ppb and TSP: 99 µg/m<sup>3</sup>) and the Theatre of Marcellus (NO<sub>x</sub>: 133 ppb and TSP: 91 µg/m<sup>3</sup>) with peaks almost in the same time bands: early morning (8-9am) and late evening, (between 20.30 and 23.00 pm respectively and until 0.30am). Lower concentrations for NO<sub>x</sub> (between 10-40 ppb) and TSP (between 50 and 110 µg/m<sup>3</sup>) were found in the two sites in Tivoli.

**SO<sub>2</sub>**: concentrations for all sites were a great deal lower and almost equal to instrumental zero during night hours.

Trends in traffic significantly influenced concentrations of NO<sub>x</sub> and TSP throughout the day, whereas the limited concentration of sulfur dioxide should be viewed in relation to the lower sulfur content **in conventional fuels and the progressive reconversion of heating systems** for residential purposes that has obviously been felt not only in areas that have adopted methane almost totally, but also in those that have only partially converted to methane.

The hazard level for NO<sub>x</sub> and TSP has been amply confirmed

Reasons for this research were that:

- this problem is pertinent to life and activity in megalopolises
- it is a major problem in historic city centres
- human safeguard is also the protection of cultural heritage

Another important aspect of this research resulting from the consequence of urbanisation represents **THE SECOND AND FINAL OBJECTIVE of the research** in relation to my 6 years experience of running the Master

1. The importance of the business world in CULTURE at the basis of its valorization
2. The consequent knowledge of the TERRITORIAL FORCES i.e. CULTURAL and BUSINESS UNITS
3. Various problematic issues related to CULTURE FOLLOWING THE TRAINING OF HUMAN RESOURCES
4. The importance of diffusing and communicating results to experts, scientists, political representatives and the general public
5. In other words the territorial forces, intervening in the protection, promotion and valorization of cultural heritage, generate value not only for the heritage but also benefits for the same territory.

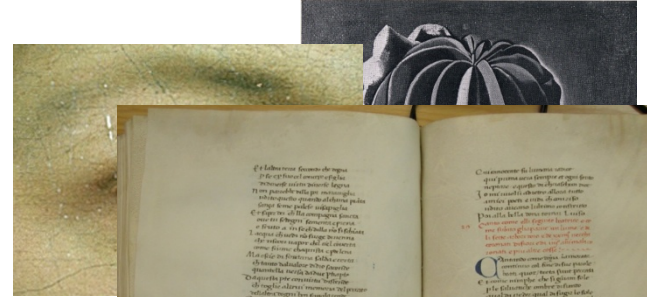
# Conclusion

The last thought is this

# Beauty outside us

# is

# beauty inside us



In relation to this assertion I report (quote), my words in the opening of the Journal «Conservation Science in Cultural Heritage»:

And this is true, if it is true that:

”Perhaps, the greatest challenge one must face up to is that of beauty” .

Because individuality, difference, superiority, excellence is “beautiful”, while everything that is standardization, number, quantity, dullness and normalization is ugly.

How can we have economic development with the “beautiful”?

How can we conserve the “beautiful”, which the past has left us?

How can we continue to create the beautiful, choose the beautiful, diffuse the beautiful and educate people to respect the beautiful?

I think that we can if, from the beginning, there is “beauty” inside us.