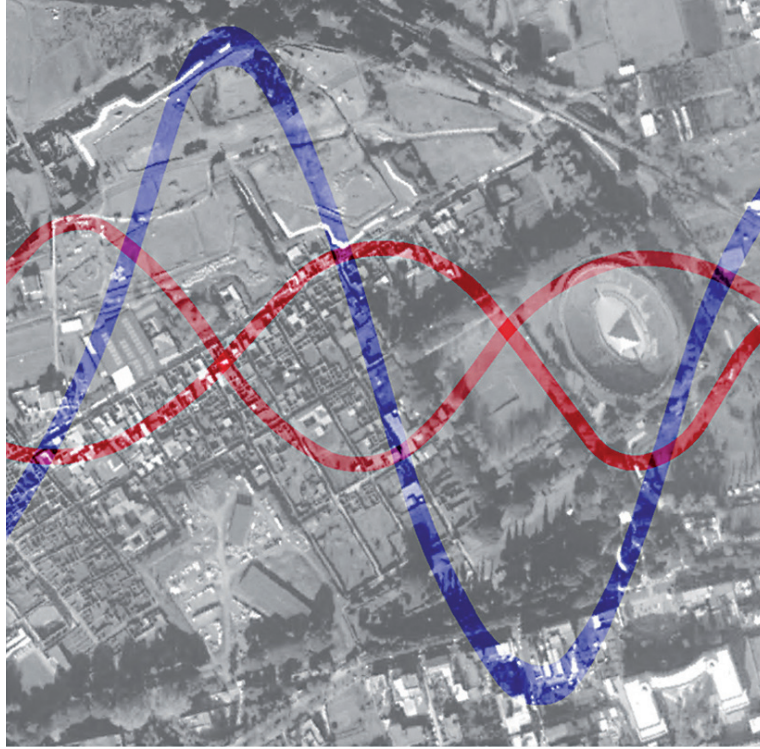


ARCHITECTURE HERITAGE and DESIGN

Carmine Gambardella

XVII INTERNATIONAL FORUM

Le Vie dei  
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# WORLD HERITAGE and LEGACY

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## Preface

*The XVII Forum “World Heritage and Legacy” addresses the issue of the handed down in the sense of transmission over time of generation, at the state of knowledge, the material and immaterial heritage that comes from the past. A generational commitment to operate, in the cyclical temporal process, in order to preserve and protect the cultural heritage; a duty of the present generations to deliver to the future generations the legacy of the past at least in the same conditions in which it is received.*

*A commitment that takes on an even more meaningful significance in a historical moment that is crossed by destructive and iconoclastic wars and by great migration phenomena involving abandonment of territories undermining the identities of places, traditions, material and immaterial culture, which characterize the Cultural Landscapes. A re-appropriation by humanity of the value of a biological continuity that is traceable in its genetic complexity as a custodian and bearer of the memory of the past and, at the same time, belonging to those who live in the future by living the present. Moreover, “to the state of knowledge” should not be interpreted as a limitation but as an exhortation not to live on the position income and above all to remind men that they were not “made to live like brutes but to follow virtues and knowledge”.*

*Knowledge therefore contains an evolutionary value in the history of progress. Where knowledge is substituted by acts or policies conducted by brutal and unreasonable actions against Humanity and its Patrimony, a fracture on historical continuity is created, which produces a negative value due to the great expenditure of economic resources and loss of human values. Therefore, in the awareness that the value produced by the past generations, which have given us and above all entrusted as heritage to be transmitted to the future is not commensurable to the value of time to re-establish and restore continuity to the regenerative space of the common good, it is impossible to activate more and more moments of reflection and I would say to monitor the behavior of supranational cultural policies.*

*This in the spirit of inducing to avoid the disastrous temporal intervals that involve serious losses of the human heritage, which break the glue that binds the generations. Architecture, Cities, Infrastructures and Landscape not only represent the form of time but all the disciplines that have contributed to and contribute to their characterization. The form of time is the body of a cultural program of society and the modification project makes use of the knowledge at the date. Economics, mathematics, physics, in one the sciences are always traceable in the construction of man’s works, from the simple artifact to monumental architectures, to cities, to large infrastructures. In fact, with*

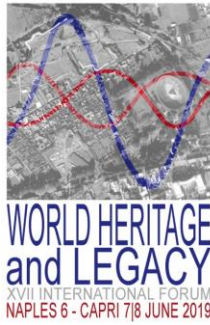
*the previous sixteen editions of the International Forum “Le Vie dei Mercanti” an interdisciplinary community has been created of about 6000 scholars and researchers, coming from over 50 Countries of the World. These have presented realized projects, theoretical research, good practices, technological innovations, which are recognized in the principles and actions to be carried out so that the Planet with its species can always adapt itself to the needs of humanity in a sustainable reciprocal relationship for the salvation of the same Planet. And if Beauty will save the world, the principles and actions shared in these sixteen previous years will find with the seventeenth Forum a moment of evaluation of the state of art so that they can increasingly reach, interest and belong to as many people as possible such as Governments, Institutions, Universities, and Enterprises.*

*This is to create and disseminate a new Humanism that acts as a generational glue through a review of the inheritance concept, or of an ongoing heritage formed by resources intended as lot, which, declined as an income statement, create solidarity, peace, trust, work with art and quality of life.*

*For these reasons and for the history of the Forum, I am sure that the scientific community will establish a debate in Naples and Capri on 6th, 7th and 8th of June which will bring further richness to the discussion among researchers who have faced the protection and safeguard of heritage handed down to us and the researchers who through their works will be the bearers of the future legacy.*

*Carmine Gambardella*

*President and Founder of the Forum*



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## Toward the programmed preventive conservation of the historical-architectural heritage as system and as "*antifragile*" process

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### Abstract

The conditions of fragility to which the built environment and, consequently, the architectural historical heritage are exposed, necessitate the activation of approaches characterized by a greater attention to the relationships between causal links and systems, logically interscalar and interdisciplinary.

It seems increasingly unavoidable the need to arrive at cultural and disciplinary guidelines useful for allowing conservation to come out of the dimension of the extraordinary and finally move towards that of ordinariness; to build more effective organizational and procedural tools for the maintenance of buildings in relation to the multiple factors that characterize each specific urban and territorial area.

The implementation of maintenance processes aimed at preserving the historical and architectural heritage postulate the affirmation of a new design culture that can be based on the "*antifragility*" paradigm for the affirmation of more effective ways of organizing the processes and systems for conservation of architecture.

The essay proposes a methodological reflection on how to conserve the historical-architectural heritage by analyzing the characteristics of programmed preventive conservation as a process and as an organizational system, highlighting how the contribution of maintenance technologies gives specific connotations of "*antifragility*" essential to counteracting the insurgent conditions of "*fragility*" of the heritage.

**Keywords:** Programmed preventive maintenance, conservation, historical-architectural heritage, "*antifragile*" process / system, HBIM.

### 1. Introduction

The increasing aggressiveness of some natural phenomena that create situations of seismic, hydrogeological and environmental risk, as well as those resulting from pollution and harmful emissions that irreversibly compromise our habitat constitute fragile conditions for the constructed environment, determining significant vulnerable conditions in the historical-architectural heritage.

In the historical centres of agricultural and mountain territories characterized by depopulation and abandonment, as well as cities subject to drastic transformations, the situations of risk for architectural heritage are also increased by the fragility of a social and economic context increasingly weakened by an economic and cultural crisis of international dimensions.

The conditions of fragility to which the constructed environment and, consequently, the historical-architectural heritage, increasingly appears to be exposed, makes it necessary to activate approaches characterized by greater attention to the relations between systems and causal links, logically interscalar and interdisciplinary, and suggests openings towards diverse themes and outlooks.

The control of degradation processes can be effectively pursued by implementing an organizational system capable of providing a continuous care process over time, paying attention to the evolution of all possible damage factors. To ensure the survival of the historical-architectural heritage, maintenance technologies must be affirmed as an integral part of the conservation project, a fundamental methodological approach for defining the design choices for a planned preventive conservation.

The implementation of maintenance processes aimed at preserving the historic-architectural heritage, postulates the affirmation of a new design culture that can be founded on the paradigm of antifragility for the affirmation of more effective ways of organizing processes and conservation systems.

**2. Antifragility**

The scholar Nassim Nicholas Taleb introduced the concept of "antifragility" as an important new feature for the improvement of systems and processes [1].

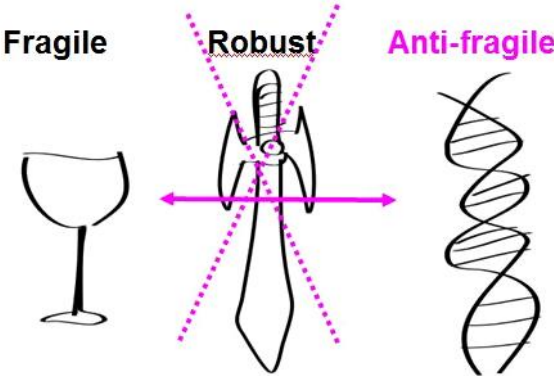


Fig. 1: Fragile, robust and antifragile.

Taleb introduced the neologism of "antifragility" to define the characteristic opposed to "fragility", since the opposite of "fragile" is not, simply, what is "robust". Antifragility is a real quality distinct from those, already known, of fragility, strength or resilience. What is fragile breaks easily; while that which is robust holds up well to blows and does not suffer damage; what is resilient settles into a new, different state of equilibrium; while what is antifragile, when subjected to stress, actually improves its own characteristics: it becomes more resistant.

Antifragility, in essence, is the characteristic of what, through "adverse" events, grows and improves. Therefore, all that is strengthened thanks to the difficulties it encounters can be defined as antifragile. In systemic terms, antifragility could be defined as the characteristic of an autopoietic system in which the structural coupling with the environmental system is particularly effective [2].

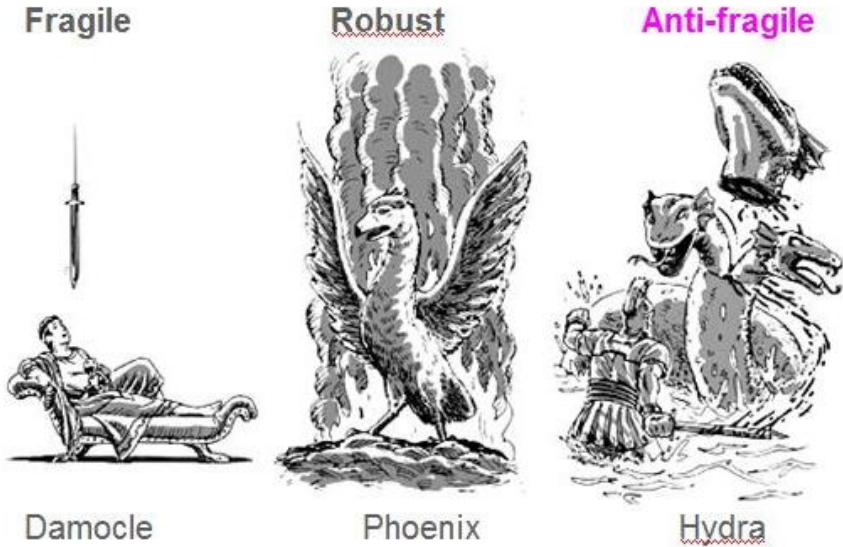
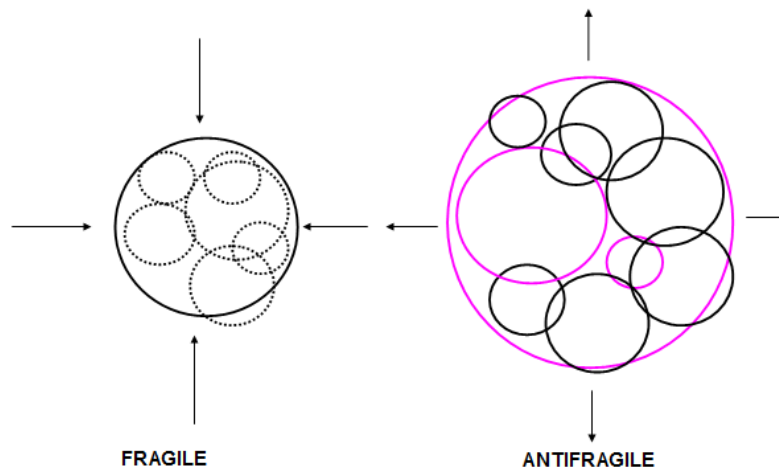


Fig. 2: The sword of Damocles, the Phoenix and the Hydra as examples of fragility, robustness and antifragility.

By opening itself selectively to the external environment, in its dynamic of existence, the antifragile system is the one that is endowed with a powerful ability to develop and maintain a superior internal complexity in relation to changing external complexity.

Capable of performing evolutionary adaptations, when subjected to unforeseen events, the antifragile system "learns" from events and evolves, thus improving, that is, adapting its functionality and structure in order to adjust the correlation between itself and the environment.

The evolutionary adaptation is implemented by sacrificing/developing some of its own characteristics to promptly and better cohere with the changed environmental conditions.



**Fig. 3:** Antifragile system "learns" from events and evolves adapting itself.

Antifragility can be a useful reference if one intends to think of the future not in terms of mere survival under conditions of uncertainty, but of developing new forms of cybernetics of human systems in conditions where events are unpredictable [3].

The notion of antifragility, if attributed to historical-architectural heritage, is evident; heritage, if considered in its generality, is antifragile; if it were not connoted by this characteristic, in fact, it would not have come down to us through the centuries, adapting to changing situations and contexts. On the other hand, individual buildings, always in relation to specific situations, can be fragile and not resist or derive any benefit from changing circumstances and, therefore, when events change, they may succumb. It is possible, therefore, to configure possible elements of innovation resulting from the correlation between the paradigm of antifragility and the processes of conservation, highlighting in these the contribution of maintenance technologies as a factor of antifragility.

### **3. The planned conservation process and *antifragility***

Planned conservation - understood as care that is implemented through the maintenance technologies adopted for conservation objectives - is characterized as a fundamental approach to oppose the fragility of heritage inasmuch as it aims to reduce/eliminate the numerous conditions of vulnerability and exposure.

The introjection of the logic of maintenance also permits a preservative process itself connoted by the characteristics of antifragility, because of the knowledge, understanding and re-appropriation of the systems that are the object of study: these are not abstractly isolated, but in continuous interaction with their environment. It is possible, in fact, to consider conservation as a process essentially aimed at the permanent identification and reduction of any conditions of fragility of the heritage in relation to the evolution of the changing conditions of the context understood as environmental, normative, or customary.

The founding basis of this approach consists in a continuous commitment aimed at knowledge of the "Artefact-Environment System" in its individual components. The cognitive apparatus is constituted as fundamental with regard to the identification of the numerous components to be maintained and in the continuous planning, implementation and verification of the forecasts and results of the interventions, as well as in the permanent adjustment and refinement of the investigation tools and forecasts. Through scheduled and periodic checks, not only can the validity of the measures adopted in the planning phase be evaluated, but also the eventual transformations undergone by the system in the "Artefact-Environment" interaction.



Maintenance renders the preservative process antifragile because it assumes a real cybernetic function with regard to the ability to promptly impart instructions or actions to determine, in the managed systems, the ability to defend, react, or employ some new form of resistance, useful in counteracting the degrading events, whether these are planned or not. Maintenance technologies open the practice of conservation to a procedural approach that shifts interest not only from the restoration event to the temporal sequence of preventive actions but, also, from the single architectural object to the entirety of them, or from the single monument to the entire heritage of a territory [4].

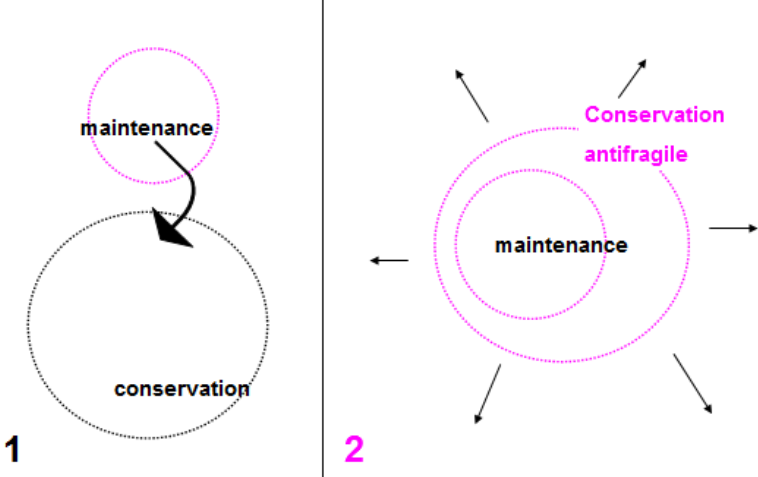


Fig. 4: Maintenance approach allows the conservation to acquire the characteristics of antifragility.

This is obviously an approach for surpassing the culture of restoration understood as an episodic and exclusively reparative event of overt and consistent damage, to the benefit of a new vision of a procedural type, and therefore continuous over time, of a conservation activity aspiring to the realization of the conditions for the survival of the building through a constant attention to the physical degradation factors, the modality of fruition and possible new uses, and the presence of threats in the specific context.

**4. Planned preservation as a system and antifragility**

Besides the processes, the criterion of antifragility can support the development of effective systems for planned conservation.

For Taleb [1], a system, an organization, is antifragile if it is able to evolve. Experimentation, therefore, is constituted as a fundamental element for comparison with a reality in permanent change.

A second important aspect is that the excess of centralization, planning and scheduling expressed by hierarchically overarching organisms, inhibits the spontaneous capacity of reaction, of evolution, and of growth. What is imposed and passed down from above determines fragility; all that proceeds from the bottom up prospers thanks to solicitation, stimulus and stress.

The definition of an organizational structure, of its way of acting and deciding, must therefore be defined by privileging strategies generated from below in an experimental and emerging way. The organization must adopt an evolutionary approach in defining management policies, rules and the organizational model.

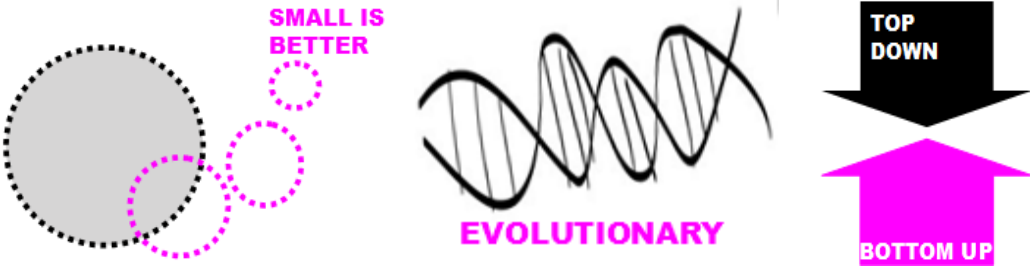


Fig. 5: Characteristics of an antifragile organizational system.



The indications provided by Taleb on how to implement an antifragile organizational system are effectively and generally relevant to all maintenance systems since, by their nature, these are highly contiguous in character to those that are the object of care and implement processes in permanent evolution with regard to the continuous innovations of documentation techniques and tools concerning the characteristics of managed systems, diagnostic technologies and intervention management.

The processes have a bottom-up character, since knowledge is constructed from below, starting from the direct observation of phenomena and their causes. The degree of adequacy of decisions is closely related to the quality of the flow of information that must be permanently fostered [5].

Thus, the dual nature of planned conservation is evident: it is a process, but it is also a system. It takes the form of a process that accompanies the existence of heritage and requires the activation of a system that guarantees the organization and provision of the same. To organize and implement the described process it is, in fact, necessary to arrive at a real "Planned Conservation System", that is, a socio-technical macro-system consisting of two systems in permanent relationship: one, consisting of the heritage of buildings in a specific evolutionary environmental context in which new threats can always be produced, and the other, consisting of the set of organized human and material resources, whose fundamental requirement is the ability to respond promptly and effectively to the needs related to the organization and implementation of the process of conservation.

The management of a complex process of a multidisciplinary nature such as that of planned conservation through the implementation of a system of the type described, characterized by evolutionary capacities, entails the constitution of a new field of work that postulates the cultural evolution of all the operators and that requires consolidated technical skills and new organizational and managerial skills to be combined [6].

If to preserve the existing historical heritage means promoting not only studies, but also the praxis of the approach to planned conservation, it would therefore seem appropriate to prepare not only theoretical but also organizational models for the implementation of planned conservation processes.

## **5. The HBIM for a preventive and anti-fragile planned conservation**

Planned conservation defines criteria, methods and procedures that allow the planning, scheduling and execution of maintenance interventions on monumental architectural heritage; it is a technology that consists of a systemic approach to the organization of processes, referred to the territorial scale as the most minute component, for the prevention of all the possible risks pertaining to the building. The pillar of this technology is knowledge of the building and its surroundings and its updating in relation to the evolution of the dynamics of deterioration or possible damage.

Preservative action postulates a culturally and scientifically determined critical analysis - of reading and interpretation of the artefact and of the phenomena that involve it - whose adequacy is related to the quality of the knowledge on which it rests; this act must be validly and periodically reiterated - regarding the evolution of factors intrinsic and extrinsic to the artefact -, for the definition/updating of the strategies and methods of intervention to be planned with the conservation project.

The preservative intervention, in fact, must be founded on scientific data acquired through the use of the most appropriate means that the evolution of technologies makes available, taking into account the interdisciplinary character of the problem.

The need to know and document the historical heritage, in fact, is contrasted with a wide spectrum of possible characterizations of elements, parts, dynamics, relationships, assuming the implementation of multidisciplinary studies whose results must lead to the certain identification of the necessary conservation measures attuned to the aspects of static and structural consolidation or the integrity of the components and of the construction material and, where possible, reduction/elimination of all possible risks linked to the context.

In recent years, at the international level, an increasingly widespread use of BIM (Building Information Modeling) systems of the HBIM type (Heritage Building Information Modeling) have been implemented, whose uses in the field of conservation suggest interesting new developments in the direction of the antifragility of systems and processes of conservation in the direction described. In fact, research in this field is aimed at determining methods and tools useful for creating digital archives of data relating to the geometric and morphological description of the factory, the articulation of the components of construction with the related material information, the analysis and the resulting studies from diagnostic processes.

One of the most interesting topics of research currently underway regarding innovation in the field of HBIM modeling systems is the creation of tools capable of bringing the management and control of the conservation process onto interoperable platforms, further enhancing the ability to plan heritage conservation through the exchange and sharing of data between the various operators who also intervene in the process on a territorial basis. This result can be implemented through the design of advanced and integrated design tools, based on the BIM and GIS systems.

The GIS system could permit the extension of the value of the planning data of digital Heritage Building Information Modeling through the visualization and analysis of the structures involved in the context environment with different risk scenarios; the aim of this would be to create an antifragile conservation model for a more effective implementation of the process.

The integration of BIM and GIS could in fact allow a more in-depth and relational view of the phenomena of risk in order to generate a better process of decision-making, communication and understanding with regard to the conservation of monuments.

## 6. Conclusions

The conservation of the historical heritage intended as the prevention of degradation is now recognized and shared as the approach that allows the preservation of the authenticity of cultural heritage. It is now possible to observe a widespread and increased attention towards "planned conservation" as a priority-area of applied research.

The implementation of a reflection on the correlation between the paradigm of antifragility and planned preventive conservation would seem to be able to support the development of more effective management systems/processes by deploying, for each product and for the entirety of them in a given context, an approach aimed at studying, observing and measuring the conditions for the antifragility of conservation, in order to reach the identification and analysis of all possible sources of risk and corresponding forms of prevention and protection.

Elements of reflection are related to the implementation and strengthening of HBIM systems for the improvement of the effectiveness and efficiency of choices and actions for the antifragility of planned conservation as a process of forecasting and planning strategies, projects and conservative actions that concern the small as well as the large scale for the continuity of the historical architectural heritage.

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