

# Evaluation Methodologies of Earthquake Damages to Cultural Heritage

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## Abstract

The identification of adequate evaluation methodologies of earthquake damages to Cultural Heritage is a highly topical subject, considering the frequency and intensity of the seismic phenomenon, in recent times, in Italy (the latest is the earthquake of August 2017 in the island of Ischia, in the Metropolitan city of Naples, Campania Region). The subject is related to the broader theme of the attribution of a "monetized" economic value to the cultural assets, widely investigated in the appraisal and evaluation Italian disciplines. In this perspective, the article aims to verify the principles and evaluation methods for the monetary assessment of the damages caused by earthquake disasters. Starting from the definition of cultural assets as in the Italian legislative system, the article highlights the characteristics and several values of cultural assets (section 2); it then defines, in a systematic way, the damage and its differentiation (section 3), subsequently discussing the main damage evaluation approaches (section 4); some conclusions end the article (section 5).

**Keywords:** Earthquake Damage, Cultural Heritage, Economic Evaluation

## INTRODUCTION

At a European level, Italy is one of the countries most exposed to natural hazards due to its typical geological and geomorphological conformation; it is in fact subject to various types of hazards (seismic and volcanic hazards, landslides and flooding). In accordance with the Civil Protection Department, Italy is also one of the Mediterranean countries with the highest seismic risk due to its particular geographic position. This results in the significant dynamism of its territory that is at the basis of earthquakes and volcanic eruptions [1]. The highest seismicity is concentrated in the central-southern part of the peninsula, along the central Apennine region, which recently, as it is sadly known, has experienced several major earthquakes.

Generally, an earthquake not only can causes grave risk to human life, but also heavy damage to physical structures and infrastructures as well as historical buildings, monuments and cultural assets, widely consistent in all of the Italian territory, such as the many UNESCO sites. With specific reference to this last, if in Europe 16% of UNESCO sites fall in zones with high seismic degree and the 62% in zones with low seismic

degree, for Italy the scenario results overturned, with 28% of the sites in zones with high seismic degree and only 16% in zones with a low seismic degree [2].

The effort to identify adequate evaluation methodologies of the damage suffered by cultural assets in consequence of earthquake disasters, leads back to the broader theme of the attribution of a "monetized" economic value to the cultural assets, widely investigated in the appraisal and evaluation Italian disciplines. From a methodological point of view, in fact, for the evaluation of damage, the difference must be operated between the value of the economic good object of appraisal, assuming the absence of the damaging event, and the minor value subsequent to the same event.

Since it is logically impossible to determine depreciation without the preventive determination of the initial value, it follows that, methodologically, for the evaluation of the damage suffered by the cultural asset the determination of the economic value of the same asset necessarily occurs.

In other words, the principle at the base of the identification of the measure of the damage is the "with/without" principle: it is necessary to identify and measure all the alterations between the situation after the earthquake and the hypothetical situation existing if the disaster had not occurred.

As cultural assets, due to their characteristics, cannot always be monetized, also for the damage evaluation, there is reference to their categories of value estimable through several evaluation approaches. In this perspective, the article, starting from the definition of cultural assets as in the Italian legislative system, highlights the characteristics and several values of cultural assets (section 2); it then defines, in a systematic way, the damage and its differentiation (section 3), subsequently discussing the main damage evaluation approaches (section 4); some conclusions end the article (section 5).

## CULTURAL ASSETS: CHARACTERISTICS AND VALUES

According to the Italian legislative system, cultural assets belong to the Cultural Heritage which, as in article 2 of the Italian Code of the Cultural and Landscape Heritage (L.D. n.42/2004), consists of cultural property and landscape assets. Cultural property are immovable and movable things

belonging to the State, Regions, other territorial government bodies, as well as any other public body and institution, as well as private non-profit associations, which possess artistic, historical, archaeological or ethno-anthropological interest and any other thing identified by law or in accordance with the law, as testifying to the values of civilization.

Cultural property also includes, when the declaration of cultural interest intervenes, immovable and movable things of particularly important artistic, historical, archaeological or ethno-anthropological interest, which belong to subjects other than those previously indicated.

Further, cultural property are immovable and movable things, to whomsoever they may belong, which are of particularly important interest because of their reference to political or military history, to the history of literature, art and culture in general, or as testimony to the identity and history of public, collective or religious institutions. Among the things previously indicated are included villas, parks and gardens possessing artistic or historical interest; public squares, streets, roads and other outdoor urban spaces of artistic or historical interest.

For the purpose of this article, it is possible to classify immovable cultural assets in the following categories: monuments; historic buildings or dwellings located in historic centers, churches registered as historical heritage, museums, archeological sites. Among this classification, it is possible further to classify public historic heritage buildings, including historic assets declared as such that are the property of the state and private historic heritage buildings, whether owned individually or by foundations.

This broad range of immovable cultural assets, are also "economic goods" for their characteristics of utility, considering their capacity to satisfy particular types of learned needs (nowadays, in the knowledge economy, perceived increasingly); accessibility and limited availability or uniqueness [3].

In the same time, cultural goods differ from other goods because they possess not only private but also public goods characteristics (non-exclusive and non-rival character). In other words, not all cultural goods are either purely private or purely public and many of them fall into a category of "quasi-public goods". Further, cultural assets can also be treated as a "merit good", which, according to Cwi is a good that «some persons believe ought to be available and whose consumption and allocation are felt by them to be too important to be left to the private market»[4].

As well highlighted by Carlo Forte in the 1970s [5], many cultural assets owned by private subjects can be object of exchange and for them it is possible to forecast a market price. Also for the cultural assets owned by the state, despite their juridical regime of «unsaleability», it is possible to hypothesize an exchange and, then, it is possible to appraise a market value (hypothetical date), independently from the effective exchange that could occur and from the consequent market price (historical data).

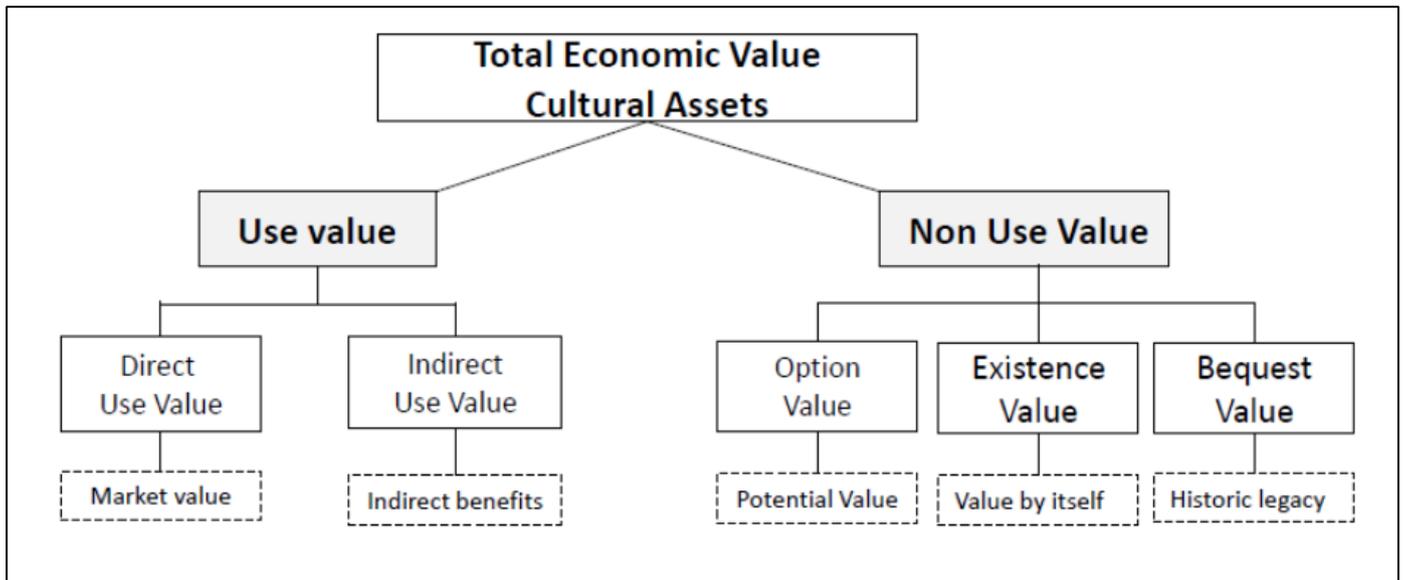
Ultimately it follows that for the majority of buildings with historical, artistic or environmental characteristics, there is or can be a hypothesis of a demand and, then, a market. Therefore, the evaluative problems which arise about the architectural cultural assets can well concern the determination of the market value, placing themselves within the typically methodological questions of appraisal [6,7,8].

At the same time, the author, recognizing the utility which, directly or indirectly, can be deployed by the immovable cultural assets for the benefit of the overall community, identified the "social use value", different from the exchange value, as the appreciation which the community express for that cultural goods on the basis of their social utility and collective availability. He also suggested several methodological approaches for the appraisal of the "social plus value" of the cultural assets (deriving from the difference between the social use value and the exchange value). Starting from these assumptions, Carlo Forte dealt with the evaluation of the damage to cultural assets as a consequence of the tremendous earthquake disaster in Friuli Venezia Giulia in 1976 [9].

Successively, several further values for the historical and cultural heritage were identified, improving and detailing the components and different categories of the users. The approach to Economic Conservation by the Neapolitan School of Monuments Restoration [10] has found convergence in the main scientific studies at European and international levels. At both these levels, in accordance to CHCfE «the past few decades have witnessed main conceptual and policy developments which have recognized the multiple and valuable benefits that cultural heritage brings at society as a whole» [11].

In this perspective, the common approach towards the economic value incorporated into cultural assets has to the "holistic" one, which recognizes that cultural assets possess both cultural and economic values, categorized according to their use and non-use characteristics; this approach has been verified also for the "new architectural assets" characterized by the interaction between creativity, beauty and innovation and expression of the contemporary age [12,13]. In Figure 1 several typologies of values are schematized, based on the studies provided by different authors, but not exhaustive, with there being many different interpretations on the overall value of cultural heritage (as the extensive open debate on intrinsic value).

As highlighted in current international scientific literature, the non-use value of a cultural asset constitutes an important component of its total value and it is the most difficult to assess, despite several evaluation methods being put forward; some of them refer to the 'willingness to pay' concept (under both the conditions of existence or not of a market). In any case, each one of them presents advantages and limits, as shown in section 3.



**Figure 1:** the several values of cultural asset

### THE DAMAGE AND ITS DIFFERENTIATIONS<sup>1</sup>

In literature, the term damage presents several definitions, each one enounced with different aims in relation to the specific problematic area. However, the different definitions substantially converge toward a common interpretation of the term, summarized as follow: damage is any “economic prejudice which resolves itself in a patrimony decrease for a determinate subject and occurs as consequence of any human matter of a fortuitous event” [15].

On the basis of this definition, the main elements constituting damage seem to be the following:

- i) an event attributable to the human conduct or to accidental events;
- ii) a change for the worse or a detriment in the economic consistency of a certain good;
- iii) a subject titular of the good which suffers injury.

Such elements assume different characteristics on the basis of the typology of prejudice concretely examined. To this last results in fact subordinated the specification both of the nature of the damaging event and the effects which the same event is able to produce in relation to the characteristics of the goods and the subjects affected.

In the specific case of prejudices deriving from an earthquake, a form of natural disaster caused by environmental factors, various types of damage result, both directly and indirectly. Among the several classification proposed, it seems useful to start from a basic distinction between private and public damage.

<sup>1</sup> This section is substantially developed with reference to the volume of Del Giudice V. and Salvo F., *Principi e metodi di valutazione dei Danni da esondazioni fluviali* [14].

### Private and public damage

Damage can be private or public and the characterization does not depend on the juridical nature of the good which suffers the prejudice (private good or public good) but only from the perspective of the analysis from which the prejudicial actions inducted by the event are observed.

Damage, both to a private and public good, may consist both in a lesion of private or subjective interest (private damage) and in a lesion of public interest (public damage). If the good affected by the damage is private, the damage presents itself under the dual aspect: a) the worsening of the economic-productive characteristics of the good and consequent impairment of the real right belonging to the owner of the good; b) the disadvantages resulting for the entire community for the damage of a super individual interest, damage deriving from the compromising of the cited real right.

This happen also when the object affected by the event is a public good in a strict sense (pure public good) or a private good, which, playing both private and public functions, appear as a mixed good.

In such cases, private damage regards the patrimonial loss and/or not patrimonial (as example, physical and psychic damages) suffered by the single individual member of the community or also, if the object of the damage is a mixed good, by the individual to which juridical has to be attributed the property of the good. Public damage, instead, consists of the prejudice which the event causes to the overall community.

### Physical and monetary damage

Damage, private or public, can be represented both in physical and monetary terms. In the first case, it is expressed in the form of the modification of the quantitative/qualitative attributes of the good affected by the event (physical damage).

In the second case, the modification is translated into a monetary expression, reducing to a common measure the several physical aspects of the damage (monetary damage).

Generally, the determination of the physical damage precedes the quantification of the monetary damage. This is obtained by applying to the procedures of the physical damage, and that is to the variations of the quantitative/qualitative consistency of the good, the unit prices of the compromised resources. These prices have to reflect the effective grade of utility of the resources from the point of view of the subject or the community of subjects to whom is referred the quantification of the monetary damage.

### **Economic, material and financial damage**

Monetary damage is economic when it expresses the modification suffered by the capital stock and by the flow of the incomes. Economic damage assumes the dual form of: a) loss of value regarding a certain capital stock (*damnum emergens*) and b) alteration or interruption of a series of future incomes (*lucrum cessans*). The first form can be traced back to the amount of the expenses required to eliminate or contain the harmful effects; the second reflects the diminution of the utility consequent to the worsening of the qualitative/quantitative characteristics of the damaged good [16].

The cost to be sustained for restoring the damaged good represents the material damage, while the financial damage equals the present value of the missed future revenues. Economic damage may also refer to eventual lesions or disablements of the physical integrity of the person, as suggest the juridical principle that the right to health is an integral part of the individual patrimony.

### **Tangible damage and intangible damage**

Generally, the damage deriving from an earthquake manifest itself as:

- i) variation in input (increasing in costs) and/or output (decrease of revenues) related to the economic activities which have been hit by the earthquake;
- ii) losses of well-being suffered by the community located in the territory after the earthquake.

The first type of damage is consequent to the productive resources detriment; the second results from the alteration of the environmental and cultural resources.

Damage to the productive resources, since it can be expressed in monetary terms, starting from the market prices of the damaged goods, are usually indicated as tangible damage. The damage to the environmental and cultural resources are defined as intangible damage as well as extra-economic damage, since it does not result directly expressible in monetary terms, for their extra-mercantile nature.

### **Primary damage and secondary damage**

Tangible damage can be subdivided into: primary damage (or direct) and secondary damage (or indirect). Primary damage is a direct consequence of the event itself. It mainly consists of: i) the disruption or degradation of property and structures; ii) the loss of revenues; iii) the costs which have to be sustained for eventual emergency measures to activate in recurrence of the earthquakes.

Secondary damage is the indirect effects which involve the productive components of the macroeconomic system. These effects involve not only the "internal" sectors of activities in the territorial context affected by the earthquake, but also the "external" sectors which use the outputs which derive from these.

### **Preventive damage and consumptive damage**

The evaluation of the damage can be elaborated in a preventive way (ex-ante evaluation) or in a consumptive way (ex-post evaluation). In the first case, the evaluation concerns the forecast of the measure of the damage deriving from a certain hypothetic event; in the second case, it is necessary to ascertain the measure of the damage consequent to a certain event concretely occurred. Hence, the damage is preventive when it is evaluated at an initial moment of the time horizon where the event happens. On the other hand, the damage is consumptive when the evaluation is elaborated at a final moment of the time horizon. The determination of the preventive damage has to be developed through the comparison between a real anterior situation and a posterior hypothetic situation.

The consumptive damage has to be verified through the comparison between an anterior hypothetic situation and a real posterior situation.

### **Compensable damage and not compensable damage**

Regarding the matter of the compensation of damage, article 2043 of the Italian civil code says "Any malicious fact or culpable which causes an unjust damage to others, obliges the one who has committed the fact to compensate the damage". Elements of the compensation are: i) a malicious or culpable fact; ii) an unjust damage; iii) the causal link between the fact and the damage.

As malicious or culpable fact is understood a human conduct which can consist in an action or in an omission attributable to the will of its author, also when it happens under the "threshold of consciousness" of the same author. When that condition does not exist, it is evident that the obligations of damage compensation do not rise for any subject. It follows the impossibility to frame inside the compensation matter the damage induced by a natural disaster as the earthquake.

## THE EVALUATION OF DAMAGE: DIRECT AND INDIRECT APPROACHES

Generally the damage which cultural assets have incurred as a consequence of earthquake disasters can be divided into two groups: the first includes the material damages, for example the collapse and damage of the physical structure for the shock caused by the earthquake and the loss and deterioration of the art pieces, contained in them [17]. The second group of damage is linked to the relationship between the cultural assets and the community settled in the affected territory.

Usually, the methodology for the monetary evaluation of the damage proceeds through the preliminary definition of the physical effects inducted by the event. The successive phases of the evaluation methodology consist of researching the prices to apply to the physical damage, or the modification of the physical attributes of the assets which suffer prejudice.

The nature of these prices (market prices, shadow prices or accounting prices) varies in function both of the type of the assets damaged (immovable cultural property or environmental resources) and the perspective from which the evaluation is elaborated, from private or the community.

In the private perspective, the evaluation of the damage is based on the market prices. The existence of a market makes it possible to assess the direct damage suffered by the immovable cultural assets. The main procedures under the hypothesis of the existence of a market are developed by the orthodox appraisal discipline, as the market prices approach; the costs approach (replacement cost) and the income capitalization approach.

When the perspective is public, the market prices cannot be used because they do not reflect the effective grade of utility attributed from the community to the damaged resources. The main reasons are: the level of imperfection implicit in the real markets and the presence of externalities.

For the evaluation of public damage, the market prices have to be substituted by the shadow prices, able to reflect the social value of the damaged resources. At a theoretical level, the shadow prices should be measured on the base of the marginal costs which the community sustain for the use of the resources. The shadow prices are obtained "depurating" the markets prices from the aliquots which represent utility effects for the overall community.

As mentioned in section 2, cultural assets represent a special category of good, mostly not traded on the market; therefore, in the absence of a market, the damage to the cultural assets has to be evaluated indirectly. In this perspective, several methods have been developed, some of them deriving from Environmental Economics and are based on the willingness to pay concept, rooted in behavioural economics. As it is known, the willingness to pay reflects the individual utility functions and it is anchored to the individual wellbeing variation, as in the Hicksian welfare theory.

This variation can be expressed in the form of equivalent or compensating variation of the monetary income. Regarding the evaluation of the damage, the equivalent variation allows

to express the income deduction occurring for avoid the wellbeing decrease consequent to an hypothetic event (ex-ante evaluation). The compensating variation, instead, is used to express the income deduction occurring for taking back the individual to the wellbeing level pre-existent to an event concretely occurred (ex-post evaluation), as in the Italian praxis. Here, in fact, contrary to other European countries, in the case of natural disasters, the evaluation of the damage is based on government funding deliberated after the occurrence of the disaster. The main consequences are the uncertainty of the entity of the effective compensation achievement and the scarcity of incentives for prevention investments.

From an operative point of view, among the evaluation methods based on the "willingness to pay" and, then, the amount of the damage to cultural asset, it is possible to distinguish "revealed preference" and "stated preference" methods. Revealed preference methods, such as hedonic pricing and travel cost, draws data from reviews of actual choices made by individuals in the real world.

The hedonic prices method is based on the fact that the prices of goods in a market are functions of their characteristics; through statistical techniques the method tries to isolate the implicit price of each of these characteristics [18,19,20]. In accordance with Vecvagens [21], the use of the hedonic pricing method in the damage assessment of cultural assets can be limited to places where detailed data (historical prices) and information on the residential property are available. Furthermore, this method does not capture non-use values of the cultural assets.

The travel cost method seeks to put a value on the individuals' willingness-to-pay for a cultural asset, by the overall costs incurred to consume it. The method measures the value of the cultural asset beyond to the price effectively paid using concrete information, but, as in the hedonic pricing, it only assesses the use-value and not the non-use one (existence, bequest, etc.). The use of this method in the damage assessment of cultural assets, as Vecvagens highlights, can be limited to countries and places where the data on the total expenditure of visitors are available and has been collected prior to the occurrence of the damage. The stated preference methods, such as contingent valuation, collect data from people responses to a hypothetical market in order to estimate the individual's willingness to pay for the non-market good.

The contingent valuation method, the most frequently used both in the evaluation of the environmental and cultural assets, aims to elicit people's intended future behavior in the markets by revealing individual preferences, in monetary terms, for a non-market good or service [22].

With this method, the absence of a concrete market value for the cultural assets is replaced by imagining a hypothetical market and its focus is on real choices and implied willingness-to-pay. Even if this method allows to evaluate the non-use-value of non-market goods, it results complex to apply (being the most controversial one). Regarding the damage evaluation of cultural assets, Vecvagens suggests how the contingent evaluation method can be very useful in assessing the total value of the damaged asset; use of

hypothetical scenarios helps to better construct possible alternatives and reconstruct the damaged cultural asset for the respondents.

Further, exist several cost based valuation methods, as replacement cost, that estimate value based on costs of replacing, restoring or substituting goods, assuming that the value of cultural assets is equal to such costs. Even if this methods often underestimate the total value of the cultural assets, they are frequently used for post disaster damage evaluation.

Finally, for the evaluation of the indirect damages, the economic impact studies occur, assessing the economic significance of a cultural asset/service based on the direct and indirect income that it generates. There is a wide variety of cultural impact studies that use different approaches [23]. The most well-known and implemented is the input-output models. In general terms, these models estimate the way in which money spent on cultural heritage may stimulate actions and flows of financial resources in other areas or sectors bringing additional income or development to a given place: the multiplier effect. Regarding the specific issues of evaluation of indirect damages to the cultural assets, this model of analysis can be used for the estimation of the consequences which on the cultural heritage can have the losses of output verified in a certain sector hit by the damage.

## CONCLUSIONS

Cultural assets, due to their characteristics, cannot always be monetized and for the damage evaluation occurs referring to their different categories of value (use and non-use values). As the article has highlighted, many evaluation methods are available to assess the different values of cultural assets, each one with its strength and weakness. In Italy, many of these methods are implemented in the academic world, while the praxis which characterizes the Italian political system in the case of earthquake disaster, is mainly based on the replacement cost method (ex-post evaluation).

For example, regarding the recent earthquake that shook Central Italy in 2016, according to the Civil Protection Department, the total monetary amount of damage has surpassed € 23.53 billion. This figure includes the emergency costs and an estimation of the damages to the infrastructure, private buildings, cultural assets, public buildings, and the production system, both for the agro-industrial sector and livestock. In accordance with the MIBACT (Minister of Cultural Heritage), there are 293 immovable cultural assets collapsed or gravely damaged only in the most restricted area; the total value (use and not-use) of each one of this cultural asset obviously exceeds the total replacement or restoration costs.

Beyond the issue of the cultural assets, in Italy, the respect of the budget constrains does not allow to have sufficient economic resources to prevent catastrophic effects consequent to earthquakes or other natural disasters, becoming the *ex-ante* evaluation methods, as the defensive expenditure one, particularly adapt. It has been discussed for years an assurance

system against the natural disasters, as in other European countries, which could incentive a correct prevention approach. The insurance premium should be fixed in function of the risk which depends on from the historical and artistic value of the buildings. This perspective should open new research frontiers for the appraisal and evaluation disciplines.

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