Disasters and Cultural Heritage: planning for prevention, emergency management and risk reduction

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Abstract. The need to investigate the topic of risk management of cultural heritage and to work on the regulatory framework relating to its protection and enhancement become even more urgent in light of the recent seismic events that hit the Italian territory. The current emergency planning methods against natural or human-induced hazards have proven to be deficient. Reflecting on the way we normally conceive the cultural assets, the question is not only how to protect our heritage, but how to shift our perception to conceive it as a positive asset, and not only a responsibility. Cultural heritage is not only a document of the identity of a community and a territory, but it can also be the keystone for reconstruction and building resilience to disasters. Starting from this awareness, this paper introduces a methodology for the analysis heritage sites aiming at proposing risk reduction strategies that consider the participatory dialogue between different professional figures. The approach is based on the consolidated methodological framework identified by UNESCO, ICCROM and ICOMOS. The study entails a preliminary evaluation of the most hazardous events, threats and risks that can impact on the heritage values. By considering a worst-case scenario, the procedure allows for modelling and stressing the post-event resilience of the site or cultural asset under consideration. The results of the investigation highlight the potential of this procedure in practical terms. In fact, its adaptability to different scales and contexts responds to the common need of a rapid, integrated methodology for risk assessment. Finally, the paper discusses the current prevention policies involving cultural heritage, focusing on the need to balance conservation and active protection issues to those of safety.
1. Introduction

With a high number of UNESCO World Heritage Sites (WHS) and a century-old artistic tradition and history, Italy has a rich cultural heritage and can also be considered as an “open-air art” thanks to its natural landscapes and historic centers. This massive cultural presence gives an extraordinary tourist vocation to the country. However, in recent years the effects of the economic crisis have worsened the general conditions of national cultural heritage (CH) despite the need of incentives for its integrated development. The lack of funds in the infrastructure sector, especially in the southern regions, the unemployment, the low incomes, the weakness of the production system, the limited access to new information technologies and communication, have significantly contributed to neglect the preservation of cultural assets causing their isolation and, often, decline. In a sort of chain reaction, the abandonment of the territory has produced devastating effects, with an alarming increase of vulnerabilities to natural and man-made hazards affecting cultural heritage [1].

Learning from the difficult post-earthquake reconstruction in Central Italy, the national programmatic framework aimed to reduce disaster risk on CH, addressing several multilevel issues:

- regulations, deriving from a stratification of rules and competences that generate operational confusion and excessive bureaucratization;
- applications, resulting from the lack of effective intervention tools (e.g. plans, projects) that require a shared linguistic and procedural code.

Efforts aimed to develop regional databases, such as Information System for the Seismic Risk Assessment (SIVARS) proposed by the Ministry for Cultural Heritage in 2007 [2]. It is a rapid procedure that allows for evaluating the physical vulnerability by means of a first-level assessment method which is useful for addressing further in-depth analysis and for planning mitigation interventions. Despite the drawbacks of the procedure, the SIVARS represents a valid starting point for the knowledge and safety of CH and could be further developed. On the programmatic-operational front, the “Casa Italia” project promoted in April 2017, after the 2016 earthquake, responds to the need for improving the culture of prevention throughout the country in a structural and non-emergency way. For example, it is working on a large-scale database regarding the quality of the natural and built environment that could be used for a capillary identification of risks [3]. From the procedural point of view, several procedures and methodologies for the management of CH at risk have been proposed by international bodies, such as UNESCO, ICCROM, ICOM and ICOMOS/ICORP.

This contribution adopts an integrated methodology for the assessment and management of CH sites based on the experience of the aforementioned international actors. The application have been developed in cooperation with the Institute of Disaster Mitigation for Urban Cultural Heritage (DMUCH) of the Ritsumeikan University, within the International Training Course in Kyoto. The case study regards the Palatine Hill in Rome and aims at proposing intervention measures for the WHS, in compliance with current strategies for disaster risk reduction (DRR).

2. Methodological framework

The study is based on two interwoven phases that consist in the evaluation of risk in the site and the identification of a set of strategical actions for risk reduction. One of the main challenges is to link the risk assessment to the risk management phase, hence establishing multi-level policies and mitigation measures to improve prevention activities into CH sites [4, 5].

In modern risk analysis, risk is a mathematical probability depending on three main measures: hazard, vulnerability and exposure [6, 7, 8]. Hazards are natural or man-made phenomena that have the potential to cause disruptions and depend on the geographical location of a given site. A growing body of literature is considering and developing multi-hazard approaches that include...
cascading effects or interactions between different events [9, 10]. The complexity of the proposals is affected by the choice to use of a qualitative, semiquantitative, or quantitative procedure for risk assessment. One of the main models for multi-hazard evaluation is the American HAZUS that allow for estimating losses in case of occurrence of a variety of natural and technological hazards. Moving on to the other causal factors, risk involves different types of vulnerabilities that can be categorised in physical, functional, socio-economic, and political. Literature on CH mainly refers to physical vulnerabilities that measure the liability to damage of buildings, and infrastructures at different scales (national, territorial, urban, building) [11, 12, 13]. However, little attention is given to the evaluation of sociocultural values, both tangible and intangible, of CH [14] whose importance is paramount for any resilience-enhancing intervention planning. Finally, exposure refers to people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

In this research, risk is assessed by means of a qualitative procedure that allow for including the different dimensions of vulnerability into the investigation. It is an expert-based evaluation on perceived risk that have great potential in bridging the gap between the disciplines of risk analysis and heritage studies. The necessity to conduct a rapid evaluation and to focus on the management of the CH site justifies the adoption of a qualitative risk assessment procedure [15]. Besides, any attempt to quantify losses or potential damage is affected by great uncertainties that may hinder the effective implementation of DRR actions. In this framework, literature illustrates risk management as a cycle in which each step corresponds to a temporal phase: before, during, and after the hazardous event [16].

In detail, the methodology for the resilience-oriented management of CH sites comprises the following steps: (1) multi-level CH site analysis; (2) value assessment and identification of the specific attributes of CH; (3) identification of hazards, vulnerabilities and impacts with reference to the set of exposed attributes; (4) definition of a reference multi-hazard risk scenario; (5) intervention planning for DRR and monitoring at all stages; (6) stakeholder mapping and analysis. These steps are summarized in figure 1, and the following sections will further describe the materials and methods adopted in each phase.

![Figure 1. Methodological steps for the resilience-oriented management of CH sites.](image)

### 2.1. Multi-level CH site analysis

The first step of the methodology consists in a detailed situation analysis to establish the context and characterise the site at the territorial, urban and building scales. A preliminary analysis of regulations is important to understand the legal restrictions in the area. Moreover, historical and constructive data should be incorporated into the risk assessment and management, combining different disciplines (risk analysis, engineering, architecture, heritage conservation, sociology and urban studies) in order to base scenarios on realistic conditions. The basic information that should be collected can be summarized in: (i) location and identification; (ii) context analysis including topography, accessibility, services; (iii) physical characteristics of the site, ranging from territorial to building features; (iv) infrastructure and services, such as sewage, drainage, water supply, electricity, roads, or visitor facilities.
2.2. Heritage attributes of the site

The value assessment of CH is based on an in-depth analysis of the specific attributes of the site that contribute to its authenticity. As discussed by Boccardi [17], practitioners and researchers are showing an increasing interest in the notion of authenticity, but its definition may be ambiguous. Building on the reflections included into the Venice Charter (1964), the Nara Document on Authenticity (1994) specifically refers to “the ability of heritage to convey the importance of its cultural significance” [18]. It is the first official report that recognises the multiple aspects of authenticity which “may include form and design, materials and substance, use and function, traditions and techniques, location and setting, and spirit and feeling, and other internal and external factors” (art. 13). Overtime authenticity has gained more attention becoming one of the criteria for the recognition of ‘outstanding universal value’ by UNESCO, as emerged during the 2003 Convention on Intangible Cultural Heritage. The concept can be adopted in risk-related studies for the analysis of the most relevant attributes of the site, according to the Nara Grid developed by Van Balen [19]. An attribute is intended as any well-defined part of the site with characteristic heritage value. Particularly, the grid evaluates two set of features of the CH site. First, the “aspects” that are subdivided in: form and design; materials and substance; use and function; tradition, techniques, and workmanship; location and setting; spirit and feeling. Then, each category is evaluated according to its artistic, historic, social and scientific dimension, referred to as “dimensions”.

2.3. Assessment of hazards, threats and vulnerabilities for the definition of risk scenarios

The step moves from the identification of the main hazard on a fixed site, hereinafter called primary hazard, which is associated to one or more secondary ones. This multi-hazard approach is based on the analysis of any hazardous event that is likely to be triggered by the occurrence of the most critical hazard in the area. Basic materials for the analysis are geological and hydrogeological maps of the region of the CH site, as well as micro-zonation hazard maps reporting specific areas that are prone to various hazards such as earthquakes, floods, cyclones etc. Furthermore, past events provide important information on hazards and threats, hence the history of natural and human-induced disasters should be collected.

Vulnerabilities result from the critical analysis concerning the impact of primary and secondary hazards on the previously selected attributes of the CH site. Then, one or more disaster risk scenarios can be elaborated assuming the worst-case condition for each attribute. Hence, there is a close relation between risk analysis and heritage studies because attributes provide a prioritization criterion for interventions.

2.4. Intervention planning for DRR

When approaching an integrated risk management, any intervention is planned based on the DRM cycle [16]. Risk mitigation measures can be classified in three groups: (a) strategical and institutional, including the funding, education and networking activities; (b) technical, which are structural, non-structural or material measures; (c) management and planning, referring to organisational regulations or procedures to implement over time.

2.5. Stakeholder mapping and analysis

The role of stakeholders in managing heritage-related issues has been recognised since the adoption of the Faro Convention [20] in 2005 by the Committee of Ministers of the Council of Europe. Besides, this aspect has been further developed in the international recommendation on Historic Urban Landscape [21] for the preservation of tangible and intangible assets through inter-institutional cooperation and bottom-up approaches.

The stakeholder analysis aims at identifying the actors of the decision-making process in order to guarantee the effective implementation of DRR measures. A commonly accepted definition of
a stakeholder refers to a person or group of people who have a vested interest in the development of a project and is affected by its success. Assuming that CH management should not be made in isolation, the process presupposes the involvement of individuals and organizations that have the right of decision and can play a role in the preservation of the attributes.

3. Case study: Palatine hill in Rome

3.1. Site analysis
Rome has its origins on the Palatine Hill that hosts the most ancient parts of the city. The first traces date back to the 10th century BC, and it was the residential area of affluent Romans during the Republican period. Under the Empire (27 BC), Augustus destined the area to his private House, and the hill gradually became the exclusive domain of Emperors. The ruins of the palaces owned to Augustus (27 BC – 14 AD), Tiberius (14 – 37 AD) and Domitian (81 – 96 AD) can still be seen here. From the 16th century the hill belonged to the Farnese family and was occupied by the Horti Palatini Farnesiorum, or Gardens, that are partially preserved above the remains of the Domus Tiberiana. Intensive archaeological excavations and research on the Palatine began in the 18th century at the behest of Francesco I, Duke of Parma. The campaigns continued from 1877 to 1980 thanks to R. Lanciani, ”director of the excavations of Rome”, who extended the excavations to the detriment of the Farnese Gardens, whose surface was drastically reduced.

The Palatine is today an archaeological site that boasts millions of visitors from all over the world. Since 2017, it is part of the Colosseum Archaeological Park, together with monuments of extraordinary importance such as the Colosseum, the Domus Aurea, the Roman Forum etc. The area was listed as WHS in 1980 responding to the i, ii, iii, iv and vi criteria.

3.2. Heritage attributes of the site
The 19th and 20th century archaeological excavations of the hill have brought to light very important monuments of the ancient history of Rome, which are essential qualifying factors for defining the attributes of the site. The historical and artistic importance of the Palatine can be expressed in terms of aspects and dimensions that contribute to the authenticity, integrity and uniqueness of the place. The three main attributes are: (1) the Palatine hill, (2) the Farnese Gardens, and (3) the group of monuments and ruins on the Palatine Hill (domus, temples, houses, etc.), including the Museum (Antiquarium of the Palatine) with movable archaeological heritage, for a total of 22 “artefacts” (figure 2).

Figure 2. Heritage attributes of the Palatine Hill.

Figure 3. Example of the evaluation table for the 3rd attribute.
3.3. Assessment of hazards, threats, vulnerabilities for the definition of scenario

Rome is not located in a highly seismic-prone area, but the city suffered from the shocks occurred in the Alban Hills and, most of all, the central Apennines. The moderate seismicity (PGA = 0.15 g) is not negligible especially for the diffuse presence of invaluable historical and artistic heritage that is particularly vulnerable. Previous experience and historical sources report on the large amount of buildings and churches damaged over the centuries, such as the 1703 earthquake that caused the collapse of some parts of the Colosseum [22]. Due to the geological stratification, the hill presents instability of slopes and the consequent likelihood of landslides [23].

By linking the vulnerability of the site and the artifacts with the primary (earthquake) and secondary hazard (landslides), it is possible to trace the consequences (impact) of the event on the Palatine, listed in ascending order of severity (figure 3). The resulting most likely scenario considers the occurrence of an earthquake, which causes the collapse of some archaeological structures of the Palatine during the visit of tourists. Indeed, during the event, as a direct consequence of the earthquake, a number of landslides occur along the slopes of the hill causing the blockage of some routes limiting the access of rescue teams to the archaeological site. Furthermore, the very tall trees in the Farnese Gardens may fall causing a short circuit and consequently a fire. Figure 4 shows the impact of the scenario on the key heritage attributes. In particular, the example refers to the Augustus House and the “Gallery of Collapsed Vaults” [24], for which the occurrence of the hypothesized scenario could cause significant and serious loss of CH value.

![Figure 4. Diagram of hazard, vulnerabilities and impacts.](image-url)

3.4. Intervention planning for DRR

Several measures are proposed for reducing risk through a site-specific management plan whose objectives are: a) to minimize the impact of the disaster to preserve the site’s values for future generations and to ensure the safety of visitors, staff, guides, etc.; b) to prepare a public-private partnership task force; c) to promote a rapid recovery process for the post-event phase. These measures are classified in groups according to the methodological framework (sec. 2.4) and are listed in table 1.

3.5. Stakeholder mapping and analysis

In order to guarantee the effective implementation of DRR measures, the stakeholders have been identified on an international, national and local level with reference to the different phases (planning, mitigation, execution and recovery) of the disaster risk reduction plan (figure 5).
| Class                      | Measures                                                                 | Level          | Stakeholder                                      | Cost  |
|----------------------------|--------------------------------------------------------------------------|----------------|--------------------------------------------------|-------|
| Institutional and strategic| Cooperation and inclusion of human resources: roster of expert (Archit., Engineer., Archaeol. etc); volunteers and communities (training) | Regional       | Local and Regional government, universities MiBACT, Civil Protection, ICRM | Low   |
|                            | Build Guidelines for Protection                                          | Structures, Buildings | Superintendence                                  | Low   |
|                            | Provide hazard maps and evacuation plans to custodians/staff/guide/tourists| Site           | Superintendence, Civil Protection, Fire Department| Low   |
| Technical (structural)     | Consolidation and local interventions                                    | Structures, Buildings | Superintendence, professionals, funders: EC-WMF | Medium|
|                            | Restoration/Isolation system (reversible)                                | Structures, Buildings | Superintendence, professionals, funders: EC-WMF | High  |
| Technical (non-structural) | Installation of hydrants and mechanical hydrant near the Farnese Garden and in the green areas of the hill | Site           | Superintendence, Fire Department                 | Medium|
| Management                 | Alarm system in isolated zones                                           | Site           | Superintendence                                  | Medium|
|                            | Regular maintenance                                                       | Buildings       | Superintendence                                  | Medium|

Figure 5. Impact of the scenario on a sample site’s attribute.

Figure 6. Stakeholders for different phases of DRR plan.

4. Conclusions

This paper explored the topic of risk assessment and management of CH sites, starting from an investigation of the current operational tools and prevention policies involving Italian cultural assets.

The methodology identified by UNESCO, ICCROM and ICOMOS was illustrated and thus organised in several phases that allow for a better understanding and usability for decision-makers. In this methodological framework, the case study highlights the potential of the procedure in practical terms. The approach consists in an expeditious methodology that allow for integrating, in an overall vision, the themes belonging to the risk assessment and management, from the identification of a realistic scenario, up to the selection of the most effective prevention measures and safety measures. Its adaptability to different scales and contexts responds to the common need for an integrated, shared and expeditious methodology for disaster risk reduction.

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