STORM Policies and Recommendations – a new vision for authorities, first responders and civil protection towards an effective protection of cultural heritage.

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Abstract. Every year, cultural heritage all over the world is lost or damaged under the devastating impact of climate change and natural hazards. Many times these damages are irreversible and often result from insufficient and disjointed preparedness systems, unable to cope with these threats. Awareness of this situation and the urgent need to find solutions for it has been a motivational call to taking actions towards the raising of consciousness of all involved, the incentive to training and the sharing of good practices. Project STORM - Safeguarding Cultural Heritage through Technical and Organisational Resources Management (funded by the European Union’s Horizon 2020 research and innovation programme – H2020-DRS-11-2015: Disaster Resilience & Climate), introduced a new vision for authorities, first responders and civil protection services towards cultural heritage, by proposing new policies and recommendations. This new paradigm based on the STORM experience sets the way towards the implementation of an overtly risk-oriented approach to the preservation of heritage sites, following the objectives that guided the STORM project through the development of new operative proposal – STORM 5 Cs – for different levels of intervention and responsibilities, namely: Heritage Conservation and management guidelines and procedures at site and government levels; Communication between climate researchers and heritage managers, including government authorities, in particular concerning the scientific body of knowledge built on climate change, aiming to improve adaptation strategies; Coping and adaptive capacities of heritage sites and organisations to meet their specific risks, and namely the actions that may enhance their resilience facing disasters; Cooperation between the different actors involved in the disaster risk management (DRM) of cultural heritage, which is demonstrably a cross-sectorial endeavour; Capacity building of heritage professionals, as well as of other pertinent stakeholders, via training and education at diverse levels in site-specific DRM measures and climate change adaptation. Regarding the safeguarding policies for cultural heritage to face natural hazards, STORM recommends the adoption of disaster reduction policies that lead to the creation of effective natural disaster reduction, i.e., the adoption of a new pathway that takes us from safeguard to effective protection of cultural heritage.
1. Introduction and motivation

Every year, cultural heritage all over the world is lost or oftentimes irreversibly damaged, under the devastating impact of climate change and natural hazards, and also from insufficient and disjointed preparedness systems, unable to cope with such threats. Awareness of this situation and the urgent need to find solutions for it, has been a motivational call to take actions towards the raising of consciousness of all involved, the incentive to training and the sharing of good practices.

Starting from previous research experiences, STORM proposed a set of novel predictive models and improved non-invasive and non-destructive methods of survey and diagnosis, for effective prediction of environmental changes and for revealing threats and conditions that could damage cultural heritage sites. STORM also studied how different vulnerable materials, structures and buildings are affected by different extreme weather events together with risks associated to climatic conditions or natural hazards, offering improved, effective adaptation and mitigation strategies, systems and technologies. An integrated system featuring novel legacy sensors systems, state of the art platforms, as well as crowdsourcing techniques have been implemented, providing applications and services over an open cloud infrastructure. Results were successfully tested in relevant case studies located in Italy, Greece, UK, Portugal and Turkey.

The Municipality of Grândola is an entity of the Portuguese local level governance, responsible for the territory administration with attributions in the areas of patrimony, culture and science and civil protection, among many others. Recommendations for new policies and guidelines for best practices regarding a new paradigm for the effective protection of cultural heritage were the main interests of the municipality in the STORM project. Therefore, in this paper we will focus on the policy recommendations and on a new paradigm based on a set of guidelines entitled the STORM 5 C’s.

2. STORM 5 C’s

The STORM 5 C’s are a set of guidelines aimed to improve the disaster risk management (DRM) of cultural heritage. It is an overtly risk-oriented approach to the preservation of heritage sites ensuing directly from the STORM experience. All these recommendations identify the areas where improvements may lead to a qualitative improvement of the DRM cycle and, thus, to the improvement of cultural heritage protection. They resulted from the identification of five “C” keywords from areas thought to be the ones where the advancing of resources could have the highest impact in terms of heritage risk management. Each one of the STORM 5 C’s guidelines is split into a set of recommendations deemed necessary for its fulfilment.

2.1. Heritage Conservation and management guidelines and procedures at site and government levels

Conservation can be defined as all actions designed to understand a heritage property or element, know, reflect upon and communicate its history and meaning, facilitate its safeguard, and manage change in ways that will best sustain its heritage values for present and future generations [1]. In this sense, conservation encompasses an extremely vast array of actions and procedures in order to have a sustainable management of change to a significant place. DRM, in turn, may be defined as a strategy to deal with the negative risk of change. Therefore, it should be developed and implement DRM programs for all tangible heritage assets.

The focus of conservation, as said, essentially corresponds to the array of values that are bestowed upon a heritage asset by its stakeholders, in a given moment of time and space. When dealing with cultural heritage, its values should be clearly stated and explicitly sustain management guidelines. Bearing this in mind, DRM programs for tangible heritage explicitly based on the cultural values of the heritage asset(s) should be promoted, in compliance with currently accepted conservation deontological principles.

If one were to map, simply and generally, the current shape of conservation policy and practice, one would find a rather linear path with different groups of professionals engaged in distinct steps along the way [2]. This is precisely one of the major problems encountered: the diversity of fields that may be involved at any given step taken towards the conservation of a heritage asset, which may effectively
inhibit the establishment of a truly cooperative dialogue. The multidisciplinary nature of the STORM consortium was, undoubtedly, one of its major strengths and, at the same time, represented big risk due to its heterogeneity. A straightforward answer to this dilemma was the creation and sharing, at the early stages of the project, of an agreed-upon reference framework that would describe the main issues at stake and provide guidance on how to address them. The STORM Frame of Reference (FoR) described a common vision for the project by defining its boundaries, framework and terminology in what pertains to heritage risk. In a word, it harmonised the multitude of expertise present in STORM.

From the STORM experience we can say that, at site level, any intervention that calls for the interdisciplinary involvement of heritage professionals should be framed by a common framework, agreed upon by all stakeholders involved. At government level, central and/or local levels a FoR should be defined and promoted including, among other things, principles, concepts and terminology documents, in order to enable and/or support the development and implementation of conservation and/or risk management initiatives.

Tangible Cultural Heritage, like historical places, architectural constructions, monuments, artefacts, among many others, are constantly exposed to different environmental aggressions that threaten its conservation and transmission to the future. Therefore, the development of research on the deterioration mechanisms of heritage assets would be highly desirable, supported by adequate analytical and monitoring technologies, aimed at defining more compatible and sustainable conservation and protection treatments. Additionally, some difficulties can arise in codifying methods, analyses, and responses related to environmental assessments and consequent actions. The promotion of systematic and interdisciplinary methodologies aiming at the conservation and maintenance of heritage sites can be an answer to these difficulties, since it includes all the necessary disciplines to each specific asset with the inclusion, in all cases, of a conservator-restorer of the adequate specialties. A maintenance plan that supports conservation interventions should be set up and include, as much as possible, regular on-site monitoring, preferably with low impact technologies, testing, and thorough documentation about the heritage site.

Finally, the improvement of financial instruments is one critical aspect of heritage conservation. On average, every euro spent for reduction and preparedness activities saves between four and seven euros that would have been spent in response to the aftermath of disasters [3]. The STORM Cost-Effectiveness Analysis (CEA) methodology was developed as a tool for the practical implementation of tangible heritage conservation interventions, supporting decision making whilst ensuring the application of the aforementioned conservation principles [4]. The CEA developed within STORM is a decision-support system specific to interventions affecting built heritage at site management level and it does not consider impacts outside the site, nor does it allow for comparisons among different sites. Therefore, at site level, resources should be allocated for DRM measures that are supported by comparative analyses weighing the costs against the benefits or effectiveness of the different options. At all government levels, it should be given preference to preventive approaches to heritage risks, using DRM procedures, instead of merely reactive approaches.

2.2. Communication between climate researchers and heritage managers, including government authorities

Climate change is a global issue, but the adaptation to climate change should be considered more locally, on a national or regional scale, as climate change effects are widely distinct for different regions. European Union policy encourages member states to develop their own comprehensive climate adaptation plans covering from local to national levels in coordination with neighbour-states [5]. Many EU member states have incorporated climate change policies and legislation in order to adapt to climate change impacts, that often don’t include cultural heritage [6].

Therefore, communication between climate researchers and heritage managers, including government authorities, should be improved, and cultural heritage should be included as a dimension in all national adaptation strategies. Also, cultural heritage must be incorporated in climate change research and governance to increase its consideration within climate and environmental policies. Regarding risk
management, strategies based on risk assessment considering information on climate change (and other national hazards) as well as the heritage vulnerability to these changes should be developed. Finally, climate change risks on cultural heritage should rely on high-resolution climate model simulations.

2.3. Coping and adaptive capacities of heritage sites and organizations to meet their specific risks

According to the United Nations Office for Disaster Risk Reduction (UNDRR), coping capacity is “the combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience” [7]. Similarly, the Intergovernmental Panel on Climate Change (IPCC) indicates that coping capacity encompasses the ability of people, institutions, organisations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term.

Adaptive capacity is the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences [8]. While the focus of coping is on immediate reaction, adaptive capacity implies a long-term strategy that enables community to change and transform in order to deal with expected negative consequences of climate change [9]. Furthermore, Birkmann states that the ability to adapt to permanent change, or to transform without reducing future adaptive capacity is essential in the face of current climate variability and future climate change.

Bearing this in mind, together with several guidelines from the international community which were analysed by the STORM Consortium [10], several recommendations in terms of coping and adaptive capacities aroused. First of all, countries and governments should acknowledge cultural heritage as a cross-sectoral area and strengthen the integration of heritage needs in disaster risk reduction and climate change adaptation agendas. Risk-preparedness policies and practices, at national, regional and local levels, mainstreaming cultural heritage through a collaborative approach, should be developed and promoted, together with the setup of effective risk governance for cultural heritage on a national level, promoting agreements between different actors, improving resources availability and increasing training opportunities. Finally, it is fundamental that financial mechanisms for preparedness activities, including regular drills, and emergency response, are created.

2.4. Cooperation between the different actors involved in the disaster risk management of cultural heritage

The occurrence of natural disasters, which will tend to be more frequent in the short and long term, severely affect cultural heritage widely dispersed in the various humanized territories. Its vulnerability and high exposure to various hazards requires coordinated responses among civil protection agents, firefighters, other emergency management professionals and cultural heritage professionals to ensure that these assets are protected and properly safeguarded. The Civil Protection authorities - or any other emergency officials that assist in the preparation and update of emergency plans, assure the implementation of risks and hazards mitigation activities, and support the emergency teams and disaster victims - play an important role in the safeguard of buildings, monuments and cultural assets. The involvement of these professionals must not be limited to relief operations and recovery actions, but their expertise must be present in the first stages of the emergency processes, especially in the planning and preparedness phases.

Another key aspect is the creation of an operative structure that can manage emergency situations on heritage assets, establishing and coordinating the necessary actions to be performed by the different actors. This structure should be based on a knowledge sharing network that guarantees the exchange of hazard and heritage risks data and emergency plans (with definition of roles, tasks and procedures), among all the involved stakeholders. All site emergency plans must be elaborated in close articulation with national and local authorities, and their information must be in compliance with emergency management and territorial planning instruments.
The use of digital tools to improve accuracy of data and to serve as a collaborative network is another key aspect, together with the execution of drills, since they are a crucial component for emergency plans, first aid actions on cultural heritage and for the improvement of the cooperation between all the stakeholders involved.

The establishment of agreements or partnerships between private and public sectors, for the enabling of a shared management of cultural heritage at risk and implementation of risk management plans, will foster public-private partnerships to support long-term strategies and capacity building for heritage risk reduction and climate change adaptations, since they can provide supplementary financial aid and fundamental resources.

Finally, it is essential to support and promote voluntary work in cultural heritage prevention and conservation projects, and encourage organisations to involve trained volunteers in the emergency services structure.

2.5. Capacity building of heritage professionals, as well as of other pertinent stakeholders
Capacity building among heritage and DRM professionals can significantly contribute to regional and national disaster reduction strategies and processes. With this in mind, it is essential to organise DRM and Climate Change Adaptation training programs, designed to protect cultural heritage, for heritage professionals (Engineering, Conservation-Restoration, Architecture, Archaeology, Art History), heritage site managers, disaster managers, climatology experts, public or private administrators and local residents. These training courses should be based on an integrated approach to DRM of cultural heritage embedding disaster risk management, cultural heritage management and urban development needs and should encourage the use of technological solutions to improve data communication, data analysis and facilitate the decision-making process.

Encouraging the transfer of knowledge from the academia to the public and supporting universities in the development of courses with contents on safeguarding and managing Cultural Heritage in the face of climate change, are two fundamental aspects.

3. STORM recommendations for policies regarding an effective protection of cultural heritage

3.1. Existing policies
On November 16, 1972, during the World Heritage Convention held in the seventeenth session of the UNESCO General Conference in Paris, a set of factors were identified as threats to the assets that are part of the cultural heritage of humankind, including “calamities and cataclysms; serious fires, earthquakes, landslides; volcanic eruptions; changes in water level, floods and tidal waves”. The same General Conference adopted a recommendation for each Member State to formulate, develop and apply, in accordance with its specific legislation, a policy to coordinate and use all available resources in order to ensure the effective protection, conservation and public fruition of the cultural and natural heritage in their territories.

43 years later, in 2015, after many initiatives and reference documents, a set of guidelines were published by the United Nations in the form of a framework – the Sendai Framework for Disaster Risk Reduction [7] – intended to set guiding principles for the period 2015-2030, following the lessons learnt from previous frameworks and guidance documents, namely, the Hyogo Framework for Action [11]. Among other guidelines, the Sendai Framework stated that all the states should adopt national risk reduction plans and elaborate management plans that should include risk analysis studies, namely, for World Heritage. In 2016 the European Commission also predicted the development of good practices regarding the inclusion of cultural heritage in the strategies of risk reduction to be developed by Member States as a key area in the already mentioned Sendai Action Plan [12].

In STORM a comprehensive analysis of the current policies and procedures was undertaken in the pilot countries of the project [12]. The result of this analysis revealed, in some cases, an absence of a national strategy, or a lack of practical implementation of the political speech and legal frameworks. Despite these negative results, the analysis also found some success cases: the creation of MIBAC/Civil
Protection Crisis Units, executive coordinating structures specifically designed to guarantee the safeguard of cultural heritage (Italy); the establishing of a national Strategy for a Preventive Civil Protection (2017) that identifies priority goals to reduce vulnerabilities, promotes mitigation actions and enhances cooperation between players (Portugal); and the Regulation on the Protection of Monuments from Earthquakes (2010) (Greece), among others.

Nevertheless, it was concluded that there is no comprehensive and structured approach to ensure an effective protection of cultural assets exposed to natural hazards, due, especially, to a set of constraints, some common to most countries:

(i) **Lack of national strategies** - national legal systems do not include a national risk management plan, nor climate change adaptation plans, for cultural heritage;

(ii) **Lack of coordination** - the nonexistence of risk management policies for cultural heritage is reflected in the absence of cooperation between the authorities responsible for civil protection, cultural heritage and the environment (including territorial planning);

(iii) **Lack of capacity** - inability to implement preventive measures on cultural heritage due to the lack of resources, including funds (the funds, when available, are only aimed at recovery and restoration actions). Also, there is no accumulation with other lines of financing, mostly because the managing entities of the funds are dispersed through distinct ministries, which implies a close coordination;

(iv) **The importance of scientific and technological research** for a better understanding of cultural heritage risks and vulnerabilities, and thus for the development of an efficient legal and policy framework.

An essential assumption, is the acknowledgement that cultural heritage is a transversal value to all the key governance areas – Civil Protection, Territorial Planning, Public Works, and Environment – and it is a priority that needs to be in the political agenda in the coming future [12].

3.2. **STORM recommendations for policies adoption**

The following recommendations are the result of a major teamwork developed by the STORM consortium led by the Portuguese National Directorate for Cultural Heritage that followed the STORM comprehensive analysis of the current policies and procedures. They should be seen as proposals to develop national or European policies to reduce hazard impacts, vulnerabilities and exposure of cultural heritage in risk. These recommendations are based on the intention of reducing the hazard impacts, the vulnerabilities and the exposure of cultural heritage, rather than on preparedness, response or recovery, they settle in international and European guidelines, and good practices on this subject [12]. Also, they are intentionally very generic to allow the adaption to each country’s national legal system. Hierarchically, no precedence is established among them assuming that any sequencing or any prioritisation is possible, depending on the government’s responsibilities for the entities in charge of its adoption (national, regional or local levels).

3.2.1. **Political commitment of the national, regional or local government communities.** In articulation with the main stakeholders a political commitment with all levels of government should be established with the objective of reducing vulnerability of cultural heritage facing natural disasters. This commitment does not necessarily require a legislative instrument; it can be set out with memorandums of understanding, provided that they clearly enable the parties concerned to be committed to common objectives, deadlines and results. This commitment should work as a framework for solving funding limitations and promote preventive measures in the scope of shared management of endangered heritage assets.

3.2.2. **Creation of a High level Permanent Intersectoral Forum.** This forum should have a mandate to promote legislation review, establish guidelines and methodologies, disseminate good practices, promote the articulation between central government and local authorities, and ensure the empowerment of actors involved in the protection of cultural heritage. Regardless of the institutional and functional solution found, it should have the support at the organisational highest level in order to guarantee the
members of the forum a mandate in the interpolation of the services of the public administration and other stakeholders.

3.2.3. **Include risk assessment information on the listing or designation procedures for cultural heritage.** The identification of hazards, vulnerabilities and exposure level of cultural heritage to threats, should be considered as criteria in the decision-making processes and thus facilitate the enforcement of mitigation measures to be adopted for the effective protection of heritage properties or sites.

3.2.4. **Involve communities in heritage safeguarding.** Participatory management models are widely recognised by international organisations, including UNESCO, who clearly requires the involvement of World Heritage Sites stakeholders in the preservation and maintenance of its outstanding universal values. The participation of local authorities in national heritage management and conservation can also work positively towards cultural heritage resilience; they play an important role in cultural heritage protection, often assuming the allocation of financial resources to support preventive measures. Finally, within communities, the strong connection that citizens develop towards assets that are close to them, and which may lead them to assume the role of “heritage guardians”, should be acknowledged and streamlined, enabling the creation of alert networks for cultural heritage protection. Such procedures furthermore contribute to the resilience of the heritage communities themselves.

3.2.5. **Set up Local Framework Plans.** This non-legislative instrument should allow to collect in a single document (which can contain both textual and graphic information) all normative references, whether legal, standards or good practice, that the political decision maker, or any interested party, must take into account in territorial planning where protected (or pending protection) cultural heritage is located. For a greater degree of functionality, these plans should be drawn at a local scale and identify, in the territory, the overlapping of preventive measures related to cultural heritage risk management.

3.2.6. **Implement risk mapping on heritage management.** This tool is recurrently mentioned by managers of cultural heritage as a missing and necessary key element to support decision making. This instrument should also inform other territorial planning instruments, as well as emergency plans, and be communicated for the purpose of adequacy of the action of civil protection agents.

3.2.7. **Secure funding for the financing of preventive measures for cultural heritage.** Develop a line dedicated to risk prevention and management projects, including the financing of risk prevention plans. Portugal has the Cultural Heritage Safeguarding Fund, allowing accumulation with other funds, which is an example that can be followed in the STORM partner countries. In practice, however, most of the funds are mutually exclusive, either because their statutes do not allow or because, and above all, managing entities from other governmental areas do not consider their participation in the risk prevention of cultural heritage, which should be considered in future funds or financial lines.

4. **STORM experience and conclusions**

STORM project promoted several drills and exercises to test the STORM technological solutions and recommendations. In the Portuguese pilot site – Roman Ruins of Troia – one of the most daring drills was held, in which more than 50 professionals and volunteers took part. The preparation and execution of this drill was done in an environment that mixed simulated actions with concrete actions of protection and safeguard of endangered cultural heritage.

Held in February 2019, it intended to secure one of the walls of fishing salt workshop no. 21. The necessity for improving communication channels, in order to strengthen an integrated collaboration of all actors involved in emergency management processes, was recognised. Heritage site owners, civil protection authorities, security forces, firefighters, cultural heritage authorities, conservator-restorers, environmental agencies, and military forces, namely, the Portuguese Navy and the Maritime
Police/Authority, participated in this exercise bringing together, for the first time, different expertise for cultural heritage safeguarding.

This successful experience was possible due to the endeavour of the local authority of civil protection (SMPC), who mobilized and coordinated the different actors involved, demonstrating that coordination can be done at the local level. The exercise was recorded on video and is available on the following links: https://youtu.be/VQLxI0wHLDM and https://youtu.be/6Ea7QXyXbc4.

This drill is the proof that the STORM recommendations are viable and establish a new paradigm towards the adoption of a new pathway that will take us from safeguard to effective protection of cultural heritage.

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