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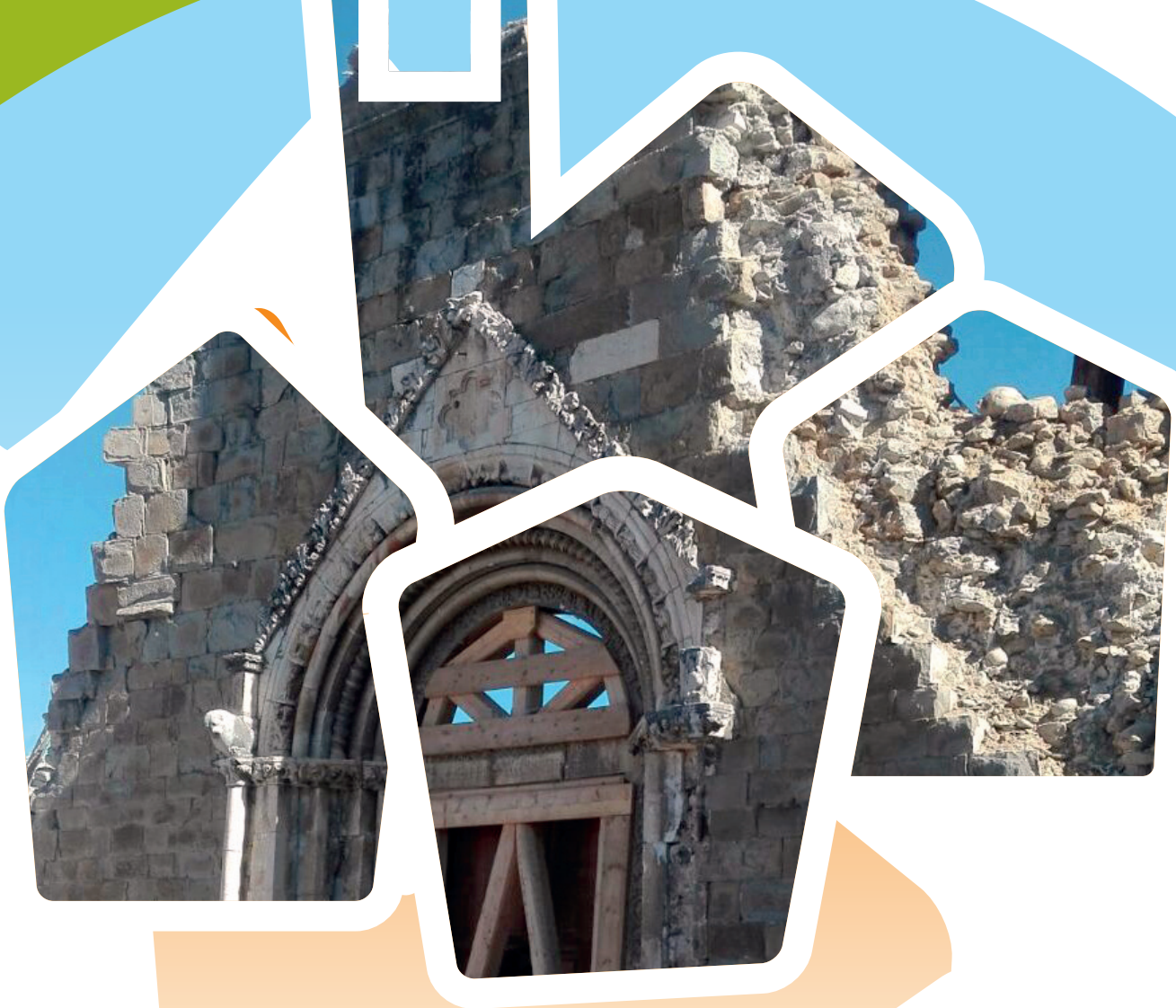


Alpine Space



Cheers

European Regional Development Fund



Cultural heritage risks and securing activities

Approaches, tools, and techniques of Emergency Planning
for protecting and safeguarding Cultural Heritage.

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Foreword

Heritage Conservation and Climate Action: Building Synergies for Transformative Change

Climate change is increasing the number of disasters and their devastating impacts on lives, properties, livelihoods and cultural heritage. Recent floods in Belgium and Germany, and forest fires in Greece and Italy are grim reminder of the challenge we are confronting in Europe.

The likelihood of increased weather extremes such as heavy downpours, heat waves, and strong hurricanes and cyclones therefore gives great concern that the number or scale of weather-related disasters will also increase putting heritage at greater risk than ever before. Moreover, greater variability in temperature and precipitation due to climate change is also posing challenges for the conservation of historic built fabric. This necessitates transformative change through bold decisions for transition to a carbon neutral and resilient world that can sustain heritage for future generations, and at the same time considering radical changes in conservation and management practices to adapt to changing environmental context.

Therefore, cultural heritage risk management is not a simplistic proposition that can be reduced to taking some measures for expected emergencies. Rather, addressing this subject requires much deeper thinking both for the underlying causes that put cultural heritage at risk and their long-term implications.

Risk is the product of hazard and vulnerability and therefore we need to reconsider our understanding of these very terms and their inherent relationships. This also implies that we need to understand the inherent link of physical vulnerability of both movable and immovable cultural heritage to that resulting from social, economic, institutional and larger 'development' processes.

Considering the direct and indirect impact of increasing frequency and intensity of disaster risks, especially those resulting from climate change, we can no longer afford to be passive in our approach toward heritage conservation and management. Rather than fixing damages and deteriorations and solely dealing with post disaster response and recovery, there is an urgent need to shift our focus on pre-disaster actions. These include mitigation and preparedness through development of risk scenarios based on predictive (rather than deductive) modelling and development of comprehensive national and regional databases of the loss and damage to cultural heritage due to disasters caused by climate related hazards.

This would require coordination between institutions and departments and respective policies from disaster management. Most importantly, effectively meeting this challenge would require collaboration among various countries in Europe and other regions of the world. ICCROM has included disasters and climate change as key concerns in its programmes and is committed to advise its Member States in Europe for effectively meeting this global challenge through research, capacity building and advocacy.

Dr. Rohit Jigyasu

Project Manager,

Urban heritage, climate change and disaster risk management ICCROM



The Idrija mine represents an exceptional example of human interaction with the environment, that after the closure of the mine has now become more vulnerable. At the same time, it demonstrates how mining activities gave rise to peculiar cultural expressions and determined specific intangible and unique characteristics, whose main value consists in the conservation of the spirit of the place as manifested by the community's commitment to its history.

Rather than by human factors, the world heritage of Idrija mercury mine is much more endangered by natural hazards (earthquakes, floods, landslides, and fires). The Idrija region is positioned at the crossroads of two mighty mountain chains, the Dinarides and the Alps. This is what gives the area its main natural features, which today represent the biggest threats to our cultural heritage and make it vulnerable and at risk.

Idrija Municipality joined the CHEERS project as Observer and was actively involved in many activities: we gained new knowledge, expertise, and created new bonds with partners from Italy, Austria, Germany, France, and Switzerland.

Idrija's rich cultural and industrial heritage must be preserved for future generations. Participating in international projects like CHEERS also allows us to reach this goal.

Mr Tomaž Vencelj

Mayor of Idrija

It is necessary to establish relations between the various institutional and operational agencies, "Following this CHEERS meeting, the Department's Office of Territory and Sea Management will be able to carry out awareness-raising actions with metropolitan areas and selected officials, and to lead them to commit themselves to the heritage, as well as actions to add the safeguarding of heritage to seismic plans."

Mr Stéphane Liautaud

*Seismic referent in the Department's Office
of Territory and Sea Management*

In the framework of the activities of a Superintendency, which are necessarily focussed on the daily needs of the 'here and now' protection, it is not always easy to develop medium and long-term actions aimed at preventing the effects of natural disasters on cultural heritage. In this regard, participating in the CHEERS project, as an Observer Partner, represented a fundamental and valuable opportunity given to the Superintendence for Cultural Heritage, in collaboration with the Risk Prevention Service of the Autonomous Province of Trento.

Our purpose was not only to identify the sites that are most exposed to the risk of flooding of the Adige River – this is the chosen scenario for the Trentino area – but also to build a rapid method for assessing the intervention priorities, defining the actions to mitigate damages, and quantifying the time and resources needed. We did all this to provide decision-makers and stakeholders with an analysis and planning model that we hope will be usefully enhanced in the future, in Trentino and beyond.

Franco Marzatico

*Superintendent for Cultural Heritage
of the Autonomous Province of Trento*



Why a sourcebook on emergency planning and cultural heritage?

All over Europe, emergency plans are the instrument commonly used to manage preparedness and response to natural hazards and risks in the territory. When a disaster hits, as a consequence of a natural hazard, be it a flood, an earthquake, a landslide, a forest fire, the community is prepared and ready to tackle the emergency (and even try to prevent it, if possible) thanks to plans that have been designed in “peacetime”.

Ordinarily, these emergency plans are managed by systems (e.g. offices, structures, forces, etc.) called Civil Protection or Disaster Management. The structures and the way they are organized and managed may differ from country to country, although there is a quite large consensus on their scopes, functions, and goals.

This *Sourcebook* has been developed within the framework of an international project called CHEERS and will try to represent the common denominator of the various systems, as well as to highlight the relevant differences, with the final goal of providing a shared approach and a base over which all the countries can build solid measures for safeguarding cultural heritage at risk.

The true focus of emergency planning is, firstly and rightly so, people’s safety: this simple concept ought to be stated once again and will never be disputed when presenting the CHEERS approach. From now on, it will be accepted as a premise.

Among the main goals of Civil Protection as a system is that of guaranteeing in any possible way to maintain, in the face of a disaster, a civilized life standard, endangered by conditions that may implicate severe physical and psychological distress.

CHEERS project acknowledges the key role that cultural heritage plays in the “civilized” life standard of any population.

The challenge

In most parts of Europe, disaster management plans at the local level **seldom include** cultural heritage as an objective for safeguarding and response measures. This is particularly true when it comes to non-managed assets, minor and local cultural assets widespread on the territory, as is the case, for instance, of so many small, old chapels that can be found in Alpine valleys, whereas more frequently major museums or cultural sites may already have their own Emergency Plans in place.

Therefore, the **main goal of this Sourcebook** is to provide clear guidelines on how to operate according to the current Civil Protection and Disaster Management response systems in place, in order to integrate the specific needs of cultural heritage and ensure its protection on the territory.



For whom?



Cultural heritage managers/curators

Those who are called upon to manage and preserve the cultural heritage may be interested in:

- Understanding whether the assets they manage are exposed to natural hazards of any kind and, if so, what is the risk level, in terms of frequency and severity;
- Understanding who, in the area, is responsible for managing those risks, as well as how and with what tools the alerts and emergencies are tackled;
- Knowing how they can generally improve the safety of the assets they manage, also by interacting with the subjects involved in risk management and the related tools;
- Knowing how they can set top priorities when safeguarding the cultural heritage entrusted to them, and what should be preserved first and foremost, if necessary?



Civil Protection/Disaster Management Operators or similar services, and Emergency Planners

Those who institutionally or professionally deal with risk management in the area, design and implement the planning of emergencies from natural and **Natech** hazards may be interested in:

- Integrating in their actions and planning the theme of cultural heritage located in the respective territories;
- Understanding where to gain information about the assets located in the area;
- Knowing the main features of these assets so they can be included in emergency planning;
- Acknowledging the specific legislation that safeguards cultural heritage and defines who can and should deal with it, starting from decision making, up to the physical act of manipulating cultural assets if needed;
- Knowing who, and in what capacity, manages cultural assets, therefore with whom to interact in their activities of risk management and planning.

Natech events (Natural Hazard Triggering Technological Disasters) can be defined as “Technological accidents such as fires, explosions, and toxic releases that can occur within industrial complexes and distribution networks as a result of natural disasters”¹.



Local officials

Local administrators (mayors and institutional representatives at various levels) can be held accountable on both of the above-mentioned issues. Notably, they are (often) primarily responsible for the Civil Protection and Risk Management actions in the area. For this reason, they are also the first ones interested in safeguarding and enhancing cultural heritage in their respective territories.



How to use this book: when is it applicable and for what?

This *Sourcebook* contains the description of a path, consisting of several steps, the ultimate goal of which is the integration of cultural heritage preservation measures in ordinary emergency plans at the local level. The path is designed to help users to:

- **become aware** of the risk management and emergency planning tools that are viable and available in their own territory and which are the most appropriate to include and illustrate protective measures dedicated to cultural heritage;
- **acquire knowledge and skills** necessary to produce such protective measures (for example: where to find useful data and information on cultural heritage and natural hazards? How to combine this information? Who can intervene on assets in case of emergency? What skills are needed?);
- **integrate the measures** into the risk management tools at local level and in particular the Civil Protection emergency plans.

The *Sourcebook* also provides users with:

- **tools and methods** that contribute to define intervention priorities aimed at safeguarding cultural heritage:
 - **ATTACH**: *evAluaTion Tool for Alpine Cultural Heritage (ATTACH)* is a participatory method for assessing the significance of a set of cultural assets that will help establish priorities for intervention in the case of natural hazards, if necessary.
 - **FRATCH**: the *Fast Risk Assessment Tool for Cultural Heritage (FRATCH-Tool)* was developed to identify and assess current and future risks and threats to cultural heritage. The tool represents a multi-stage process that involves several stakeholders in order to establish a common understanding on the topic. FRATCH produces a risk assessment which clearly presents the risks and threats to the cultural heritage/asset and the related hazardous events on the specified site and/or the cultural asset in question.
 - **3.2.1 Fragility**: this tool is suitable for performing damage and loss scenarios, aimed to support the definition of emergency plan. If exhaustively precompiled and adequately complemented with FRATCH and other tools for the management of rescue teams, its design allows to be used as a fast dashboard and simple decision support system in the emergency response coordination centre for the prioritisation of cultural heritage safeguard and rescue intervention.
 - **THREAT tool & Handbook on fragility and techniques for the preservation of cultural heritage**: a tool for vulnerability and risk assessment on cultural heritage (*THREAT - culTural Heritage Risk EvaluATion*), developed starting from the same logic as FRATCH, therefore based on the concept of “likelihood” of damage and permanent loss of value that may occur to cultural property. The tool is accompanied by a Handbook, that serves as knowledge and a reference base, on fragility and safeguarding techniques for cultural heritage.
- **references** to materials and sources for further information;
- **examples** taken from the application of the steps and approaches on the pilot areas of the CHEERS project.

As noted above, the project was designed in an international context, where differences between the various systems, as well as similarities, were highlighted. The *Sourcebook* is committed to disseminating knowledge that is valid for everyone, stressing these differences only where relevant.



The structure of the sourcebook



Sharing knowledge

Module 1 can be used to deepen elements of the “governance” of the management of natural hazards and of cultural heritage, and to understand the rules and roles in both fields.



Identifying heritage at risk

Module 2 introduces two themes: which cultural assets are in the area of interest? Where can I find information on them? What kind of information? What natural hazards threaten them? How to combine this information and structure risk scenarios?



Determining rescue priorities?

Module 3 presents in more detail the concepts of exposure, fragility, and vulnerability of an asset in relation to a certain natural hazard: in short, the concept of risk. The final result of this module is a quantitative, objective and transparent approach in defining the priorities for intervention on cultural heritage, through two fundamental components: an approach for assessing the relative significance of cultural heritage, to be applied in case a prioritisation of the assets is needed in the face of a threat, and the definition of their fragility and vulnerability to various agents of damage, according to the nature of the asset, its material characteristics, and particular circumstances.



Defining safeguarding techniques

Module 4 will describe methods of protection in terms of prevention, safety, and stabilisation and will guide you through pondering the available resources, times, and means necessary to implement the safeguard measures themselves.



Integrating emergency plans

Module 5 will frame the safeguarding measures in the context of the planning and management tools of natural risks at the territorial level, referring to fundamental components: the chain of command and control (“who does what?”) in the management of emergency interventions; the detailed definition of the operating procedures (“how are the measures carried out?”); finally, indications on how to organise and manage a trial procedure that can effectively test the procedures and planning developed.



Testing and improving

Like any process aimed at structuring an action strategy, emergency planning can also benefit from an iterative, circular approach, in which what is done along the process is tested and possibly corrected, updated, and improved through use over time.

Module 6 shows a possible outline of the contents of a test/simulation for the management of an emergency that involves the safeguarding of cultural assets.



Building capacity and training

At the same time, the *Sourcebook* will also deal with the fundamental theme of training: what knowledge and skills must officials and operators involved in managing cultural heritage at risks acquire? What are the possible approaches for capacity building and training?



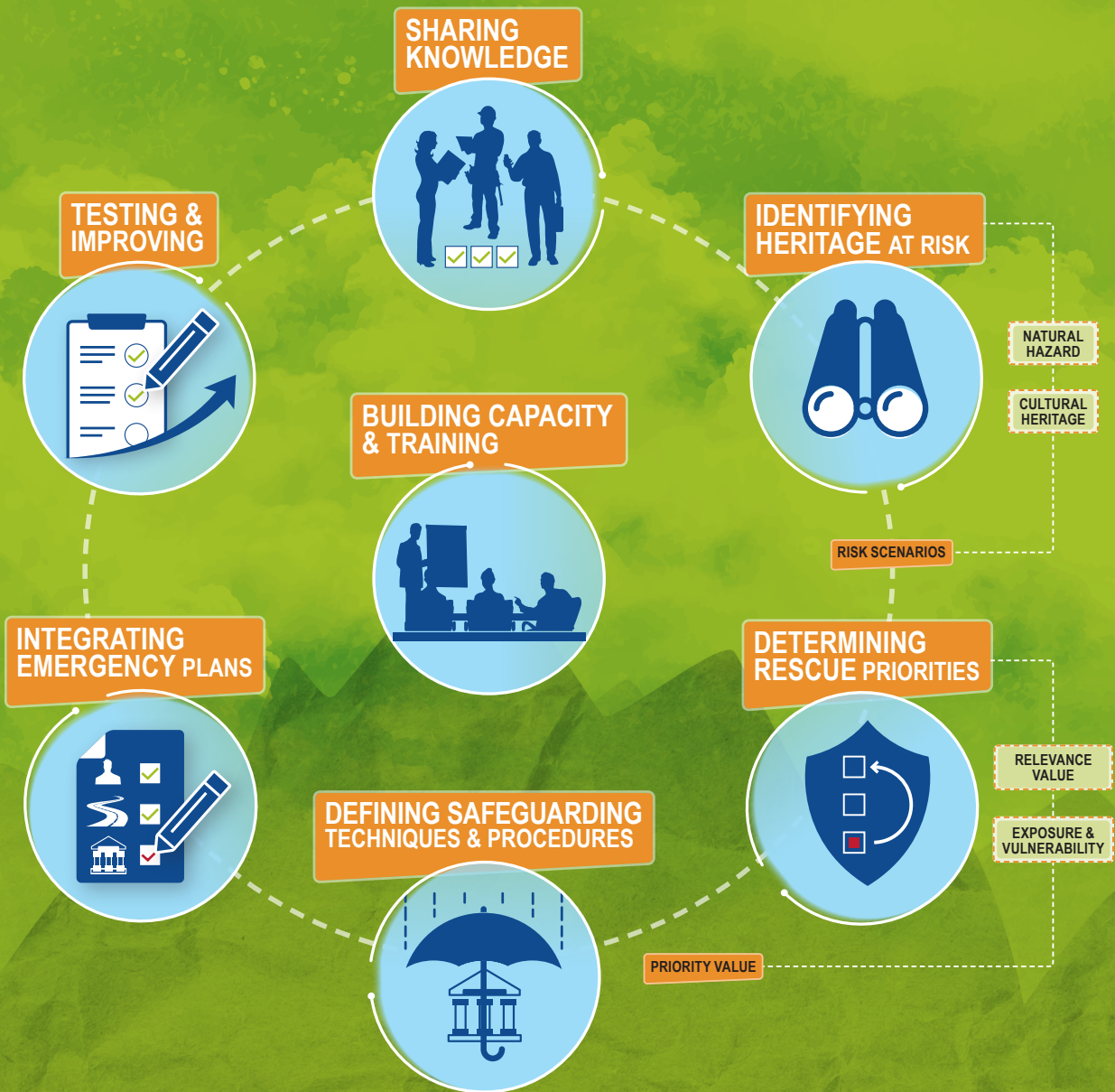


Figure 1 The road ahead: overview of the modules

Types of hazards and planning

It is important to understand that the sourcebook logic was developed with a clear idea in mind. There are different types of natural hazards, with dynamics that characterize them in a fundamental way and that affect the way in which emergency management will be planned.

Predictable events (with precursors)

Take for instance the flood hazard in a typical valley floor area or in a river plain. A flood event normally develops over a relatively long time: the rainfall, which can be predicted by the meteorological services, may lead to an increase of flow rate in bodies of water such as to produce the effect of overflowing or breaking of the riverbanks. However, under ordinary conditions, Civil Protection systems are prepared to handle a possible emergency, if conditions become critical. Therefore, there is an “attention”, or “alert” time, and only in the end an “emergency” time. The CHEERS project, for example, examined the case of the Adige River flood scenario in the city of Trento, with a 200-year return period, that is, a scenario that materialises over a period of approximately 48 hours.

Non-predictable events

This is the typical case of earthquakes, such as those, for instance, that devastated central Italy in 1997, 2003, then subsequently in 2009 and 2016-2017. An earthquake is an event that can be handled in “peacetime”, through anti-seismic and specific risk mitigation measures (e.g. attaching shelves to the walls, etc.), or in response to the event, in the aftermath. Therefore, if we consider an event of this type, there are no possible intervention scenarios during the “alert” time or in the phases immediately preceding the emergency: there is, essentially, only the response in the aftermath.

The former events, with precursors, are those for which the entire timespan of emergency planning (prevention – attention – alert – alarm) must be developed, thus it is likely that they are cited more often as examples in the context of the Sourcebook

Timing and development events

There are cases, however, in which even predictable events can develop very quickly. Intense rainfall can produce very rapid events (flash floods) in basins with specific characteristics. Some landslides, although one may be aware of their existence and the probable nature of their dynamics, can be unleashed and then evolve very quickly, within a few hours or minutes. Similarly, a forest fire can develop very quickly and unpredictably, depending on the circumstances and, if it’s an interface fire, it can rapidly reach and threaten facilities and inhabited areas. In such cases, rescue and safety operations take place thanks to the reaction skills of trained and qualified operators, rather than on a series of planned actions, which would be feasible only in the event of full safety and availability of time.



SHARING KNOWLEDGE



The governance and regulatory frameworks: Civil protection & Cultural heritage management

Roles and responsibilities: institutional and non-institutional actors and stakeholders in Civil protection/Disaster management and Cultural heritage management

Required qualifications and training

NEXT STEP



IDENTIFYING HERITAGE AT RISK

SHARING KNOWLEDGE

What is the starting point for developing an Emergency Plan?

Imagine the territory of a Municipality where a river flows, knowing that it could be subject to overflow and flood the areas surrounding its riverbed when heavy rainfall occurs.



Figure 2 Aerial view from Dürnstein during the 2014 flood event.

Emergency Planning requires you to ask yourself some key questions, which need to be answered. The first ones will definitely be the following:



What are the areas at risk? Does anyone live there? Are there any houses, industries, commercial, or production structures? What could happen to those people and buildings? How should their safeguarding be managed?

The underlying idea of CHEERS is to integrate the local cultural heritage into this line of reasoning and develop strategies dedicated to this specific category of “structures” (container buildings) and “objects” (contained or displayed assets): in addition to people, houses, structures, **are there also cultural assets in the area? Would they be in danger if something harmful happened? What could happen to them? How can damage be avoided, if possible?**

These are just the first and simplest questions. To begin, one must be aware of who and how, locally, manages the risks related to natural disasters and, moreover, know the cultural heritage that exists in the area.





The governance and regulatory frameworks: Civil protection & Cultural heritage management

Whether the issue is addressed on the part of those who manage the emergency (e.g. a Civil Protection official: who owns the assets kept in this place? Who takes care of them? Wouldn't it be better to relocate them?), or on the part of those who manage the existing cultural assets (e.g. a curator, a parish priest, etc. – Is there any risk? What should I do? Who takes care of cul-



tural heritage here, in this area? What happens in the event of an emergency?), each actor involved must understand and know how the system works, including the following elements:

- bodies and persons in charge of emergency management,
- bodies and persons responsible for the management and handling of cultural assets and, in both cases, if there are specific rules and laws.

	 		
	<p>Are there any restrictions on the territory? What is the competent authority for cultural heritage? What are the reference standards? Who are the managers of the assets? Who are the owners? What obligations must they comply with? What obligations do the administration have towards them?</p>	<p>Who manages natural hazards in the area? Who can I contact to be informed of the risks? In case of emergency, how and by whom would it be managed?</p>	<p>What does the legislation say about the safeguarding of cultural heritage in this area? Who are the people in charge, the managers, the authorities in this regard? What are the specific Civil Protection (by) laws?</p>
<p>Who will be able to take charge of cultural heritage, if necessary?</p>			

Generally speaking, a cultural asset can be defined as “a tangible asset that has value as a witness to a civilisation”. However, regardless of its theoretical definition, (tangible) cultural assets are often objects or places subject to a legal restriction, which aims to protect, preserve, and enhance such assets.

What laws are in force in the territory? Who determines a restriction and how? What does that restriction entail?

The existence of a restriction imposes limitations on what can or cannot be done with a cultural asset, often even in case of emergency.

example  **ITALY**

Imposing a restriction sets forth the obligation to “preserve the specific function of the cultural asset, both through a use compatible with its historic and aesthetic value, by carrying out the conservation measures required by the Public Administration, and by asking the same administrative authority for prior authorisation for any restoration, dismemberment, displacement, removal, demolition (to be distinguished from destruction, which is always prohibited), or more generally for the execution of any work that alters the integrity of the asset.”

Regardless of the country where you live, it is reasonable to assume that local laws impose specific limitations and cautions when moving, removing, or handling restricted property, even under emergency conditions, and even in relation to Civil Protection officials and fire fighters. It is also possible that the law determines and regulates interventions in particularly urgent circumstances, in which operators have freedom to act .

On the other hand, those who own and/or manage an asset are obliged to preserve and maintain it: therefore, they should know (at least in broad terms) the potential risks to which the assets are exposed by way of natural hazards.



example



ITALY

Two regulatory frameworks interact

- a. Only authorised Civil Protection officials, Fire Fighters and Police are allowed to enter a Red Zone established by competent authorities during the alert phase or in the aftermath of a catastrophe.
- b. Only authorised experts (certified renovators can manage (handle) cultural assets and even their movement must take place under the supervision of personnel authorised by the Superintendency and the Ministry (or by the local Superintendency in the Autonomous Regions and Provinces), and under the custody of the Carabinieri Headquarters for the Protection of Cultural Heritage.



example



GERMANY

Cultural heritage and natural hazards in Germany

In Germany, protection and preservation of cultural heritage sites are subject to the laws of federal states. However, these measures are managed on a regional basis. The higher-level cultural heritage protection is defined in Section § 18 DSchG BW (Law for the Protection of Cultural Monuments - Baden-Württemberg) as the preservation of cultural heritage sites against several catastrophic events as follows:

- If tangible objects are moved or stored in other places, the owner must duly inform the lower-level cultural heritage protection authorities.
- Cultural assets should be labelled and marked according to the standard international system.
- The owner must inform the authorities in case of rescuing and securing any objects and transfer them to the official venues listed by the authorities.
- The owner of culturally relevant monuments must approve the scientific recording or other measures for documentation, protection, or restoration prescribed by the Monument Protection Authority.
- If it is not possible to protect the monument or the registered movable asset from a hazard, expropriation in favour of the State or another legal entity is permitted under public law.



Please note that the regulatory framework strongly impacts safeguarding, emergency/risk planning and management, both in terms of possible actions and the choices to be taken. Knowing the law in force in your territory is therefore crucial!



For an analysis of the roles and responsibilities in the various countries of the Alpine Area in Europe, please refer to the CHEERS reports “[Essential elements of the policy framework for cultural heritage protection in the alps – National regulatory framework review](#)”, and “[Critical overview of emergency planning schemes at the Alpine level](#)”, an overall picture of the different schemes applied at the Country level, with a summary of final recommendations for policymakers”.

Roles and responsibilities: institutional and non-institutional actors and stakeholders in Civil Protection/Disaster Management and Cultural Heritage management

As noted above, in Europe Civil Protection and Disaster Management are often organised as systems. This means that many different actors contribute to the array of Civil Protection activities, ranging from institutional subjects to voluntary associations, also including fire fighters and, sometimes, the army.

Generally speaking, all of the countries involved rely on the “subsidiarity principle”, namely the principle that a central authority should exercise a subsidiary function, performing only those tasks which cannot be performed at the local level.

The organisation of countries in either federal or unitarian states does not appear to have a major impact on the structure or design of the Civil Protection (or equivalent) systems in place, especially since the unitarian states are also quite strongly decentralised and because of the subsidiarity principle, that put the first-level responsibilities in the hands of the closest organisational level of the municipalities.

This means that, in general, **Mayors of municipalities are the first responsible for the Disaster Management/ Civil Protection systems on their territory**, unless an event hit on a wider scale or hit so hard that the local resources cannot cope all by themselves.

In the case of Italy, this “system” character is particularly strong and evident: the organisation of the entire Civil Protection structure is established under the authority of the Presidency of the Council of Minister (e.g. the office of the Prime Minister), which prioritises the theme and pinpoints its intersectoral nature: all sectors overseen by the various ministries may be called to participate in the Civil Protection effort.

In other countries, the system is organised under either the Ministry of the Interior or the Ministry of Defence. Nevertheless, also in that case, very often a coordinated organism is in place, bringing together competencies from different Ministries and bodies.

It is also the case that the Civil Protection/Disaster Management systems are arranged in a way that brings together three types of actors: political authorities (e.g. a federal or state ministry), administrative institutions (e.g. agencies, departments, regional and local offices), and technical/operative entities and support organizations (e.g. Fire Brigades, Technical Relief Agency – THW, Bundespolizei, etc.).

In keeping with its nature as a “system”, the Civil Protection/Disaster Management organisations bring together a range of actors, with different roles and responsibilities. Among those, the main ones (and recurring in most countries) are:

- **Fire Fighters** are the main corps involved in all countries, including both professional and volunteers.
- **Professional services** of different types also play a key role, as specialists qualified and entitled to operate in their specific field of competence: medics and paramedics, veterinary, social care, divers, speleologists, technicians, etc.).
- **Private sector** can get involved as well, especially when a hazard threatens **IT, energy, and transport infrastructures** (often large companies managing the infrastructures have emergency plans of their own and coordinate with the Civil Protection to provide assistance).
- **Police** are usually involved in any situation that requires the keeping of public order.
- In most countries, the **Military** can be involved in Civil Protection operations, if the conditions require it, providing manpower, equipment, and know-how.
- **Associations and NGOs** also often participate, with tasks of capacity building, training, knowledge transfer, awareness raising, qualified interventions such as restoration, etc.)



In many countries, **volunteers** represent a very large and fundamental resource in Civil Protection/Disaster Management systems, and they take part in the activities, with various roles and organised under different fashions: there are volunteer fire fighters, paramedics, civil protection units, as well as people involved with associations and NGOs who may have specific expertise.

Please note that local legislation rules on what human resources can be involved in the Civil Protection systems, with rules governing the scopes and limits of their actions.

Required qualifications and training

In many cases, cultural heritage is subject to special protection, in terms of who can actually handle works of art and restricted assets in general, in any context, even during a state of alert or emergency due to natural hazards. It is therefore crucial to be aware, at the local level, of the laws regulating who can manage cultural heritage, especially in circumstances such as those requiring Civil Protection interventions, that often involve volunteers (which are often average/poorly qualified people given the nature of voluntary activity).

Ultimately, it must be the competent authority for cultural heritage (e.g. Ministries, Superintendencies, etc.) to establish the qualifications (or positions) necessary to handle restricted assets, possibly in agreement with the Civil Protection/Disaster Management authority: in all likelihood, it will not be sufficient for a volunteer to have attended a generic course on the protection of cultural heritage in a crisis area to be qualified to handle such assets.

However, the activation of Civil Protection/Disaster Management volunteers generally depends on the Civil Protection/Disaster Management authority itself. Therefore, if the competent authority for cultural heritage determines whether volunteers, based on their qualifications, can operate or not, the Civil Protection/Disaster Management, in turn, activates the volunteers and decides whether they can or cannot access the areas at risk and work there.

As we will see in [Module 4](#) and [Module 5](#), the activities for safeguarding cultural heritage can be diverse and complex, so it is reasonable to assume that unskilled volunteering can still be used for simpler activities, such as packaging or cataloguing support, while more complex operations must be reserved for qualified and authorised personnel.

Given the increasingly recognised importance of safeguarding cultural heritage, there is a growing need to clarify the aspects related to the qualifications required to be able to participate, even as volunteers, in these activities, and to support a specific type of training to ensure that the new operators are properly qualified.



FINAL CHECKLIST



They identify who are the competent authorities for cultural heritage, or curators of specific assets in the area (for identification of the assets, see [Module 2](#))



Check out the local Civil Protection/ Disaster Management structure, get in touch with the local Council or Mayor to find out about the Civil Protection/Disaster Management Plan and the risks that exist in your territory



Check out the local regulatory framework on cultural heritage!



Find out about our local Civil Protection association/volunteers

IDENTIFYING HERITAGE AT RISK



Identifying cultural heritage

Identifying natural hazards

Matching information: areal exposure of cultural heritage

NEXT STEP



DETERMINING RESCUE PRIORITIES

IDENTIFYING HERITAGE AT RISK: CULTURAL HERITAGE AND NATURAL HAZARDS

What cultural assets (in this case structures, buildings) are included in the historic centre? Pictured, buildings deemed as cultural heritage (or which contain cultural assets) are marked with a yellow star. ★

The river is subject to flooding. In that case, what are the areas subject to flood risk in the historic centre area?

Consequently, which of the cultural heritage buildings (or containing it) would be affected by a possible flood? Heritage exposed to hazard is marked with a blue star. ★

This operation, which conceptually is very simple, is technically called “overlay”: it involves superimposing two layers of available information on a map to verify their possible spatial interaction.

“**Overlay**” is the simplest and most immediate action that can be performed to understand if cultural heritage is placed in a potentially risky area. As we will see later, the mapping of different types of hazards works in different ways.

However, overlay alone is not sufficient to fully grasp the nature of the hazard to which heritage may be exposed, nor to know if it is actually at risk. Let’s look at an example.



example  **ITALY**

The *Church of Sant'Apollinare* in Trento is located near the right bank of the Adige River, just beyond the embankment. In the event of a flood, the Church would certainly be affected. Through the mere overlay operation, all heritage contained in the Church (statues, paintings, frescoes, architectural elements, and so on) would also be exposed to the hazard. Is this true? In the event of a catastrophic flood, the water could reach 2 metres in height. The ancient portal of the Church would certainly be involved, but the Statues of the Holy Bishops are placed on platforms at a height of about 2.5 metres: it may be assumed that the water would not touch them.

Therefore, detailed information on the placement of individual assets can be crucial in assessing the actual exposure of heritage to a hazard.

However, we will delve into these issues in [Module 3](#), and for the time being the aim is just to put cultural heritage and natural hazards in spatial relation.

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HAZARD: “The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.”

EXPOSURE: “The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.”

RISK: “The potential for consequences [= impacts] where something of value is at stake and where the outcome is uncertain (...). Risk results from the interaction of vulnerability, exposure, and hazard (...).”



In this phase, the key questions we must ask ourselves are therefore the following:

	<p>Which cultural assets are included in the reference area? What risks exist in the reference area? How and where are the phenomena related to natural hazards distributed? Where would they develop?</p>	<p>Where can maps of hazard-prone areas be found? Where can one find cultural heritage maps? What information does such maps include?</p>	<p>What types of risks are cultural assets exposed to? What are the dangerous areas?</p>
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Identifying cultural heritage

Starting from the fundamental principle that **we cannot protect what we do not know**, in each territory the competent Institutions, or even the action of private citizens (see “The role of the Open Data” box), carry out a cataloguing of the existing cultural heritage, both aimed at preserving it and enhancing its function.



CHEERS report “[Knowledge base on geo-spatial catalogues of cultural heritage in the Alpine area](#)” addresses the existing repositories and archives of the partner countries where cultural assets are quantitatively and qualitatively documented and archived, with a special focus on online open sources.

Thus far, the cataloguing conditions of cultural heritage that the CHEERS project has been able to find in the Alpine area are rather heterogeneous from country to country. However, albeit with differences, catalogues of cultural heritage are available in all countries, both at the national and local level.

There are two main questions to answer when considering these resources:

- Are the catalogues publicly available or is access to them restricted? (see “The role of the Open Data” box)
- Are the catalogues “georeferenced”?

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Georeferenced means, in layman’s terms, that it contains precise information with respect to the spatial location of the objects described, through coordinates in a geographical reference system; or, even more precisely, that data are provided by a geographic information system, namely a Geographic Information System (GIS).



Another crucial issue is whether the cataloguing is carried out using standard criteria, established by legislation that attempts to standardise information through which an asset is identified and described. Indeed, even in the same territory we could find different catalogues, implemented by different subjects with their own purposes, in which the same asset is described by heterogeneous details and data. Furthermore, only a few inventories are organised by means of scientific cataloguing logic (with information such as the weight, the characteristics of the materials, the structural features, etc.), while many others comply with criteria that are mostly geared towards boosting tourism.

What cultural heritage is at stake?

The catalogue profiles of cultural assets are often organised into three main categories:

- Amovable items (for example objects such as paintings, sculptures, or archaeological finds)
- Immovable assets (for example palaces, churches or archaeological sites and monuments)
- Intangible assets (for example oral traditions, languages, the performing arts, social and ritual practices)

Please note that the CHEERS project only deals with tangible heritage whether or not this refers to movable or immovable assets. In fact, these are the only objects of interest in terms of emergency planning.

The general categorisation of tangible heritage taken into account here, includes:

Items (potentially movable)	Collections and individual items (paintings, sculptures, carved objects, culturally relevant assets, etc.); Documents (papers, books, photos, etc.).
Structures (immovable)	Monumental sites; Archaeological sites; Modest (or small) and local vernacular heritage.

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It should also be borne in mind that, when dealing with immobile heritage, two elements must be taken into consideration: **the architectural features of the buildings**, together with the **valuable aesthetic elements** that decorate and complete the structure, which may represent particularly vulnerable components.

In [Module 3](#), we will also discuss the materials of which a cultural asset is made, in relation to the fragility or vulnerability of those materials with respect to damage agents linked to natural hazards.

Further characterisation of cultural heritage, which is fundamental for emergency planning purposes, concerns the current management level of the asset or site. There are sites, such as many museums, that already have management staff and often also a security plan, which engages with the safeguarding of their heritage in the face of different types of emergencies. At best, these security plans are also already integrated with the local disaster management system, in case the museum is unable to handle the emergency on its own, but it needs to resort to the intervention of Civil Protection.

Other possible cases are those of complex sites that are fully managed, such as an archaeological area which includes different structures and extends over a large area; complex sites



that are only partially managed, such as the historic centre of a town full of cultural heritage, integrated into the urban fabric; single, isolated, minor, and unmanaged or only partially managed cultural assets, such as votive chapels, churches, or isolated historic buildings, etc.

The first and most relevant information to be obtained is the location of these assets, i.e. precisely where they are located within the reference territory.



So, what are the main sources of information and catalogues of cultural heritage, which are also “georeferenced”, or available in the countries and towns of the Alpine area?

Below you can find a list of the main portals and sources of information on cultural heritage and their location in the territory (last update: July 2021) for EU countries of the Alpine area (plus local portals, where available).

State	Level		Source
Austria	National	Bundesdenkmalamt	Bundesdenkmalamt-Denkmalverzeichnis
	Wien	Stadt Wien	Wien kulturportal / Stadtplan / Kulturgut
	Lower Austria	Land Niederoesterreich	NÖ Landesverwaltung / NÖ karten und geoinformation / NÖ Atlas
			Kleindenkmäler - Zeichen unserer Kulturlandschaft Niederösterreich 3D
	Upper Austria		Digitales Oberösterreichisches Raum-Informationssystem (DORIS)
	Salzburg		Land Salzburg / Geodaten / SAGISonline Portal / Kultur
	Tyrol		Land Tirol - Tiris Map
	Vorarlberg		Geodaten des Vorarlberger Geografischen Informationssystems (VoGIS) / Vorarlberg Atlas
	Carinthia		KAGIS-Geoinformation Land Kärnten /KAGIS Maps /KAGIS-Projekte / Kultur
Styria		Landesentwicklung Steiermark / GIS-Steiermark / Digitaler Atlas / Kartenportal /Fachkarten / Bildung und Kultur	
France	National		Ministère de la Culture - Atlas des patrimoines Ministère de la Culture - data.culture.gouv.fr - la plate-forme de donnée ouverts
Germany	National		Deutsche Denkmallisten
	Bayern		Denkmalnetz Bayern



State	Level	Source
Italy	National	Ministero della Cultura Istituto Centrale per la Catalogazione i Documenti (ICCD) dati.beniculturali.it Vincoli in rete Carta del Rischio
	BeWeb	CEI - Ufficio Nazionale per i beni culturali ecclesiastici e l'edilizia di culto BeWeB - Beni ecclesiastici in web
	Liguria	Regione Liguria ICBC - Inventario Catalogo dei Beni Culturali della Regione Liguria
	Piemonte	Regione Piemonte Mèmora - piattaforma del patrimonio culturale del Piemonte
	Lombardia	Regione Lombardia SIRBeC - Sistema informativo Regionale dei Beni Culturali Geoportale Regione Lombardia
	Veneto	Regione Veneto Catalogo Beni Culturali del Veneto
	Friuli Venezia Giulia	Regione Friuli - Venezia Giulia ERPAC FVG - Ente Regionale Patrimonio Culturale del Friuli-Venezia Giulia
	Valle d'Aosta	Regione Valle d'Aosta Catalogo dei beni culturali della Regione Valle d'Aosta
	Alto Adige/ Südtirol	Provincia Autonoma di Bolzano/Bozen Catalogo dei beni culturali dell'Alto Adige Beni culturali Alto Adige - Monumentbrowser
	Trentino	Provincia Autonoma di Trento Portale Geocartografico Trentino
Slovenia	National	Republika Slovenija - GeoHub-SI



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Types of maps: points or polygons

A particular aspect to consider when searching for data related to cultural heritage buildings (data to be used in emergency plans) is the type of “geometry” employed to make those data available (Figure 3). Notably, having point-based data (usually the *centroids* of the building plans or, in the worst case, an approximation of the geographic coordinates of the building) allows you to perform rougher analysis than those possible with the polygons-based data. For example, in case of risk analysis that can be derived from a forest fire or a crash of vegetation nearby the structure, it is crucial to know the layout details of the plan to identify the actual contact between the vegetation and the building. Even in the event of a flood, it is possible that only one of the façades of a building is actually exposed to water.



Figure 3
in pink, centroids indicating the location of cultural heritage buildings; in blue, the polygon delimiting the perimeter of the building itself



How is cultural heritage catalogued and described?

? What are the standard or most common fields in the cataloguing of cultural heritage?

In the most structured catalogues for cultural heritage, each asset is described by a set of information regarding:

- Who: the author and / or cultural sphere; the owner or holder; the competent institutional body tasked with protection
- What: the typology; the denomination; the description
- Where: the location of the asset
- When: the dating of the asset
- How: the material and the construction technique

The above-mentioned characteristics vary according to the type of items, and descriptions may be associated with one or more multimedia documents.

However, cultural heritage catalogues have not necessarily been designed for emergency planning purposes, although they already incorporate, in many cases and in general, the logic inherent in the conservation and safeguarding of cultural heritage.

The situation of these catalogues is therefore multi-faceted: on the one hand, there is often a lack of useful information, in particular that related to the georeferencing of assets; on the other hand, the catalogue may contain a large amount of high-quality information, but which is not relevant to the purpose of safeguarding assets in the face of natural hazards.

? What information describing cultural heritage is particularly useful for the purposes of Emergency Planning?

Regardless of the information contained in the various catalogues available, we shall attempt to briefly summarise what information could be fundamental in terms of emergency planning and should therefore be included in catalogues as part of the description of cultural heritage.

- **Location** (X, Y and Z): the precise location of each asset. For an immovable asset, say a piece of architecture, it would be ideal (as previously suggested) to have the geometry of the building plan available. For a movable asset contained in a building, it would be best to have the most accurate information possible on its position

inside the container. Its height from the ground, in this case, is not secondary information; it is useful, for example, to ascertain if the expected water level would reach the asset, or if the asset is reachable if it must be relocated, and it's also useful to verify the height at which it will be damaged from a fall in the event of an earthquake ([Module 3](#)).

- **Material and state of conservation.** Information on material and the current state of conservation of an asset can instead be particularly useful for understanding its fragility and vulnerability to agents that can cause damage (water, fire, physical impact, etc.). Furthermore, it is good to know the materials it is made of, in case of handling ([Module 3](#)).
- **Weight and dimensions, handling methods** (leaning, hanging, fixed asset, etc.). At the same time, it could be crucial to know the weight and dimensions of an asset and the methods to be used to remove it in the event that handling is needed or appropriate ([Module 4](#)).

Although in this phase location is the only information needed, in [Module 3](#) and [Module 4](#) we will discuss and explain the fundamental importance of the other information listed above.

Identifying natural hazards

The methodological path and the various pilot cases of the CHEERS project involved a wide range of natural hazards that can threaten cultural heritage. In particular, they include:

- floods,
- storms,
- avalanches,
- earthquakes,
- landslides and rockfalls,
- wildland-urban interface forest fires.

Each of these hazards is characterised by a different dynamic, and it develops in specific times, places, and ways. Hazard and risk studies, along with emergency planning, are devoted to address these natural and dangerous phenomena.

While on the one hand, Emergency and Civil Protection Plans are designed by municipalities, studies concerning hazards of a territory require different skills and abilities, which only Regions or even States can afford (in terms of funds and resources).

Information and data obtained are then made available to those who are tasked with managing the security of the territory and emergency planning in different ways.

The objective of this module is to briefly discuss what information is useful for distinguishing natural hazards, where such information can generally be found, and finally how to use it in identifying what we will call “cultural heritage at risk”.

What natural hazards can affect the area?


Cultural heritage can be situated in a territory exposed to a number of risks, not necessarily just one. The hypothesis that multiple hazards coexist is indeed the most probable.



CHEERS report “[Knowledge base on natural hazard mapping in the Alpine area - Survey and analysis of natural hazard mapping sources and methodologies available](#)” provides detailed information about the sources and characteristics of databases of natural hazards in Alpine countries.



Below you can find a list of the main portals and sources of information on cultural heritage and their location in the territory (last update: May 2020) for EU countries of the Alpine area (plus local portals, where available).

State	Hazard	Level	Source
Austria 	Floods Landslides Earthquakes Storms	National	• HORA – Natural Hazard Overview & Risk Assessment Austria
	Rockfalls	National	-
	Forest Fires	National	• Zentralanstalt für Meteorologie und Geodynamik (ZAMG)
	Avalanches	National	• HORA – Natural Hazard Overview & Risk Assessment Lawineninfo Österreich
France 	Floods	National	GeoRisques (BRGM) Inondations Cartes interactive
		Provence - Alpes - Côte d'Azur	Observatoire Régional des Risques Majeurs de Provence - Alpes - Côte d'Azur (ORRM PACA) RiskPACA (BRGM)
	Landslides Rockfalls	National	GeoRisques (BRGM) Mouvements de terrain Cartes interactive
		Provence - Alpes - Côte d'Azur	Observatoire Régional des Risques Majeurs de Provence - Alpes - Côte d'Azur (ORRM PACA) RiskPACA (BRGM)
	Forest Fires	National	GeoRisques (BRGM) Feux de forêt Cartes interactive
		Provence - Alpes - Côte d'Azur	Observatoire Régional des Risques Majeurs de Provence - Alpes - Côte d'Azur (ORRM PACA) RiskPACA (BRGM)
	Avalanches	National	GeoRisques (BRGM) Avalanches Cartes interactive INRAE – www.avalanches.fr Meteo France Météo Montagne
		Provence - Alpes - Côte d'Azur	Observatoire Régional des Risques Majeurs de Provence - Alpes - Côte d'Azur (ORRM PACA) RiskPACA (BRGM)
	Earthquakes	National	GeoRisques (BRGM) Séismes Cartes interactive
		Provence - Alpes - Côte d'Azur	Observatoire Régional des Risques Majeurs de Provence - Alpes - Côte d'Azur (ORRM PACA) RiskPACA (BRGM)
	Storms	National	Meteo France



State	Hazard	Level	Source
Germany	Floods	National	<ul style="list-style-type: none"> • Hochwasserportal Länder-Übergreifendes • Risklayer - CEDIM – Risk Explorer (Center for Disaster Management and Risk Reduction Technology) • Geoportal.de – GDI-DE (Geodateninfrastruktur Deutschland) • Bundesanstalt für Gewässerkunde Wasserstände
		Baden Württemberg	<ul style="list-style-type: none"> • Landesanstalt für Umwelt Baden-Württemberg Hochwasservorhersage BW Daten- und Kartendienst • Hochwasservorhersagezentrale Baden-Württemberg
		Bavaria	<ul style="list-style-type: none"> • BayernAtlas Naturgefahren • Bayerisches Landesamt für Umwelt - Hochwassernachrichtendienst Bayern
	Landslides	National	<ul style="list-style-type: none"> • Bundesanstalt für Geowissenschaften und Rohstoffe BGR-Geoviewer
		Baden Württemberg	<ul style="list-style-type: none"> • Baden-Württemberg – Regierungspräsidium Freiburg – Landesamt für Geologie, Rohstoffe und Bergbau (LGRB) Kartenviewer
		Bavaria	<ul style="list-style-type: none"> • BayernAtlas Naturgefahren
	Rockfalls	Baden Württemberg	<ul style="list-style-type: none"> • Baden-Württemberg – Regierungspräsidium Freiburg – Landesamt für Geologie, Rohstoffe und Bergbau (LGRB) Kartenviewer
		Bavaria	<ul style="list-style-type: none"> • BayernAtlas Naturgefahren
	Forest Fires	National	<ul style="list-style-type: none"> • Deutsche Wetterdienst Waldbrand-Gefahrenindex
	Avalanches	Bavaria	<ul style="list-style-type: none"> • Lawinenwarndienst Bayern • BayernAtlas Naturgefahren
Earthquakes	National	<ul style="list-style-type: none"> • Geoportal.de – GDI-DE (Geodateninfrastruktur Deutschland) • Risklayer - CEDIM – Risk Explorer (Center for Disaster Management and Risk Reduction Technology) 	
	Baden Württemberg	<ul style="list-style-type: none"> • Baden-Württemberg – Regierungspräsidium Freiburg – Landesamt für Geologie, Rohstoffe und Bergbau (LGRB) Kartenviewer Aktuelle Erdbeben 	
	Bavaria	<ul style="list-style-type: none"> • Bayerisches Landesamt für Umwelt - Erdbebendienst Bayern Erdbebenkatalog Aktuelle Beben 	
	Rheinland-Pfalz	<ul style="list-style-type: none"> • Rheinland-Pfalz - Landesamt für Geologie und Bergbau Erdbeben 	
Storms	National	<ul style="list-style-type: none"> • Deutsche Wetterdienst Analysen radarbasierter stündlicher (RW) und täglicher (SF) - Niederschlagshöhen Warnungen – aktuell • Risklayer - CEDIM – Risk Explorer (Center for Disaster Management and Risk Reduction Technology) 	



State	Hazard	Level	Source
Italy	Floods	National	<ul style="list-style-type: none"> • Geoportale nazionale – Ministero dell’Ambiente e della Tutela del Territorio e del Mare – Ministero della Transizione Ecologica • ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale Dati e indicatori
		Local level	<ul style="list-style-type: none"> • Autorità di Bacino Distrettuali • Geoportali delle Regioni italiane
	Landslides	National	<ul style="list-style-type: none"> • IFFI – Inventario dei Fenomeni Franosi in Italia (ISPRA)
		Local level	<ul style="list-style-type: none"> • Geoportali delle Regioni italiane
	Rockfalls	National	<ul style="list-style-type: none"> • ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale Dati e indicatori
		Local level	<ul style="list-style-type: none"> • Geoportali delle Regioni italiane
	Forest Fires	Local level	<ul style="list-style-type: none"> • Siti dei Comuni d’Italia (catasto degli incendi)
	Avalanches	National	<ul style="list-style-type: none"> • ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale Dati e indicatori
		Local level	<ul style="list-style-type: none"> • Geoportali delle Regioni italiane
	Earthquakes	National	<ul style="list-style-type: none"> • Istituto Nazionale di Geofisica e Vulcanologia – INGV Portale dei dati aperti • Dipartimento della Protezione Civile Rischi: Rischio Sismico
Local level		<ul style="list-style-type: none"> • Geoportali delle Regioni italiane • Siti dei Comuni d’Italia 	
Storms	National	-	
Slovenia	Flooding	National	<ul style="list-style-type: none"> • Agencija Republike Slovenije za Okolje ATLAS OKOLJA
	Earthquakes	National	<ul style="list-style-type: none"> • Geološki zavod Slovenije GEOPEPIA.SI LITE
	Landslides	National	-
	Rockfalls	National	-
	Forest Fires	National	<ul style="list-style-type: none"> • Varstvo gozdov Slovenije - portal
	Avalanches	National	<ul style="list-style-type: none"> • Avalanche cadastre
Storms	National	<ul style="list-style-type: none"> • Agencija Republike Slovenije za Okolje ARSO Meteo: Opozorila 	
Switzerland	Flooding	National	<ul style="list-style-type: none"> • Natural Hazards Portal - Swiss Federation • Federal Office for the Environment (FOEN) Section Topics: Natural Hazards Section Data, indicators, maps: Maps
		National	<ul style="list-style-type: none"> • Swiss Federal Institute for Forest, Snow and Landscape Research WSL Natural Hazards
	Landslides	National	<ul style="list-style-type: none"> • Swiss Seismological Service (SED)
	Rockfalls	National	<ul style="list-style-type: none"> • Federal Office of Meteorology and Climatology - MeteoSwiss
	Avalanches	Canton Ticino	<ul style="list-style-type: none"> • Geoportale Ticino • Mappa dinamica del Geoportale Ticino



How hazards are assessed and described?

Natural hazards are assessed by delimiting the areas that could be affected by the specific natural phenomenon under scrutiny. Therefore, a general description of the expected territorial distribution of hazards must be provided, together with Level-1 information on the predicted impact areas and the return periods of the event.

info Given a reference event of known magnitude, the return period, or recurrence interval, can be defined as the average time between two consecutive events of equal magnitude. In other words, it corresponds to the average time in which an assigned intensity value is equalled or exceeded at least once.

The Level-1 information on the areas potentially affected by hazards should be integrated with further data, to predict the severity of the expected events, as well as to evaluate their possible impact if the collected dataset makes this knowledge available (e.g. water flow, flood speed, landslide or avalanche volume, etc.)

Floods

Flood hazard maps show the area where the water overflow can expand in the case of an event (they usually include several areas depending on its intensity). In fact, floods are generally described as an integration of possible events classified according to their return period.

An event with a 5-year return period will cause the water to overflow in an area that is probably smaller than an event with a 30-year return period, but it is still defined as a high hazard, since the focus is primarily on its frequency. An event with a 200-year return period will technically be described as low hazard (due to frequency), but also catastrophic due to its magnitude.

It should also be noted that less frequent events, yet involving more water overflow, can often determine higher and therefore more dangerous “water heads”, that is, the height that water can reach in flooded areas (15cm ankle level? 0.5m knee level? Or is it enough to submerge a person of average height?). Another very relevant piece of information (but even more difficult to predict and calculate) is the flow speed that water will reach in the flooded areas, which can determine whether a person or an object could be violently dragged away by the water flow.

Wildland-urban interface forest fires

The exposure of cultural heritage to forest fires occurs in the so-called “interface areas”. Specifically, they are defined as “wildland-urban interface forest fire”, that is, the fires that develop in areas where woods and urban settlements meet.

While datasets about forests are widespread and generally accessible, due to their tendency to be impacted by fires, the surveys carried out within the framework of the CHEERS project have highlighted the lack of maps specifically aimed at determining fire hazard in the interfaces between wooded and built-up areas.

However, some methods have been developed, for example the one proposed, in Italy, by the National Department of Civil Protection (“Operational Manual for the preparation of a Municipal or Inter-Municipal Civil Protection Plan”, 2007) and specifically designed for emergency planning. Through a GIS-based analytical process, and integrating multi-source data (type and density of vegetation, slope, type of contact between forest and urban areas, the criticality level estimated thanks to fire risk maps, and distance from previous fires), this method makes it possible to:



- Estimate the fire hazard rate in areas where woods and urban settlements meet
- Determine the criticality level to which built-up areas (and the cultural heritage they contain) are exposed at the interface with forests



Earthquakes

Storms are extreme weather events whose frequency and intensity, according to the most recent studies, are increasing due to climate change. Moreover, these are complex phenomena, which can combine several risk factors: wind, precipitation in the form of water, ice or snow, lightning. As atmospheric events, they are predictable in the meteorological sense, but remain substantially unpredictable in their effects on the ground. Similarly, they are not mappable per se: technologies such as satellites and meteorological radars allow experts to monitor storms in their spatial organisation, and local climatic characteristics make it possible to express whether an area is more or less subject to storms seasonally, but a real mapping of the phenomenon does not exist. However, there may be maps of the damage caused by the storms that have occurred and, of course, maps of the assets potentially exposed to this danger.



Earthquakes

Sismic hazard is a topic of fundamental importance, which differs, in many respects, from other hazards listed here. There are no known nor established parameters (the so-called precursors) to predict seismic events. However, every country in Europe has implemented territorial mapping, which is sometimes highly detailed and indicates how strong and devastating an earthquake could be in a certain place.



Avalanches

In the case of avalanches, data on the historical occurrence of events (possibly with a magnitude-based classification), or on the current status of snow accumulation (with an estimate of the volume and the energy potentially involved) are fundamental to structure hazard maps. Moreover, where the complex ground morphology does not make it possible a reliable identification of the avalanche situation, the maps may provide a delimitation of the areas potentially exposed to avalanches hazard.



Landslides/Rockfalls

As for **landslides** (hydrogeological risk), hazard mapping usually identifies, besides the geographical areas where instabilities already occurred, the areas where the phenomena are likely to evolve and new instabilities are likely to occur.

Specifically, they could provide information on:

- State of instabilities:
 - Active: those phenomena that are in place or which occurred during a certain amount of time in the past (e.g. 30 years)
 - Latent: those which showed sign of activity in a more recent period of time
 - Stabilised: those which were subject to consolidation works or have naturally achieved a steady state
- Type of the instabilities:
 - Processes of slope instability
 - Alluvial fans
 - Processes involving the hydrographic network in mountain or hill areas



Rockfalls are specific phenomena that depend on multiple factors, which include climate, biotic, and human-induced agents triggering such events. They are sudden events of breaking, sliding, rolling, and falling of one or more parts of a rock due to gravity.

To be able to evaluate the rockfall hazard, it is essential to quantify the frequency of rockfall, which is usually done by collecting historical data on past events or by dating rockfalls via assessing the chemical weathering of bedrock and several dating methods (using lichen on rocks, radiometry, dendrogeomorphology by assessing visual scars on trees, and geo-mechanical dating). This information allows you to determine the return period, which is crucial in the context of cultural heritage management, as rockfall are common throughout the Alpine region. The frequency and magnitude of rockfall are key inputs for cultural heritage protection/safeguarding as they are essential parameters to plan sufficient measures and avoid damage on cultural assets. A combined spatial information on both aspects would make it possible to realise a rockfall hazard map, where alternative extents (area of rockfall deposit zone) of rockfall events would be represented.

In the following [Module 3](#), we will see that determining the real exposure of cultural heritage to a certain hazard requires other information and evaluations, in addition to the simple geolocation of the assets in the territory.

Matching information: areal exposure of cultural heritage

By overlaying natural hazard maps and those showing the geolocation of cultural heritage, we therefore obtain an initial identification of two elements that will become even more critical in the subsequent phases of the emergency planning process:

- The reference risk events, around which to structure the risk and emergency management response;
- The assets exposed to danger, through a characterisation that we could define as “Level-1” or “potential exposure”.

This operation essentially provides us with fundamental data, that is, a first set of potential hazards and elements at risk on which the subsequent phases of the analysis, illustrated in the following modules of the Sourcebook, will then focus.

Defining risk scenarios

Delimiting areas that could be affected by hazards and identifying cultural heritage within these areas are preliminary, albeit necessary, phases in developing fundamental emergency planning contents. Notably, the Civil Protection or Natural Disaster Risk Management Plans include the formulation of reference risk scenarios.

info Risk scenarios can be interpreted both as “descriptions of plausible events that may occur in the future”¹, and as tools capable of supporting hazard response and planning actions to be taken beforehand, during or immediately after the onset of an event.

These are essentially descriptions of what could happen on the inhabited area and its structures in the event that a natural phenomenon strikes an area: using these data, the Civil Protection/Disaster Management system works on its own “preparedness” to be trained and be able to respond to any emergency. Thus, examples of risk scenarios are the flooding of a river with a 200-year return period, the landslide of a monitored deep-seated gravitational slope deformation, the wildland-urban interface fire that could affect a specific area, a magnitude 6 or 8 (Mercalli Scale) earthquake event, etc. Taking into consideration each scenario, the system formulates a response and implements emergency plans.





A further step is required when framing risk scenarios, that is, the description of how early warning communication contributes to activating Civil Protection interventions. As for this step, however, reference should be made to deliverable CHEERS report “[A New Concept of Civil Protection Plan](#)”

Open Data for Heritage Protection

Opening data about heritage, hazards, and risks contributes to a better and more efficient safeguard of cultural assets. Data – including texts, images, archives, and maps – is both a source of information and a tool to assess risks, prepare, respond to emergencies, and recover from them.

Opening data means to allow them to become interoperable and to potentiate their use among all stakeholders involved in risks prevention and heritage protection. Data can be used to increase awareness about risks and self-protection, and citizens can contribute to integrate and monitor data, in particular by participating in collaborative online projects such as **OpenStreetMap**, **Wikidata**, **Wiki Loves Monuments** on **Wikimedia Commons**, and **Wikipedia**.

The importance of opening data is increasingly recognised by public institutions, i.e. in Open Government, Open Access and Open Science. The **2019-2022 European Work Plan for Culture** sets out as high priority the sustainability of culture, and it stresses the importance of digitalisation – to potentiate access, expression, preservation, dissemination, and consumption of cultural heritage – and the relevance of cultural statistics to support evidence-based policy making at European and national level. In line with the **Alpine Space** strategies, the interoperability of data contributes to a fully cross-border and international exchange of information and cooperation.

Collecting data about heritage and hazards makes it possible to plan and systematise practices of intervention, useful both in terms of the preservation of the sites and in the actions to be carried out during and after the emergency.

How to Open Data

Open Data is structured data, texts, images, archives, and maps which is released with an open license and fully accessible for use, reuse, modifications for all purposes, also commercial purposes:

Open license / Free license is an authorisation that allows users to use, reuse, modify, transform and distribute data for non-commercial and commercial purposes (texts, images, information software, hardware, and so on). Among the open licenses, for data it is recommended the use of Public domain or CC0 Creative Commons Zero or similar. Texts and images can be released also under the licenses CC BY - Creative Commons attribution and CC BY-SA - Creative Commons attribution share alike or similar. It is not enough to write Creative Commons to indicate the license.

The interoperability of data requires a common understanding about how to prepare and structure data, following the principles of FAIR data:

FAIR data are data that are Findable, Accessible, Interoperable, and Reusable (the acronym of FAIR) - <https://www.force11.org/group/fairgroup/fairprinciples>. Making data FAIR means publishing them in an open repository, with metadata, in an open and editable format, and releasing them with an open license.

Data can be made available on different **platforms** to encourage their use, reuse, modification, and their selection and transformation for different purposes:

INSPIRE Knowledge Base is the European infrastructure for spatial information. It aggregates data and it is based on the infrastructures for spatial information established and operated by the Member States of the European Union. Data is interoperable but not necessarily open. <https://inspire.ec.europa.eu/>

Austria - *Hora*: <https://www.hora.gv.at/>

France - *Géorisques*: <https://www.georisques.gouv.fr/>

Italy - *Istat Mappa dei rischi dei comuni italiani* <https://www.istat.it/it/mappa-rischi>



Fully open and collaborative platforms are OpenStreetMap, Wikidata, Wikimedia Commons, and Wikipedia:



OpenStreetMap is a collaborative repository of georeferenced data released with the open license ODbL similar to the CC BY-SA. It has in 2021 around 7 million users and over 8.9 billion GPS points.

<https://www.openstreetmap.org>

OpenStreetMap involves volunteers for disaster response through the Humanitarian OpenStreetMap team (HOT) and other specific projects and cooperative initiatives for disaster response and humanitarian mapping.



Wikidata is the largest existing online collaborative repository of structured linked open data. It is multi-lingual and all data are released under the CC0 license. In 2021 it has around 94 million items, that anyone can edit.

<https://www.wikidata.org>



Wikimedia Commons is a collaborative repository of multimedia files released with an open license (CC0, public domain, CC BY, CC BY-SA or similar). In 2021 it has a collection anyone can contribute of around 74 million media files anyone can edit.

<https://commons.wikimedia.org>



Wiki Loves Monuments is a contest dedicated to photos about material cultural heritage and it has triggered, between 2010 and 2020, the upload of 2.6 million pictures taken by over 98,000 volunteers and related to 1.5 million monuments located in 93 countries. Wiki Loves Monuments is organised in over 40 countries in September each year since 2011 and it is managed by each nation independently. Data about monuments are uploaded on Wikidata in CC0 and photos are uploaded on Wikimedia Commons, frequently with the CC BY-SA licenses.

<https://www.wikilovesmonuments.org>



FINAL CHECKLIST



Which cultural assets are included in the reference area?

Which are managed and which are not? If they are, who take cares of their management?

What information on natural hazards is available in my area?



Which cultural heritage catalogues are available?

Which datasets on natural hazards exist for the area under scrutiny?

Is there any updated Civil Protection plan available? If so, what information does it contain?



What are the basic risk scenarios to be analysed in detail subsequently when implementing Emergency Planning?



Check out the local Disaster Management/Civil Protection structure, get in touch with the local council or mayor to find out about the Civil Protection/Disaster Management Plan and the risks that exist in the territory

What natural hazards threaten the cultural heritage under my supervision? How can I stay informed?



What open data is available with regard to the information I am seeking?

What kind of dialogue can I have with the open data community?

DETERMINING RESCUE PRIORITIES

3



Time, risk scenarios and priorities

The need for prioritisation

Priorities: how and what?

Evaluating risk and priorities: the CHEERS suite of tools

Defining the priority value



NEXT STEP



DEFINING SAFEGUARDING TECHNIQUES

DEFINING RESCUE PRIORITIES FOR INTERVENTION

Having established the need and urgency to safeguard the cultural heritage from natural hazards, we proceeded to identify the different types of cultural heritage and natural hazards, and began to understand how the two elements interact with each other in space.



So, now the key question becomes: how to safeguard cultural heritage from dangers?

As previously mentioned, in situations of alert or emergency, the response of the Civil Protection primarily aims to ensure people's safety, and this is the primary field of action on which operators are called to intervene.

Furthermore, interventions on cultural heritage can be time-consuming, complex, and often actions to prevent damages or stabilise the conditions of an asset must be carried out quickly, thus requiring a large deployment of forces.



The currently available resources for safeguarding cultural heritage could be fewer than the theoretical needs, thus leading to further work on the concept of "priority": **Given the limited resources available, what should I save first and what could be lost if circumstances dictate?**

This module will focus precisely on the issue of "priority", and on which criteria the CHEERS process suggests using to determine it.

The subject of resources needed for safeguarding interventions will be later discussed in [Module 4](#) of this Sourcebook.

Time, risk scenarios and priorities

In the previous module, we concluded with the need to define risk scenarios. The scenarios (e.g. a river flood with a 200-year return period) should show us not only the most likely dynamics of an event (in the worst-case scenario, at least to increase preparedness), but also the timespan associated with the development of the event. In this sense, Civil Protection/ Disaster Management systems resort where possible (predictable events) to the so-called early warning systems.

Early warning systems

As we have already seen, from the standpoint of contingency planning, natural hazards can be assigned to two main categories: predictable and unpredictable. All events for which precursors can be identified belong to the first category. Others include, with varying degrees of predictability, natural phenomena such as floods, landslides, forest fires or avalanches.



While in the event of unforeseeable risks, the Civil Protection deploys its activities immediately after the outbreak of events with the aim of managing the emergency, in the face of predictable scenarios, the Civil Protection can gradually activate its response and implement prevention activities of increasing intensity along with increasing alert levels.

To prepare Civil Protection structures to deal with and manage risky situations, emergency planning must include a full integration of early warning systems into the overall risk management process.



CHEERS realised two themed reports: "[Critical overview of Emergency Planning schemes at Alpine level](#)" and "[A new concept of Civil Protection Plan](#)", which discusses in more detail early warning systems in the context of emergency planning and their dissemination in the Alpine area.




info Forewarning


With reference to foreseeable risks, a key issue that must be taken into consideration in the planning process is the advance notice period, e.g. the time between the issuance of an alert and the moment when the first manifestations of impacts on the ground will occur.

The definition of priorities that will be discussed in this module will obviously be useful in improving the management of forewarning in case of predictable events. However, these data can also be used for planning preventive interventions in the context of seismic events, or for risk prevention and mitigation in general.

The need for prioritisation

Let's imagine these situations: "The Civil Protection system sounds an alarm: heavy rain is about to fall and a catastrophic flood could be expected. Many cultural sites are located in the city: will the sites (churches, buildings, museums, etc.) be flooded? If so, what will happen? How high could the water raise? What damage could it do?", or "the season is particularly hot and dry, the risk of fire in the woods around our town is very high. How should we prepare? What would happen if the flames came to lick the Castle?"

 Take the Church of Sant'Apollinare in Trento, for example: we know that inside there are many important objects. If the water comes, will they be in danger? Are those objects fragile, vulnerable to water? What should we do then? And what should we have done before, in peacetime? Furthermore, now, during the alert and emergency phases, time and resources are limited. What should I "save" first, if I have to choose?

 Similarly, if a fire threatened the Anthony's Main Road mine in Idrija, what objects could be considered safe, behind fire doors and protected by a fire protection system? Which ones could be damaged by smoke or flames? Should we plan to save some of them?

Here the concept of priority is introduced, along with a system that helps to define and propose a priority order of intervention for safeguard, before the impact of the disaster and in the aftermath, during the rescue phase

In the context of safeguarding cultural heritage, a priority system should take into consideration various aspects: the vulnerability of the property with respect to a specific type of disaster (immediate damage), the vulnerability to deferred damage, the severity of the damage immediately after the impact ("First aid to Cultural Heritage in time of crisis", Smithsonian Institution, UNESCO and ICCROM, 2015)

Establishing priorities therefore supports the action of planning both preventive and rescue interventions. However, there are other reasons why it is important to prioritise. During an emergency, in the absence of a preventive mechanism, the rescuer at work in the field would be required to make quick decisions, choices, and a prioritisation assessment, often with little information available. The judgments that the rescuer should express deal with a delicate matter, easily interpretable on a subjective level, and probably in the absence of a specific training. Furthermore, when operating in dangerous conditions, in a hostile environment, where the operator's tension can interfere with the assessments, the emotional component should be borne in mind. No emergency action should be improvised if possible.

The choice to save one object rather than another can also lead to the loss of what we decide should be rescued later. The object could in fact suffer further, deferred damage, delays in actions aimed at interrupting the alteration processes, and even theft and vandalism.

A consolidated methodology and the definition of resource priorities are also of crucial importance for defining clear responsibilities: they would allow operators, in emergency



times, to carry out rescue actions, with full legal legitimation and minimising their personal responsibility.

A procedure is therefore desirable and recommended both in “peacetime” and in “emergency time”, for different reasons:

- in *peacetime*, the procedure regulates a priority order of interventions aimed at risk mitigation, e.g. all operations to be carried out to prevent and minimise the risks which cultural heritage may be exposed to.
- during an *emergency*, the process is instead used to:
 - inform operators about the asset on which (upon the occurrence of certain conditions) to intervene for rescue and safeguard (*what is it*)
 - inform operators about the location of those asset inside the building (*where is it*)
 - what is the priority order in the rescue operations (*what to recover FIRST and what AFTER*, optimising the resources at my disposal, in terms of people, means and time)



Priorities: how and what?

Once the need for a prioritising method is understood, we should ask ourselves:



What are the criteria on which we will base our decision?
 What will the subject of our decision be? In other words, on which cultural assets must we establish priorities?

Decision-making criteria

The CHEERS process suggests to prioritise based on one condition and two factors:

- the fact that an asset is exposed to a hazard and a risk scenario
- an assessment of significance (or value), which therefore suggests which assets are, in a relative sense, more important for a territory (or for the community) than others
- a risk factor, linked to the fragility and vulnerability of the asset with respect to a natural hazard

In CHEERS, the concurrence of these factors produces what is called “priority value”. Each factor is addressed by specific tools developed within CHEERS:

- FRATCH: Exposure and risk
- ATTACH: Assessment of significance
- 3.2.1 FRAGILITY: Fragility and vulnerability



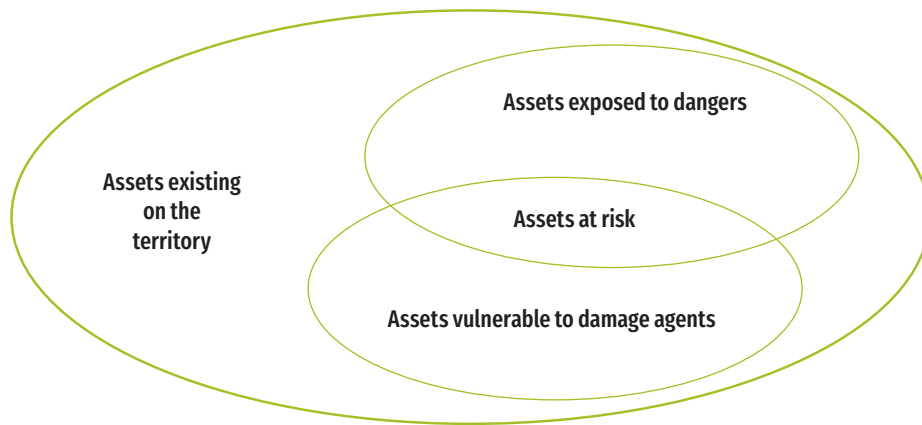
Please note that assessing the significance of cultural heritage and therefore placing different cultural assets on a scale of values is a very controversial and delicate issue.

To overcome this impasse, it is necessary to keep in mind the application context of this approach: we find ourselves in the position of having to establish priorities, since an asset could be destroyed or damaged by a natural disaster. Furthermore, as noted above, if the decision is not taken in peacetime by the pool of persons in charge, it may have to be taken in emergency time by a Civil Protection operator.

Sets subject to analysis

The first step of this process obviously requires defining the set of cultural heritage on which to apply the subsequent evaluations.

The possible sets might look like this:



We have already understood (Module 2) which cultural assets are present on the territory and which ones are potentially exposed to dangers, through the spatial superimposition of information on assets and dangers.

At any rate, in Module 2 we already suggested the idea that the overlay operation alone, was not sufficient to fully grasp the nature of the danger which the asset can be subject to, nor if it actually is, since for example, an asset could be placed higher than the height that the water can reach in the event of a flood, or because it can be made of a material that is not damaged by a certain type of agent.

Here, detailed information related to individual assets is clearly needed to assess both their actual exposure to a hazard and their vulnerability. In particular, it is a matter of understanding:

- the actual location of the asset on the territory or of an item in the container building: it's necessary to assess the **actual exposure**
 - for buildings it will be necessary to know their location with respect to the ground and to the context: for example, only one facade could be exposed to the risk of falling rocks, other façades could be protected from proximity to other buildings. Otherwise, the building may not be completely level and only one side may be exposed to the flood wave of a flooded river. This information should be available from any detailed cartography of the place, which also includes its altimetry or digital terrain model.
 - for objects, likewise, both the height from the ground and the location in the context could be fundamental information: for example, assets kept in a crypt could be more exposed to a flood but protected with respect to rockfalls. On the contrary, the frescoes on the vaults would not be affected by the direct action of the water in the event of a flood but could be severely damaged by an earthquake or by rocks hitting the roof of the building. This information should be available either through the cataloguing discussed in Module 2, or through a direct survey of the container buildings.
- the material of which the asset is made and its current state of conservation: necessary to evaluate **vulnerability**
 - each material may have a different degree of resistance or brittleness with respect to the various damage agents caused by natural phenomena. Furthermore, the state of conservation at the moment of impact may in turn strongly influence the resulting damage. As above, information related to material and state of conservation of an asset may be available in a detailed catalogue, or provided by its curator through direct inspection.

This information will then be necessary to define:

- the set of assets exposed to actual danger
- the set of assets vulnerable to danger

So, what does vulnerability mean?

info **VULNERABILITY:** “The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt”.

In the following paragraphs and, in particular, when illustrating the tools “3.2.1 FRAGILITY”









and “*THREAT & Handbook on fragility and safeguarding techniques for cultural heritage*”, we will clarify how CHEERS has tried to describe the specific vulnerability of materials and assets to various agents of deterioration, linked to the natural hazards taken into consideration.

What cultural heritage is exposed to what hazard?

In this paragraph we will define the subset of exposed asses, whether they are buildings, valuable elements of the structures or objects contained or pertaining to the buildings.

Assessing the actual exposure of an asset to a hazard needs to characterise that hazard, and therefore define the specific “agents of deterioration” related to that natural phenomenon.

The table below shows the potential agents of deterioration linked to the various natural hazards affecting cultural heritage and taken into consideration by CHEERS.

Main agent of deterioration	Specific agent of deterioration	Reference hazard
WATER	Wetting, spray Sediment Humidity Chemical pollution	Flood 
FIRES	Smoke Heat Flames Combustion gas	Wildland-urban interface fires 
PRESSURE	wave impact (due to flood, snow avalanche or explosion) bump (e.g. due to projected or shot objects, falling objects) burial (e.g. due to structural collapse, ash fall, snow avalanche) abrasion and erosion (due to water or debris flow) Gravity (falling object) or physical impact	Earthquakes, Landslides, Rockfalls, Avalanches    

“Gravity”, refers to phenomena directly involving the vertical displacement and falling of the object. It might be considered among those referred to pressure, but in this case the displacement directly concerns the object to protect, so that there are remarkable differences in terms of safeguard techniques, if compared with the phenomena where the object is passively affected by something else.

For instance, agents such as humidity, smoke, and heat, may damage objects and elements that are not necessarily nor directly reached by water or flames.

Now, thanks to the detailed information available on its location, it is possible to hypothesise which agent of deterioration (given its specific dynamics) an asset is actually exposed to.

















What cultural heritage is vulnerable to what hazard?

In this paragraph, we will instead define the SUBSET of vulnerable assets, potentially damaged by disastrous events.

Once having established the actual exposure to a damage agent, it must be understood whether and how the exposed asset would be damaged by agents of deterioration.




In this regard, CHEERS also proposes approaches and a useful knowledge base for the evaluations to be carried out. CHEERS products “3.2.1 FRAGILITY” and “Handbook on fragility and safeguarding techniques for cultural heritage” provide the sources on which subsequent evaluations are based.

The table below shows the list of materials and possible components of cultural heritage materials that have been investigated in CHEERS.

Icon	Material
	Stone and stony materials
	Terracotta ceramic; glazed ceramic; earthenware
	Enamel
	Glass
	Wood
	Textiles
	Works on paper, books, and graphic documents
	Painting (canvas including silk; excluding frescos)
	Metals
	Bones (including ivory)
	Leather
	Frescos and other semi-movable murals
	Gypsum; selenite
	Terracotta tiles



The table below gives an example of possible materials and alterations. For a full examination of the possible cases under review, please refer to the reports “3.2.1 FRAGILITY” and “Handbook on fragility and safeguarding techniques for cultural heritage”.

Hazard	Flood
Agent of deterioration	Flood Speed
Material	Alteration
	Decohesion and micro abrasion phenomena of the stone material; detachment of portions caused by the penetration of water in the fissures ----- Deposit of material transported by water
	Contractions, expansions, micro-cracking of the material and the coatings; phenomena related to the decohesion of ceramic material, if cracks are already present; detachment of parts caused by the seepage of water into cracks ----- Deposit of material transported by water
	Opalescence, iridescence, detachment, fractures, decohesion of the vitreous material, if cracks are already present; detachments of portions caused by the seepage of water into cracks ----- Corrosion ----- Deposit of material transported by water



CHEERS proposes to establish the priorities of intervention through a series of tools developed and tested in the different pilot areas the project has worked on. These tools are:

- **ATTACH:** *evAluaTion Tool for Alpine Cultural Heritage (ATTACH)* is a method for assessing, in a participatory way, the significance value of a set of cultural assets, which will help establish priorities for intervention in the face of natural hazards, if necessary.
- **FRATCH:** the *Fast Risk Assessment Tool for Cultural Heritage (FRATCH-Tool)* was developed to identify and assess current and future risks and threats to cultural heritage. The tool represents a multi-stage process that involves several stakeholders in order to establish a common understanding on the topic. FRATCH produces a risk assessment which clearly presents the risks and threats to the cultural heritage/asset and the related hazardous events on the specified site and/or the cultural asset in question.
- **3.2.1 FRAGILITY:** this tool is suitable for performing damage and loss scenarios, aimed to support the definition of emergency plan. If exhaustively precompiled and adequately integrated with FRATCH and other tools for the management of rescue teams, its design allows operators to use it as a fast dashboard and simple decision-making support system in the emergency response coordination center for the prioritisation of cultural heritage safeguard and rescue intervention.
- **THREAT:** a tool for vulnerability and risk assessment on cultural heritage (*THREAT - culTural Heritage Risk EvaluATion*), developed starting from the same logic as FRATCH, therefore based on the concept of “likelihood” of damage and permanent loss of value that may occur to cultural heritage. The tool is accompanied by a Handbook, that serves as knowledge and reference base on fragility and safeguarding techniques for cultural heritage.

Evaluating risk and priorities: the CHEERS suite of tools

The CHEERS method is designed to set intervention priorities, to be used in case of need, based on the following:

- an asset is exposed to a danger and a risk scenario
- an asset is more or less relevant, in the light of an established set of values and of a shared assessment procedure
- an asset is more or less vulnerable, based on how seriously it can be damaged by an agent related to a natural hazard.

This evaluation procedure is structured into three components:

- assessment of the significance of the asset, from a historic, artistic, identity relevance, and other points of view
- assessment of the actual exposure of an asset: starting from the procedure seen in the paragraph “[Matching information: areal exposure of cultural heritage](#)”, more detailed information, that determines the real exposure of the asset to danger, must be collected (e.g. its height from the ground or its position inside the asset container)
- assessment of the vulnerability of the asset to damage agents: this assessment is based on the characteristics of the asset (the material it is made of, its composition, the state of conservation, etc.) and the fragility of that characteristics with respect to various damage agents associated with the different natural hazards under scrutiny.

The difference between exposed and vulnerable assets becomes clearer if we imagine a real situation, in which we could find:

- an asset with high significance but low vulnerability/fragility rate
or
- a particularly vulnerable/fragile asset, but with modest significance, namely an asset which, if subject to a damage agent, could easily suffer major damages or be irretrievably lost.



What to prioritise, then?

CHEERS aimed to offer at least a partially quantitative method for establishing objectively and legitimately the priorities for intervention with respect to the cultural heritage considered.

Assessing the significance of cultural heritage

ATTACH - evAluaTion Tool for Alpine Cultural Heritage

The ATTACH method developed as part of CHEERS is an approach for assessing the significance of cultural heritage subject to risk due to natural hazards. The method includes several steps:

- contextualising the set of assets to be assessed with respect to local risk conditions, being aware of the identified natural hazards
- identifying the most relevant and representative stakeholders, both for the set of assets to be assessed and for the local context, and who will participate in the assessment process
- defining the **value categories** that contribute to determining the overall significance of a cultural asset in the reference context
- assigning a **Weight (w)** to each of the value categories (“how important is each category, compared to the others?”)
- assigning a **Score (S)** to each cultural asset exposed to a risk scenario for each value category (“what relevance does the heritage have with respect to the different value categories?”)



Finally, the weighted sum of the Scores ($w_1*S_1+w_2*S_2+w_n*S_n$) for each cultural asset results in a summary Indicator, which expresses the **significance rate**.

The concept proposed for the evaluation tool generally follows the *ABC method* (Michalski & Pedersoli 2016), which also provides a framework for risk management. ATTACH, among other aspects, inherited from the parent method the phase of assessing the significance of cultural heritage, which is a key information with risk being defined as an “expected fractional loss of value to the heritage asset per unit time”.



The Sourcebook just means to convey the fundamental elements of the tool and explain its role in the above-described process.

For more information, please refer to the CHEERS tool “[evAluaTion Tool for Alpine Cultural Heritage \(ATTACH\)](#)” and to the report “[Conceptual document on ATTACH design](#)”.

ATTACH is also provided as a simple tool, which aims to help in documenting all key steps of implementation of ATTACH and afterwards to facilitate the assessment of testing and reporting. It is a spreadsheet composed of five sections (e.g. tabs) to which responses need to be provided by those coordinating the testing.

In the following paragraphs, we will outline the most relevant steps of the logical process underlying the ATTACH tool.

Sets of assets to be assessed

Determining the set of cultural assets to be evaluated has been already discussed, both in [Module 2](#) and in paragraph “[Sets subject to analysis](#)”.

Identifying and managing stakeholders

ATTACH approach is intended to be highly inclusive (participatory) as it recommends and makes it possible to involve a broad variety of stakeholders, not only cultural heritage professionals. Both the weighting and scoring processes could greatly benefit from being performed as a collaborative action, bringing together relevant actors from fields such as cultural heritage management and protection against natural hazards.

There are several different methodological approaches to address this, although a more general term of “stakeholders’ mapping” is related to identification of both stakeholders and their expectations.

Various mapping methodologies can be used to effectively approach individual groups. Stakeholders can be identified in relation to their level of interest (from very active to completely passive), power (from strongly influential to insignificant), and attitude (from total supporter to blocker).

While it is obvious that efforts should be focused on stakeholders with high level of interest and power (“key players”), others should not be neglected, as a narrow spectrum in the categories of stakeholders involved might produce biased evaluation outcomes.



However, in structuring the panel of experts called to define the significance of cultural heritage, it is necessary to keep in mind:

- the context in which the assessment process takes place
- the regulatory and local governance framework

If the process aims to produce a formal document, e.g. part of a local Civil Protection plan, it will likely be necessary to verify the roles established by the regulatory framework before deciding who to involve in the assessment process. The actual decision-making power with respect to the assessment of significance of the cultural assets under investigation could in fact be the exclusive prerogative of a competent body, such as the Superintendence for Cultural Heritage, the Ministry of Culture, etc.



Describing risk scenarios

The stakeholders involved would greatly benefit from a briefing on the context in which their evaluation will take place. Therefore, it would be useful to devise and show them an overview of the hazard and risk scenarios that may occur, as discussed in [Module 2](#). In fact, it may be crucial to point out the question underlying the implementation of the method, namely:



"I find myself in the position of having to establish priorities, since an asset could be destroyed or damaged by a calamity event... given this context, which assets are more relevant? On which of them **should** safeguarding efforts **be focused**, if circumstances dictate the need for a choice?"

Defining value categories

The CHEERS project partners identified seven value categories that can be used to represent the significance of a cultural asset:

1. Evidential value refers to the potential of the cultural heritage unit to yield evidence about past human activity (physical remains, written records, archaeological deposits, etc.).
2. Historic value is derived from the ways in which past people, events, and aspects of life can be connected to the present through the cultural heritage unit. This type includes several issues like illustrative dimension, indicating whether it illustrates something particular or distinctive, associative meaning referring to whether it relates to a notable family, person, event, or movement, and historic importance depicting the historical period during which it originates.
3. Aesthetic/artistic value is related to ways in which people draw sensory and intellectual stimulation from cultural assets either as a result of conscious design or the seemingly fortuitous outcome of the way cultural heritage has evolved and has been used over time.
4. Communal value is derived from the meanings of the cultural asset for those who relate to it or for whom it figures in their collective experience or memory. Communal value refers to three issues: the symbolic meaning of a place for those drawing their identity from it or having emotions links to it, the social importance of places people perceives as a source of identity, distinctiveness, social interaction and coherence, and the spiritual value, which emanates from the beliefs and teachings of an organised religion or reflect past or present-day perceptions of the spirit of that place.
5. Economic value is derived from the potential of the cultural asset to become a financial resource for society as a result of direct or indirect economic activities connected to the use and function of cultural heritage.
6. In-use/fruition value relates to the fact that an asset is accessible/open to community and used rather freely.
7. Scientific/educational value is derived from an asset having information or data that (might) contribute significantly to scientific research and academic studies.

As all contributing values were hitherto defined, creating a shared evaluation process, the following step is to assign relative weights to those value categories. Weights can range from 0 to 1 with 0 meaning that the category of value is considered irrelevant by the pool of stakeholders involved in the decision, whereas 1 indicates the maximum weight of the scale. Relative weights must add up to 1, indicating the paramount combination of values to a generic cultural asset.



Which of these "categories" is more important?
What is its "weight" compared to the others?



Different methodologies can be envisaged to reach group consensus on the weights assigned to the various categories. The CHEERS project has adopted in most cases (e.g. in pilot areas) a procedure called *Analytical Hierarchy Process* (AHP).

In the AHP, each participant must make pair-wise comparisons between two value categories on a scale of 1 to 9 (e.g. category “Historic” may be considered 3 or 4 or 5 times more relevant than category “Economic”). Hence, relative importance of value categories can be expressed and AHP allows stakeholders to aggregate this information on a group-level in a consistent and comprehensive way. Technically, this step can be eased by one of many AHP on-line tools, which are freely available even for group assessments. Further on, it was resolved that an individual weighting is aggregated by employing the “balanced-n scale model” (Goepel 2018).



However, relying on AHP is not necessary, as relative importance can be derived via other means such as collaborative agreement: all participants in the evaluation panel could discuss extensively the relative weights of value categories and assign weight to each of them by voting. This is a possible and a legit alternative to AHP.

info

The AHP method for weighting

The Analytic Hierarchy Process is a method that makes it possible to turn subjective opinions into measurable numerical relationships. AHP is a methodology designed by Thomas Saaty in 1980. The method can be used in various fields, as a support tool for complex decision-making processes, in which the decision maker is called upon to express priorities in making a choice, with different options available. The AHP allows decision makers to simplify the mechanism by which a complex decision is made, ensuring that the decision maker must compare, on occasion, just one pair of options at a time. The results of the individual comparisons are then compared by the method, to produce a unique final result. A practical example can help users better understand the tool.

The table below illustrates this process.

1	Evidential value	is of equal importance as	or is	2	3	4	5	6	7	8	9	more important than	
		x											Historic value
2					x							Illustrative value	
3						x						Aesthetic/artistic value	
4	(...)												
5	Historic value	is of equal importance as	or is	2	3	4	5	6	7	8	9	more important than	
6						x					Illustrative value		
7						x					Aesthetic/artistic value		
8	(...)												

Value categories	Weight
Aesthetic/artistic value	14.9%
Historic value	23.5%
Economic	9.7%
Communal value	32.4%
Illustrative value	11.5%
...	...
TOTAL	100%



Assigning scores to assets

The final step requires assigning a score to each asset (or items of an asset) under evaluation for each value category.

The score scale is geometric (e.g. follows a geometric sequence).

The proposed scale has seven scores (points).

Definition of the score

- 0** The item does not possess the contributing value
- 1** The occurrence of this contributing value in the items is very small.
- 3** The occurrence of this contributing value in the items is small (up to 3 times greater than that corresponding to the score of “1”).
- 9** The occurrence of this contributing value in the items is medium (up to 9 times greater than that corresponding to the score of “1”).
- 27** The occurrence of this contributing value in the items is large (up to 27 times greater than that corresponding to the score of “1”).
- 81** The occurrence of this contributing value in the items is very large (up to 81 times greater than that corresponding to the score of “1”).
- 243** The occurrence of this contributing value in the items is exceptional

Each asset or item under evaluation is assigned a score for each of the seven value categories (or, in specific circumstances, the categories decided by the stakeholders).

This score indicates the maximum percentage of occurrence of this feature throughout all components of the cultural asset.

The tables below show a generic example, meant to illustrate the application of the ATTACH method.

Value categories	Weight
Aesthetic and Artistic	14.9%
Historic	23.5%
Economic	9.7%
Community and Identity	32.4%
Use and Fruition	11.5%
Scientific	8.0%

SCORES						
Cultural Asset	Historic	Artistic	Use and Fruition	Community and Identity	Economic	Scientific
Asset 1	243	243	81	243	243	243
Asset 2	81	81	81	81	243	81
Asset 3	81	243	3	81	81	27
Asset 4	81	81	3	3	9	9
Asset 5	0	3	81	1	243	81
Asset 6	243	243	3	3	81	243

SIGNIFICANCE RATE		
Cultural Assets	Value	Priority
Asset 1	224.37	1
Asset 2	96.714	3
Asset 3	91.848	4
Asset 4	34.014	5
Asset 5	40.137	6
Asset 6	121.926	2



Defining a risk level for cultural heritage

FRATCH - Fast Risk Assessment Tool for Cultural Heritage

The *Fast Risk Assessment Tool for Cultural Heritage (FRATCH-Tool)* was developed to implement, in an inclusive way, an assessment of the exposure and vulnerability of cultural heritage in a specific territory. The use of FRATCH is therefore recommended within an inclusive framework, following the identification of the Group of most appropriate stakeholders (local administrators, risk and disaster experts, curators of cultural heritage, and so on). Thus, the primary purpose would be to agree upon the vision on this theme, which will be shared and valid for the territory under evaluation.



The Sourcebook just means to convey the fundamental elements of the tool and explain its role in the above-described process.

For more information, please refer to the CHEERS tool "[FRATCH-Fast Risk Assessment Tool for Cultural Heritage](#)" and the document "[User manual for FRATCH](#)".

FRATCH has built a dashboard-style risk assessment showing the risks and threats to the cultural heritage in the territory, the impact of the main identified hazards, and the related dangerous events on the specific site and/or cultural asset.

For each asset, it provides an assessment of exposure level and vulnerability to a set of risks (determined by the user), which are displayed on Cartesian axes. The abscissa axis represents the exposure, while the ordinate axis represents the vulnerability.

Thus, FRATCH has proven useful:

- to raise awareness of the natural risks in the area
- to raise awareness of the cultural heritage existing in the area
- to promote a shared vision among experts and stakeholders about the risk level which each cultural asset is subject to.
- to lay the foundations for guiding both choices and priorities of the safeguard interventions to be implemented for the benefit of the cultural heritage in peacetime.

3.2.1 FRAGILITY

The tool 3.2.1 *FRAGILITY* is designed to identify the most fragile components of a cultural heritage asset exposed to the different natural hazards, and the actions useful to mitigate or recover the damages, which, in turn, will drive the quantification of resources requested. It consists in a multi-hazard and multi-risk tool (delivered as prototype), designed for characterising the fragility of cultural heritage items with respect to deterioration agents typically triggered by natural disasters.



The Sourcebook just means to convey the fundamental elements of the tool and explain its role in the above-described process.

For more information, please refer to the CHEERS tool "[3.2.1 FRAGILITY](#)" and the report "[Portfolio and application guidelines of cultural heritage protection reference techniques](#)".

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Fragility can be defined, within the scope of this work, as the characterisation of cultural heritage item damageability, depending on the agent (and its intensity), by using a damage scale (from zero to total and irreversible, implying the risk of a total loss of value). The potential damage on the weaker material of the asset can be considered as "first order indicator" of its overall fragility. This fragility indicator can be used to estimate vulnerability during emergency planning at the territorial level, or in early triage and intervention prioritisation, during an emergency.

In 3.2.1 *FRAGILITY*, the characteristics depending on the material and the deterioration effects that the same material suffer due to the action of different kinds of physical and chem-



ical agents, are crucial information that needs to be carefully verified, as they concur in determining:

- the residual value left due to the permanent damages suffered by a certain cultural asset because of the impact of a natural disaster, depending on the magnitude of the related agents of deterioration
- the probability that the cultural asset will be totally destroyed if hit by a particular agent of deterioration
- the conditions of actual exposure to the different agents of deterioration

3.2.1 FRAGILITY tool is available to interested stakeholders for use in risk assessment, for both movable and immovable cultural heritage. It is recommended that the application of the tool is implemented with the participation of the local experts from both the Civil Protection and the Cultural Heritage domain, in order to be properly applied to a specific site.

3.2.1 FRAGILITY requires reference data and item-specific data. A preliminary and generic set of information is provided with the tool and need to be verified and integrated by the local experts. Item specific data need to be input by the experts. Data about the damages produced by the most active and persistent deterioration agents during the natural disasters, on the materials constituting the cultural heritage items were collected during the project activity through the involvement of cultural heritage and restoration experts.

The correct formulation of the hypothesis about the selection of the agents of deterioration and the intensity of their impacts, can take advantage from the FRATCH tool, too. Once defined the specific fragility of each item with which you are concerned, the same tool will be useful for defining the specific vulnerability of the tangible cultural heritage under scrutiny.

3.2.1 FRAGILITY should work on the same list of cultural heritage items evaluated for relevance through the ATTACH method, if the users want a complete integration of the two procedures. The tool allows for a “loss assessment”, that means to compute the residual value of an item after the permanent damages suffered because of the impact of a disaster. The residual value (or the lost one) expected after the restoration is the key parameter to define the “fragility”, as intended within the scope of CHEERS.

As reference data contain a minimal portfolio of technics for the recovery of the damaged materials, the inter-disciplinary team of experts expected to use the system can also preliminarily estimate the need of human resources for mitigation and rescue interventions.

Step-by-step instructions on how to use the 3.2.1 FRAGILITY are provided with the tool.

- **Step 1.** Validating the data proposed by the tool on impacts on the materials constituting the relevant cultural heritage asset
- **Step 2.** Defining the list of relevant items or inherit the same list used in ATTACH. In case it is not possible to detail the most remarkable content of your cultural heritage sites, it will be useful to evaluate the content by rough categories defined according to the most fragile material composing the objects.
- **Step 3.** Assessing the fragility and potential loss: for each item, the expert team can assess one or more potential damages occurring to them, according to the concerned material and deterioration agent.

The tool produces a summary and a visualisation of the most affected cultural heritage items. The results can be quickly adjusted to examine the effect of specific agents (even in combination) on certain materials.

3.2.1 FRAGILITY tool is suitable for performing damage and loss scenarios, with the aim of supporting the design of emergency plans. If exhaustively precompiled and adequately complemented with FRATCH and other tools for the management of rescue teams, it can be used as a fast dashboard and simple decision-making support system in the emergency response coordination for the prioritisation of cultural heritage safeguard and rescue intervention.



THREAT - culTural Heritage Risk EvaluATion

Along with the CHEERS tool suite, developed and applied as a prototype in some of the pilot areas of the CHEERS project, a partially alternative approach called THREAT (cultural Heritage Risk EvaluATion) has been designed in collaboration with the Autonomous Province of Trento and tested on the study area of the City of Trento.



The Sourcebook just means to convey the key functions of the tool and explain its role in the above-described process.

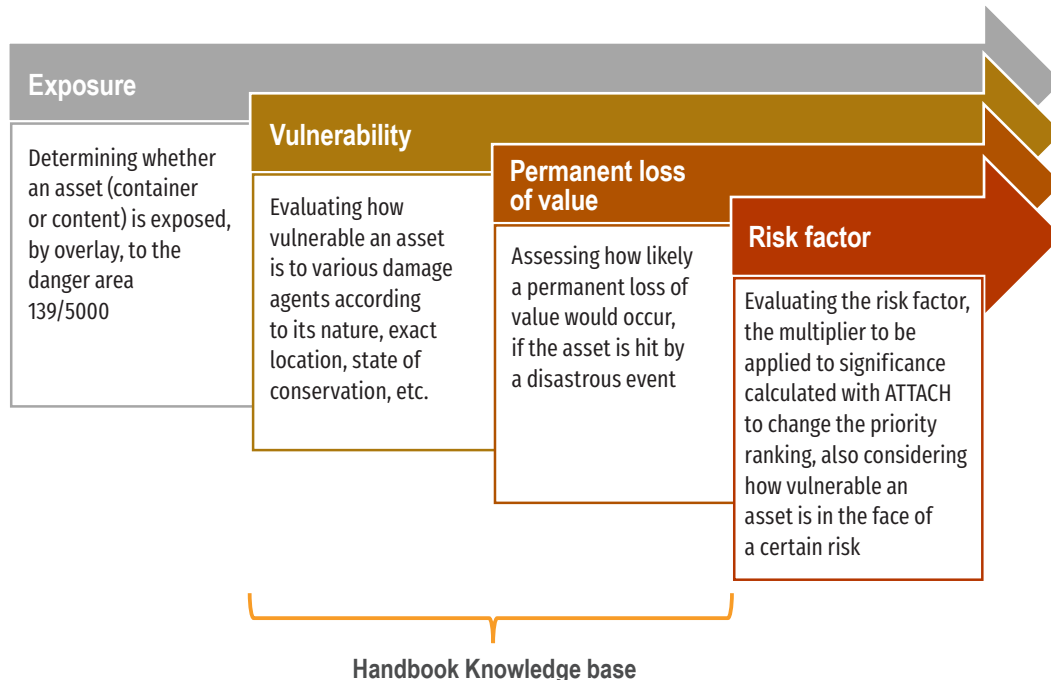
For more information, please refer to the CHEERS tool “[THREAT - culTural Heritage Risk EvaluATion](#)” and to the document “[Handbook on fragility and safeguarding techniques for cultural heritage](#)”.

The pilot case of Trento has already:

- identified the existing assets
- defined the specific risk scenario (flood of the Adige River with a 200-year return period)
- identified the assets that are potentially at risk (as well as exposed subsets)
- assessed the significance of the assets by implementing the ATTACH method

The THREAT process, implemented for planning safeguard interventions on cultural heritage, was associated with a Handbook, which was designed to meet the needs of the pilot case, and to build a reference knowledge base about potential damages suffered by cultural heritage due to agents of deterioration resulting from natural hazards.

THREAT is structured into the following steps:



The process proceeds from the assumption that an asset may be exposed to a danger, but it may not be vulnerable to agents of deterioration related to that danger or it may be only partially damaged. Thus, how should the intervention priorities change if an asset were very relevant (its significance is calculated through ATTACH), but not very vulnerable? Conversely, if an asset almost certainly suffers a permanent loss of value, but its significance is modest, how should it be considered in terms of priority?



The system developed in THREAT runs on “likelihood” logic and is consistent with the FRATCH tool. This means that when investigating the vulnerability of an asset, the question to keep in mind is “How likely is it that a deteriorating agent will cause damage to that specific asset?”. In answering this question, several factors of each asset are considered: the specific location of the asset within the building that contains it (is it on the ground? Is it hung up? If so, at which height? Is it attached to the wall? Is it supported?), its state of conservation (is it solid? Is it fragile? Could handling damage it?), its specific characteristics (is it made of a single material? Is it composite? Are there removable parts?). In THREAT, specific considerations must be made for each particular asset, as well as the context where the asset is located.

We therefore start by listing the subset exposed to risk.

	Asset (element of the structure) or item	Exposure rating
1	Detached Sant’Apollinare fresco	Inevitable
	“Sant’Apollinare” painting	Inevitable
	Roman stones in the external half pilasters	Inevitable
	“Cristo dolente” painting	Inevitable

We then proceed by assessing the vulnerability of each asset. In the example below, the natural hazard considered is a flood and the agents of deterioration associated with this hazard are water overflow speed, impact (from floating objects), wetting, humidity, and possible chemical contaminants in the water. Experts assign a “damage likelihood” value to each asset and agent.

Vulnerability (= how likely is that the following agents cause damage?)					
	Flow speed	Impact	Wetting	Humidity	Chemical pollution
2	Extremely unlikely	Likely	Inevitable	Extremely likely	Inevitable
	Extremely unlikely	Possible	Inevitable	Extremely likely	Inevitable
	Extremely unlikely	Probable	Very likely	Extremely likely	Extremely likely
	Extremely unlikely	Possible	Inevitable	Extremely likely	Inevitable

Vulnerability assessments with respect to individual agents of deterioration contribute to calculating the overall vulnerability rate. This number, combined with the assessment related to possible permanent loss of value, provides a Risk Rating (from Very Low – VL, to Very High – VH), which, in turn, determines the multiplier to be applied to the significance rate (calculated by ATTACH) to obtain the final Priority Score.

	Total vulnerability	Permanent loss of value	Risk Rating	Significance (ATTACH)	Risk factor	Priority Score
	1 (low) - 100 (high)					
3	74	Inevitable	VH9	179.4	1.50	269.1
	70	Extremely likely	H8	145.9	1.25	182.4
	66	Very likely	H8	139.3	1.25	174.2
	70	Extremely likely	H8	137.1	1.25	171.4

The considerations specifically concerning the materials which the assets are made of, in relation to the overall vulnerability of the asset (part 2), are the part on which the Handbook focuses. The manual was developed mainly by professional restorers, as part of the working group on the pilot case of Trento.



The evaluations presented in the Handbook about the likelihood of damage and permanent loss of value are based on the theoretical effect of an agent of deterioration on a generic material: they do not take into account the features of a specific cultural asset. The information is adjusted based on the specific context and assets using the THREAT process, carried out by local experts.

For each agent of deterioration and type of material, the Handbook defines:

- **type of alteration:** the document provides a short description of the main alterations expected
- **level of damage:**
 - **direct:** it takes place immediately, as a direct consequence of the action of the agent on the item (material)
 - **indirect:** delayed consequence of the action of the agent on the item (material)
- **likelihood of damage and likelihood of permanent loss of value:** the use of likelihood scale serves, in particular, to make the assessments integrable with those made at this stage with the vulnerability tool
- **prevention/protection techniques:** interventions to be carried out before an event occurs, in order to safeguard the cultural heritage which could be impacted by the phenomena
- **stabilisation techniques:** first interventions to be implemented after a damaging agent has impacted the cultural heritage to be safeguarded
- **Means and materials** needed to implement the above-mentioned techniques

This body of knowledge can now be employed for various purposes. As part of the THREAT process, it was used to:

- assess the overall vulnerability of the assets (quantitative or rather semi-quantitative assessment)
- assess the potential permanent loss of value of the asset due to the damage
- calculate the risk factor, used as a modifier of the significance rate resulting from ATTACH and therefore the priority score of intervention on the assets

However, the knowledge gathered in the Handbook was also and above all used to establish the means, materials, and skills needed to implement prevention, protection, and stabilisation techniques for each agent of deterioration and material. This information is crucial in planning safeguard interventions, together with specific assessments of the experts from the work team, and in ascertaining how to integrate these interventions with the local Civil Protection system already in place ([Module 4](#) and [Module 5](#)).



Defining the Priority Value

The priority value according to 3.2.1 FRAGILITY

In the final definition of the priority value, 3.2.1 FRAGILITY tool suggests integrating the significance established via ATTACH with a “Minimal specific residual value”, or the minimum significance rate (once again calculated through ATTACH) associated with the asset which would remain even in the event that the asset was damaged. This value, subtracted from the original significance rate, would make it possible to calculate the potential total loss in value of the asset. The priority ranking would at this point be calculated based on the greater value of loss: the greater the risk of loss, the greater the urgency to safeguard the asset.

The Priority Value according to *THREAT*

The Priority Value expressed by THREAT is the result of two factors:

$$\text{Significance rate (ATTACH)} * \text{Risk factor} = \text{Priority Value}$$

The Risk Factor, calculated as we have seen, based on a Risk Rating which associates vulnerability considerations with various damage agents and the possibility of permanent loss of value, can score values between 0.50 (thus decreasing the score of the asset on the ranking priority) and 1.50 (increasing the urgency of safeguarding the asset).

Risk Rating	Risk Factor (multiplier)
VL1	0.50
VL2	0.50
L3	0.75
L4	0.75
M5	1.00
M6	1.00
H7	1.25
H8	1.25
VH9	1.50

example

In the pilot case of Trento, the implementation of ATTACH had established the following list of priorities (please note that only the first 10 identified assets are listed below)

- 1 Church of Sant'Apollinare: detached fresco of Sant'Apollinare
- 2 Church of Sant'Apollinare: painting of "Sant'Apollinare"
- 3 Church of Sant'Apollinare: roman stones in the external half pilasters
- 4 Church of Sant'Apollinare: painting of "Cristo dolente"
- 5 Church of Sant'Apollinare: Marco Apuleius inscription
- 6 Church of Sant'Apollinare: main portal of the Church
- 7 Church of Sant'Apollinare: ark of the Provost
- 8 Church of Sant'Apollinare: historic plasters with traces of frescoes on the facades of the church
- 9 Church of Sant'Apollinare: frescoes inside the church
- 10 Aviation Museum: plane Ansaldo A1 Balilla

Implementation of the THREAT process, supported by the knowledge base provided by the Handbook, led to a re-evaluation of the above-listed ranking, and to the following result:

- ▢ (1) 1 Church of Sant'Apollinare: detached fresco of Sant'Apollinare
- ↑ (9) 2 Church of Sant'Apollinare: frescoes inside the church
- ↑ (10) 3 Aviation Museum: plane Ansaldo A1 Balilla
- ↓ (2) 4 Church of Sant'Apollinare: painting of "Sant'Apollinare"
- ↓ (3) 5 Church of Sant'Apollinare: roman stones in the external half pilasters
- ↓ (4) 6 Church of Sant'Apollinare: painting of "Cristo dolente"
- ↓ (5) 7 Church of Sant'Apollinare: Marco Apuleius inscription
- ↑ (11) 8 Aviation Museum: plane Ansaldo SVA 5
- ↓ (6) 9 Church of Sant'Apollinare: main portal of the Church
- ↓ (7) 10 Church of Sant'Apollinare: ark of the Provost

All in all, we can say that SIGNIFICANCE and VULNERABILITY work together to define the safeguarding priority, in the event that a choice must be made due to the limited resources and time to act.



FINAL  **CHECKLIST**



What are the cultural assets in the area on which preventive measures should be envisaged as a priority, in peacetime?
 Who should be involved in the assessment of significance of cultural heritage in the area?
 Which method could be applied to the assessment of significance of cultural heritage?
 Which method could be applied to the overall assessment of the risks to which cultural heritage is exposed?



What are the cultural assets on which to intervene as a priority in case of emergency, with prevention and protection measures?
 What are the cultural assets on which to intervene with more urgency with stabilisation measures, upon the occurrence of an event?
 What methods are available to establish shared and legitimate priorities?
 How does the significance of an asset and its vulnerability contribute to defining its priority rank?



Why is it necessary or appropriate to establish a hierarchy of priorities for cultural heritage in the area?
 How can this be done as objectively and legitimately as possible?
 How will this hierarchy of priorities be used in the context of Emergency Planning?
 How do the characteristics of cultural assets affect their vulnerability to natural hazards?



DEFINING SAFEGUARDING TECHNIQUES

4



Safeguarding techniques

Resources needed vs. available

Time planning



NEXT STEP



INTEGRATING EMERGENCY PLANS

DEFINING SAFEGUARDING INTERVENTIONS

In the foregoing modules of the Sourcebook, we have briefly discussed what we consider to be fundamental information, namely, one must know:

- the legal and institutional framework ruling the response to natural hazards in the reference territory, when to activate Civil Protection/Disaster Management, the management of cultural heritage (with the focus on safeguarding)
- the structure and operating mechanisms of the local Civil Protection/Disaster Management systems and in particular which human resources are involved and can be activated in the event of an emergency affecting cultural heritage
- how to identify cultural heritage and natural hazards in the reference area, to then integrate the information and build one or more risk scenarios to be addressed and used for emergency planning
- how to establish intervention priorities based on an assessment of the significance of the assets and their vulnerability to natural hazards

Hopefully, the assessments related to vulnerability have also provided indications or the knowledge base on which to develop quantifications with respect to the materials, means, human resources, and recommended timeframes for the protection and safeguarding measures.

Once having acquired this information, we can now ask:



How to protect or secure cultural assets that are exposed and vulnerable to dangers? What means and resources will be needed?

Now responsibility for safeguarding cultural heritage is in the hands of emergency planners, who operate in close collaboration with experts and managers of cultural heritage and the Civil Protection/Disaster Management system, and who develop specific assessments for each culturally relevant asset (or group of assets), evaluated in view of the following:

- **Interventions:** first of all, specific actions (prevention, protection, and stabilisation in the aftermath of an event) for safeguarding the exposed elements must be planned
- **Human resources:** subsequently, estimates regarding the operators (number and skills required, in compliance with current regulations) needed to manage the interventions must be provided within the forewarning times.
- **Means and materials:** the necessary amount of means and materials to implement the interventions, along with an assessment of the logistical aspects to allocate the resources needed (operators, means, and materials) should then be defined.
- **Timeframe:** the time required to implement the interventions and mobilise human resources, means, and materials, as indicated in the emergency plan, must be calculated.

In this phase, as noted in the previous modules, detailed information on individual assets and even more skills, knowledge, and experience of the subjects involved in the **work group** are fundamental. Success factors in planning interventions include:

- in-depth knowledge of the specific cultural assets that require safeguarding actions: their state of conservation, their actual location, whether they are attached to surfaces or not, if they are movable or immovable, and so on. In addition, emergency planners must have a detailed knowledge of the context, be it a building, a museum, a church, an open space, etc. Such data could be collected from Superintendencies, cultural heritage managers, curators, professional restorers, renovators, etc.



- knowledge and experience of the field operations implemented by insiders, of the means and resources generally available, of the territory and of the intervention mechanics in case of emergency. This knowledge can certainly be collected from operators of the Civil Protection, Emergency managers, Fire Fighters, etc.
- knowledge of the intervention models and operational procedures in place for local emergency planning. This knowledge is generally available to local Civil Protection contacts or those involved in emergency planning.

We shall now turn our attention to the actual structuring of an emergency plan, a subject to be examined in detail in [Module 5](#).

In this module, we will instead focus on the items needed to define safeguarding and protective measures, starting from the information acquired up to now (see [Modules 2](#) and [Module 3](#)).

Let us now provide a general example of the first steps in the planning process for safeguarding cultural heritage.

Asset	Location in the building	Height from ground	Exposed	Type (material)	Size	Structure	Draft intervention	Resources needed	Notes
"Cristo dolente" painting	Symmetrical to Sant'Apollinare	Lower end 2-2.5 m above the ground	yes	Oil on wooden panel (delicate)	208*114 cm	Support: wood (no precise indication - hypothesis around 130-140 kg including frame and hardware)	Detachment, grounding, photo, packing, filling card record + handling on the first floor of the rectory	5 people for handling. Presence of a certified restorer: not necessary Packaging can be carried out by a voluntary operator under supervision of a Superintendent operator Given the size, weight, position, presence of the Fire Fighters is clearly required	The rectory has a large room that can be used for storage. Check with inspection if the painting would pass through the doors/windows of the rectory. Provide site surveillance. Check with inspection which tools are needed to detach and transport

As we can note, for each asset:

1. its characteristics and nature are taken into consideration (type, size, weight and structure, position in the context, height from the ground, actions needed for any handling)
2. an initial intervention hypothesis, which allows for evaluating the necessary resources and means, albeit as a precaution, is formulated.

Operators can use a large part of these data as a guide when selecting the most effective safeguard interventions, as we will see in the following paragraphs.



Safeguarding techniques

Once having made the first general and provisional evaluations, it is now possible to delve into the details on which specific techniques to safeguard or stabilise cultural assets can be based.

The first driver for this decision is the constituent material. In particular, being aware of the material or materials of the assets will guide operators in consulting the [Handbook on Fragility and Safeguarding Techniques](#). Starting from the material, it will be possible to identify the most appropriate techniques and then submit them to experts, who in turn will verify and adjust these techniques according to specific conditions.

As we have seen in [Module 3](#), for each agent of deterioration and type of material, the Handbook provides information on:

- **type of alteration:** the document includes a short description of the main alterations expected
- **damage level:**
 - **direct:** it takes place immediately, as a direct consequence of the action of the agent on the item (material)
 - **indirect:** delayed consequence of the action of the agent on the item (material)
- **likelihood of damage and likelihood of permanent loss of value:** the use of likelihood scale serves, in particular, to allow for the assessments to be integrated with those made at this stage with the vulnerability tool
- **prevention/protection techniques:** interventions to be carried out before an event occurs, in order to safeguard the cultural heritage which could be affected by the phenomena
- **stabilisation techniques:** initial interventions to be implemented after a damaging agent has impacted the cultural heritage to be safeguarded
- **Means and materials** necessary for the implementation of techniques

The evaluations presented in the Handbook about likelihood of damage and permanent loss of value are solely based on the theoretical effect of a deterioration agent on a generic material: they do not yet take into consideration the specificity of single cultural property items.

As the Handbook points out, with regard to prevention/protection techniques, and unless otherwise specified, two reference options should be implemented **as the first and best options:** temporary **relocation/moving** and **protection systems**.

In line with this logic, we would work to exclude the element of exposure: if an asset is not exposed to a hazardous agent, there would be no need to intervene on its vulnerability and it would be considered safe. In other words, resetting the exposure factor would reset the entire risk equation:

$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$

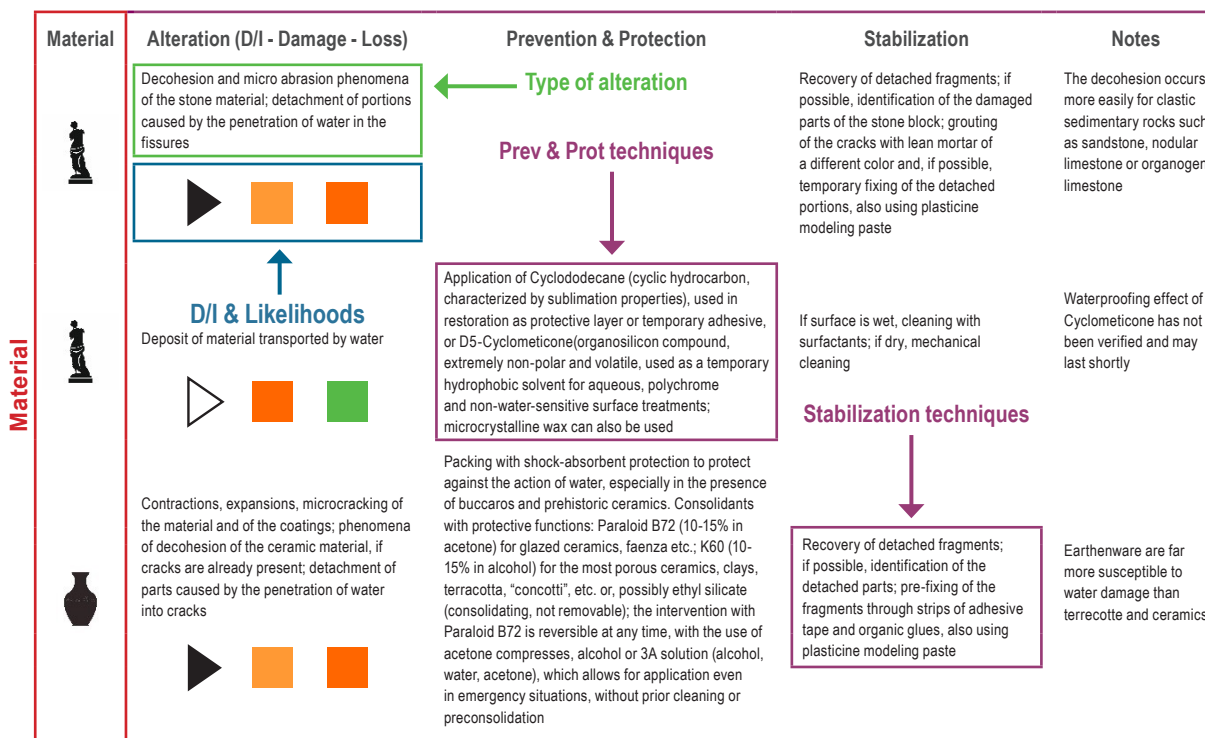
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At any rate, once having excluded these primary options, which in any case must be carefully evaluated by experts, other measures should also be considered, including:

- prevention/protection (to be implemented before the event)
- stabilisation (to be implemented after the event, as soon as possible)



Figure 4 Example from the CHEERS' volume called "Handbook on Fragility and Safeguarding Techniques"



Data gathered in the [Handbook](#) may represent a useful knowledge base for establishing the means, materials and skills needed to implement the above-mentioned measures of prevention, protection, and stabilisation for each agent of deterioration and material. This information, together with specific assessments by experts of the working group, is indeed crucial to planning interventions.

Let's look at some examples.



example 1

Hazard	Flood
Agent of deterioration	water seepage
Material	earthenware

Material	Alteration	Prevention & Protection	Stabilisation	Notes
	Contractions, expansions, micro-cracking of the material and of the coatings; phenomena of decohesion of the ceramic material, if cracks are already present; detachment of parts caused by the penetration of water into cracks	Packing with shock-absorbent protection to protect against the action of water, especially in the presence of buccaros and prehistoric ceramics. Consolidants with protective function: Paraloid B72 (10-15% in acetone) for glazed ceramics, faenza, etc; K60 (10-15% in alcohol) for the most porous ceramics, clays, terracotta, "concotti", etc. or, possibly ethyl silicate (consolidating, not removable); the intervention with Paraloid B72 is reversible at any time, with the use of acetone compresses, alcohol or 3A solution (alcohol, water, acetone), which allows the application even in emergency situations, without prior cleaning or pre-consolidation	Recovery of detached fragments; if possible, identification of the detached parts; pre-fixing of the fragments through strips of adhesive tape and organic glues and also through the use of plasticine modeling paste	Earthenwares are far more susceptible to water damage than terracotta and ceramics


example 2

Hazard	Wildland-urban interface fire
Agent of deterioration	flames
Material	glass

Material	Alteration	Prevention & Protection	Stabilisation	Notes
	Corrosion; fractures 	Protective products such as Siox-5RE20	Recovery of detached fragments; if possible, identification of the detached parts; pre-fixing of the fragments through strips of adhesive tape and organic glues ; if needed, apply Araldite 2020 or Paraloid B72 (10-15%); temporary fixing by Siox-5RE20	Restoration required

example 3

Hazard	Earthquake
Agent of deterioration	gravity
Material	stone

Material	Alteration	Prevention & Protection	Stabilisation	Notes
	Fractures, decohesion of the stone material, with potential detachments	(no forewarning time in case of a seismic event)	Recovery of detached fragments; if possible, identification of the parts of the stone block damaged; grouting of the cracks with lean mortar in a color different from the original and, if possible, temporary fixing of the detached portions	The decohesion occurs more easily for clastic sedimentary rocks such as sandstone, nodular limestone or organogen limestone

In the three examples, we have highlighted (bold in the text) the materials and products indicated for prevention, protection, and stabilisation techniques. The set of these materials obviously contributes to defining the (material) resources necessary for the interventions.

example

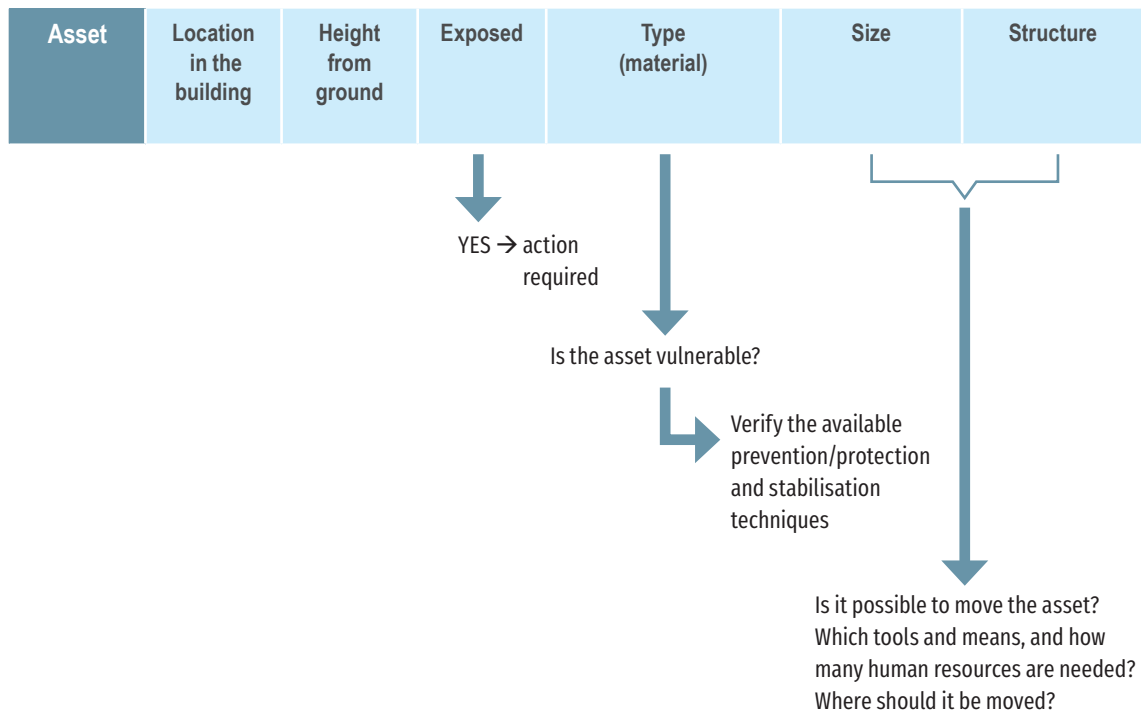
List of materials and products needed (in stock)

- shock-absorbent protection
- Paraloid B72
- K60
- alcohol
- acetone
- ethyl silicate
- adhesive tape
- organic glues
- plasticine modelling paste
- Siox-5RE20
- Araldite 2020
- lean mortar



Resources needed vs. available

Let us now return to the scheme provided by the [example 1](#) and retrace the logic diagram, complete with specific guiding questions.



These data are still part of the risk scenario elaboration, specifically the section devoted to safeguarding activities, in which an overall estimate of the human resources, means and materials to be activated to manage interventions on cultural heritage is provided within forewarning times.



As mentioned above, in situations of alert or emergency, the response of the Civil Protection is primarily aimed at **ensuring people's safety**, and this is the main field of action on which operators are called upon to intervene.

Furthermore, safeguarding interventions on cultural heritage can be time-consuming, complex, and often preventive actions (or those to stabilise an asset) must be carried out very quickly, thus requiring a large deployment of forces.

Consequently, it is fundamental to compare two elements:

1. the total amount of resources whose activation could make it possible to protect or secure the entire cultural heritage exposed to a given scenario,
2. the resources which, in case of need, Civil Protection could actually count on and make available to ensure cultural heritage interventions.

The resources available might, in fact, be lower than expected, thus reinforcing the need to work on the concept of prioritised interventions: "Given the limited resources, what should I save first and what could be lost, if I was forced to make choices?"

As can be extrapolated from the example in the table above, issues to be taken into account should be:

Human Resources

The number of operators deemed necessary should be assessed and stated, as well as structured according to the different categories envisaged by the local legislation in force (e.g. operators of the Superintendency, restorers, renovators, firefighters, specialised volunteers, etc.).

Means and materials

It will be necessary to arrange an inventory of all means and materials available at the structures belonging to those responsible for safeguarding interventions. It would also be useful to report any shortcomings and further needs to promote the upgrade of equipment.

Warehouses

Prevention activities could consist of handling operations aimed at ensuring the safety of removable assets inside safe (temporary) deposits, that is, structures that can also be used to host cultural heritage when there is a need for stabilisation, restoration, or renovation in the aftermath of events. The plan should identify locally accessible storage warehouses. If they are not available in the area, emergency planning could become a tool to facilitate the identification and activation by the competent authorities of dedicated and properly equipped depots.

Fundamental information for calculating the total amount of human resources and, if possible, means needed are:

- weight
- dimensions
- state of conservation
- handling methods
- distance from the storage place
- expertise required for handling

At this point, we should be able to structure, and include in the Plan, both a detailed description of the necessary interventions and a summary of all means, products, and equipment needed for the various interventions, which could be used to organise the storage warehouse.




example

Intervention form regarding a single asset

	<i>Frescoes inside the church</i>		
	3 frescoes: Madonna, 2 Saints, Saint		
	Structural element	X	Movable item -
	Dimensions: 174cm x 94cm (Madonna, H x W); 168cm x 120cm (2 Saints, H x W); 200cm x 107 cm (Saint, H x W)		
	Weight: not relevant (the asset cannot be moved)		
	Position: walls on the sides of the Holy Arch (semi-walled columns)		
	Height from the ground: 1.5 – 2 m		
	Exposure: yes (partially, the lower parts)		
Safeguarding interventions: application of a waterproof layer on all frescoes (cyclomethicone, Japanese paper, paraloid)			
Human Resources: 2- 3 qualified restorers			
Duration of the intervention: 2 hours			

example

Summary of means, products, and equipment needed in warehouses of the Civil Protection/Disaster Management

 TOOL BOX	
Church of Sant'Apollinare	
<ul style="list-style-type: none"> • forklift • sandbags • pipes joints (or wooden structures) • foam rubber • ethafoam • non-woven fabric • bubble wrap • camera 	<ul style="list-style-type: none"> • gauze • Japanese paper • waterproof sheet • cyclomethicone • cyclododecane • B72 paraloid • packing tape • labels containing the codes of assets removed
Aviation Museum "G. Caproni"	
<ul style="list-style-type: none"> • forklift • non-woven fabric • bubble wrap • foam rubber • Japanese paper 	<ul style="list-style-type: none"> • waterproof sheet • ethafoam • hydraulic jacks • packing tape • labels containing the codes of assets removed



Time planning

Knowing the interventions in detail can also support an estimate of the time required for their implementation.

The issues that need to be considered in establishing a general reference time plan are obviously:

- forewarning time (if any)
- time needed to activate the system
- location of the assets on the territory and time needed to reach them
- time required for the implementation of safety measures and possible removal/handling

info

Keep in mind the distinction between the different types of events, in:

- events with precursors (and forewarning time)
- events without precursors
- rapidly developing events

However, if a purely theoretical evaluation of the time required can be used to give a rough idea, more useful evaluations can be made starting from a reasonable estimate of the human resources available.

If it were necessary, for example, to break down human resources into multiple teams, it would also be possible to hypothetically plan their work in parallel and thus optimise their timeframe, as in the example provided below.

However, always keep in mind that these are merely general guidelines, which can only provide some assistance in terms of preparedness: the real conditions on the ground will determine the decisions and coordination of the responders' actions.

example

Item	Intervention	Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Fresco 1	Cataloguing, Applications, Handling	A	Yellow	Yellow																										
Frescoes 2 & 3	Applications	B	Green	Green																										
Painting 4	Cataloguing, Handling	B	Green	Green																										
Painting 5	Cataloguing, Handling	A				Yellow	Yellow																							
Inscription	Applications	A				Yellow																								
Main portal	Construction & laying, Applications	B				Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Marble ark	Construction & laying, Applications	B																												
Historic plasters	Applications	A																												
Painting 6	Cataloguing, Handling	A																												
Statues	Cataloguing, Handling	A																												
Crucifix (#1)	Cataloguing, Handling	A																												
High altar	Construction & laying, Applications	A																												
Almoner	Applications	A																												
Shutters (portal)	Construction & laying, Applications	A																												
Stone slab	Construction & laying, Applications	A																												
External railing	Cataloguing, Handling	A																												
Crucifix (#2)	Cataloguing, Handling	A																												
Chest of drawers	Cataloguing, Handling	A																												
Lantern	Handling	A																												
Insignia of the confraternity	Handling	A																												
Thurible (#1)	Handling	B																												
Candlesticks	Handling	B																												
Altar vases	Handling	B																												
Wooden kneelers	Binding	B																												
Humeral veil, silk	Handling	B																												



FINAL CHECKLIST



What are the resources that can be activated for Civil Protection/Disaster Management in the area?
What facilities and means are available?



What do the cultural heritage safeguarding techniques to be implemented depend on?
What are they?
What products, means, and skills are needed to implement prevention, protection, and stabilisation activities?



On what basis can the envisaged safeguard interventions on cultural heritage be determined?



What resources (both human and material) would be needed?
How long does it take for safeguard interventions be carried out? How should this time be organised?

INTEGRATING EMERGENCY PLANS

5



Tackling the Emergency
Management tool

Defining models of interventions
& the “chain of command”

Defining operational procedures






NEXT STEP



INTEGRATING EMERGENCY PLANS

This module aims to illustrate how data collected in the above-described processes can help structure an emergency plan, and which parts of the document will be here extensively discussed and will serve as a benchmark for such planning.

The plans referred to in the CHEERS process are, in general, linked to a specific area (single municipalities or wider urban areas, provinces, regions, etc.) which is headed by a public body, often the Municipality. However, there may also be emergency plans (also called safety plans or something similar) pertaining to individual cultural heritage sites: typically, museums are or can be equipped with such plans. Nonetheless, emergency plans of such sites can only resort to internal resources that may not be sufficient in the event of natural hazards or other dangers on a larger scale, in which intervention by the Civil Protection/ Disaster Management system is required.

	  <p>Do Civil Protection / Emergency Management plans include the safeguarding of cultural heritage?</p> <p>If not, what should I do to integrate them?</p>	 <p>Are there any safety/emergency plans for specific cultural sites? How do they integrate with local planning?</p> <p>How are unmanaged cultural sites handled by local emergency planning?</p>	 <p>Is there a plan, at the local level, that deals with Emergency Management? What does this plan say about the site (or asset) I manage?</p> <p>Is there a safety/emergency plan for my site/asset? How does it integrate with the local Emergency Plan?</p>
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Simply stated, the Civil Protection/Disaster Management plan is a document that summarises which measures must be taken when red emergency flags linked to natural, or [natech](#) hazards are raised. Given its function, it is reasonable for such a document to be as clear, easy to understand, and quick to consult as possible.

The authorities which, depending on the regulatory framework in force at the local level, are responsible for Civil Protection/Disaster Management activities will be called upon to **coordinate** a set of forces, bodies, commands, and actors, in situations that need to be faced as urgently as possible. It follows that the framework of methods, timeframes, and skills within which the various actors involved intervene, must be prepared and shared beforehand, in peacetime.

Therefore, the Civil Protection plan can also be defined as the **agreement** which the subjects who act in case of emergency rely on to establish how, where, and when to intervene.

The plan is still a tool that supports emergency management authorities in achieving the key objectives of Civil Protection/Disaster Management activities, namely:

- saving human lives (e.g. public safety)
- safeguarding the continuity of essential services (water distribution, energy, transport and traffic, school, etc.)
- safeguarding the integrity of structures and cultural assets
- safeguarding administrative continuity

Thus, how can all knowledge built and collected in the previous modules be integrated into the system as part of an emergency plan? The question is now technical (that is, how effective emergency planning is produced), and needs to be addressed in terms of governance: it is in fact necessary to verify which tools are valid and required for the management of an emergency according to the local legislation (in this regard, see also [Module 1](#)).



First and foremost, it will be necessary to understand the following:



- What are the emergency planning and management tools which are valid locally?
- Are there any guidelines that determine how emergency planning tools should be structured?
- What are the areas of action for these tools? Do they involve different objectives and areas of action (e.g. forecasting, prevention, rescue and assistance, recovery)?
- Which of these tools deal with (or would be the most appropriate for addressing) the safeguarding of the cultural heritage?

We will now try to provide some general indications (e.g. not linked to a specific local legal system), concerning how to structure and therefore integrate the function of safeguarding cultural heritage into emergency planning.

Tackling the Emergency Management tool

Based on what we have discussed and seen in the previous modules, the Civil Protection/ Disaster Management plan is structured into two fundamental parts:

- a part concerning *forecasting and prevention*, which results in an overview and analysis of the risk scenarios in the area and the related mitigation initiatives, aimed at pre-emergency management;
- an *operational part*, aimed at the actual management of the emergency, to be consulted when a potentially critical situation arises. It includes procedures and resources available, to be used according to the different alert phases and the specific event affecting the territory.

The CHEERS approach suggests designing the Plan as follows:

Reference Structure of the Plan ¹	
1. Preface	1.1. Aims 1.2. Objects of the analysis
1. Investigated hazards	1.1. Characterisation of the hazards on the territory 1.2. Strengths and weaknesses of the available data with regard to safeguarding cultural heritage
2. Cultural heritage in the area	2.1. Identification of cultural heritage on the territory 2.2. Strengths and weaknesses of the available geo-referenced catalogues
3. Early warning systems	3.1. Operating warning systems 3.2. Alerts communication
4. Risk scenario: overall event(s) analysis and management outlines	4.1. Definition of the reference risk event 4.2. Forewarning time 4.3. Identification of the exposed items 4.4. Intervention priorities: 4.4.1. value of the exposed Cultural Heritage 4.4.2. vulnerability, risk, and priorities of intervention 4.5. Definition of interventions (prevention, protection, and stabilisation) to safeguard the exposed assets and time needed for their implementation 4.6. Estimation of human resources (skills) needed to manage the risk scenario within the forewarning time 4.7. Estimation of means and materials needed to manage the risk scenario within the forewarning time
5. Resources available	5.1. Human resources (composition and number of response teams) 5.2. Means and materials
6. Intervention model	6.1. Rough deployment model for interventions? 6.2. Definition of the command-and-control chain 6.3. Operations of the intervention coordination centres
7. Operating procedures	

¹ Since these contents are intended to integrate an already existing Plan, some of them may already have been discussed in other sections of the same Plan.

² It describes how forewarning time, priorities of interventions, safeguarding interventions, time needed for their implementation, human resources, means and materials available concur in the definition of a conceptual simulation of how the interventions unfold.



With respect to the benchmark structure above, items 1 to 6 have already been addressed in previous modules of the *Sourcebook*. As regards the following parts, it should be borne in mind that an emergency plan generally provides for the structuring of a so-called “intervention model” and of “operating procedures”, parts which here will merely be outlined and then analysed in the following paragraphs.

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Intervention model: it is the conceptual scheme presented in the Emergency Plan, which lists and describes the required actions, such as organising the coordination centres and deploying the intervention teams in the field. Each intervention model relates to a specific risk scenario.

Operating procedures: they are concise instructions, addressing a specific risk scenario, which describe the tasks of the actors involved in emergency management and the conditions in which these tasks must be activated, according to the increasing alert levels.



Defining models of interventions & the “chain of command”

Designing an intervention model is a step that enters much of the information gathered up to now into the system. In particular, it requires:

- identifying the reference risk scenarios (hazard areas, exposed cultural heritage, early warning systems, forewarning time) ([Module 2](#))
- defining safeguarding interventions ([Module 4](#))
- estimating the human resources, timeframe, means, and materials needed for their implementation ([Module 4](#))
- evaluating intervention priorities ([Module 3](#))
- assessing the available resources ([Module 4](#))

The intervention model corresponds to the final section of an Emergency Plan and illustrates how the acquired knowledge can contribute to the definition of a conceptual scheme, that is, how the interventions could actually take place.

To this end, the following main themes should be examined:

- composition of the rescue teams
- methods for deploying interventions
- command-and-control chain

Intervention Teams

Here we shall re-examine the topic outlined in paragraph 4.2, but now we take a further step – from theory to practice – and establish, by declaring it in the planning document, the composition of the teams deemed most appropriate for safeguarding interventions, and then suggest ways to deploy them in the field.

How to evaluate the allocation of these teams has already been discussed in [Module 4](#).

Safeguarding interventions should be entrusted to rescue teams, whose composition should both depend on:

- the activities to be done (what kind of skills are needed?)
- the regulatory frameworks in force (in terms of the operational level, which positions are required by law?).

The number of teams that could be activated will obviously depend on the resources available in the local Disaster Management/Civil Protection system.

To optimise the implementation of safety measures, it may be appropriate to assign this task to intervention teams, each of which is composed of:



- What types of expertise can or should be involved in intervention teams?
- Fire Fighters teams, with a team leader
- Authorities in charge of the management of cultural heritage
- Qualified restorers and renovators
- Police officers to oversee the handling operations to warehouses
- Volunteers from the Civil Protection/Disaster Management system, who would support the activities

As already mentioned, it will be the actual evolution of events that will determine what resources may actually be available for cultural heritage interventions. Having this information, it will finally be possible to know the actual composition of the available teams.

Deployment of Interventions

Given the resources involved, the time available, and the estimated duration of rescue activities involving cultural heritage at risk, the Plan, with the aim of safeguarding as much exposed cultural assets as possible, in forewarning times and based on priorities and specific conditions, should develop an operational description of the safeguarding interventions needed, and assign tasks to each rescue team.

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Types of Sites

In structuring the intervention model, it may also be useful to draw a distinction between:

- **non-complex sites:** interventions do not require cultural assets to be **handled and/or removed**
- **complex sites:** these are sites containing or including a large number of vulnerable assets or valuable elements, with the concomitant issue of **protecting** the building (its structural elements) and **removing** (movable) assets.

The local legislation in force may require (see [Module 1](#)) that some interventions, in particular those related to handling assets, take place under the supervision of the authority in charge of protecting and managing cultural heritage. In that case, this type of sites is identified with those requiring continuous supervision of the interventions by the competent authority, such as a Superintendency official.

Deployment of Intervention Teams

Aside from the different types of sites, the deployment of intervention teams can be improved by providing:

- greater effort, in terms of human resources, at complex sites
- lighter interventions at non-complex sites
- “rotating” teams, capable of moving easily where needed

Layout of Interventions

For each “container site”, the time sequence for safety measures is then outlined, and their compatibility with forewarning times is also verified (see paragraph 4.3, “Time planning”).

Command-and-control chain

Another fundamental factor to be taken into consideration and included in the Plan during peacetime is the command-and-control chain.



The command-and-control chain can be defined as the organisational chart and the hierarchical scheme of the set of actors (each of them having different roles and responsibilities) who are responsible for ensuring the activation of the intervention coordination centers. This chain must therefore be specified in the Plan, also indicating:

- The way in which the coordination centers operate in the increasing alarm times or emergency phases
- The communication flow foreseen to activate rescue teams where needed

In other words, this is the section of the Plan that deals with “who does what”, in the tactical and operational sense of emergency management. The operating procedures (see next paragraph) will then also draw from this hierarchy to assign tasks and responsibilities.

Coordination Centres

In the context of emergency planning, it is crucial to identify and list the physical venues where emergency coordination bodies would meet locally. Namely, these centres should respond to the requirements of being in safe areas during an emergency, easily accessible, and equipped with communication systems, even to the point of redundancy.

Defining operational procedures

Last but not least, there is a key facet in emergency planning, that is, organising operating procedures.

They outline the roles, tasks, and responsibilities of all the actors called upon to activate, coordinate, and implement the interventions aimed at safeguarding cultural heritage in the event of an alert or an emergency.

Simply stated, the operating procedures, provide guidelines on possible duties for all those involved, both on the part of Civil Protection/Disaster Management and the Cultural Heritage Authority, depending on the ongoing alert phase.


Notably, the operating procedures are defined, where appropriate, by activation phases and alert levels. These levels are often linked to the functioning of the Early Warning systems, which were mentioned in Module 3, in the paragraph [Time, risk scenarios and priorities](#).


Furthermore, by referring back to the [types of events](#), it will be clear that different types of events will have different activation phases and, as in the case of seismic events, there could be only a post-event emergency management phase.

The operational procedures are then a sort of “recap forms” that give brief instructions to all the actors involved. An example is provided below.




example

	Alert level - LOW (YELLOW)
<p>When is it applicable? When the Provincial Warning System gives notification of a LOW ALERT (YELLOW) for hydraulic risk</p> <p>Objective: Preparing the response system for the management of a possible emergency</p>	
Civil Protection Department	
<ul style="list-style-type: none"> • interface with the Director of the Superintendency for Cultural Heritage to assess the means and materials needed to manage a possible emergency • if the equipment available is insufficient, purchases of means and materials will be urgently required 	
Superintendency for Cultural Heritage	
<p>Director of the Superintendency for Cultural Heritage (or a delegate)</p>	<ul style="list-style-type: none"> • The Provincial Warning System receives from the Provincial Alert System a LOW ALERT (YELLOW) for hydraulic risk • remains available for any communications from the Civil Protection Department • informs the officials in charge of planning activities on the LOW ALERT (YELLOW) for hydraulic risk • interfaces with the Civil Protection Department to assess the means and materials needed to manage a possible emergency
<p>Delegate Officials from the Superintendency in Charge of Emergency Planning</p>	<ul style="list-style-type: none"> • the Director of the Superintendency for Cultural Heritage (or a delegate) gives notification of a LOW ALERT (YELLOW) for hydraulic risk • remain available for any communications • support the Director of the Superintendency for Cultural Heritage in the assessment of the means and materials required to manage a possible emergency

	Alert level - MODERATE (ORANGE)
<p>When is it applicable? when the Provincial Warning System gives notification of a MODERATE ALERT (ORANGE) for hydraulic risk</p> <p>Objective: preparing, by intensifying supervision, the response system for the management of any emergency</p>	

etc...

	Alert level - HIGH (RED)
<p>When is it applicable? When the Provincial Warning System gives notification of a HIGH ALERT (RED) warning for hydraulic risk, requiring the activation of the Provincial Operations Room</p> <p>Objective: Emergency management</p>	

etc...



FINAL  CHECKLIST



Which Emergency Planning tools (Civil Protection/Disaster Management) must be developed by the local administration?
Which ones can incorporate the theme of safeguarding cultural heritage (and how)?



How is emergency planning structured locally? How can safeguarding measures of cultural heritage be integrated into such planning?
How should an intervention model for safeguarding cultural heritage and the command-and-control chain be structured?
How should operational procedures to organise safeguard measures be defined?



How can the role of cultural heritage management be integrated with local emergency planning?
What roles should cultural heritage operators play in the management of the Civil Protection/Disaster Management emergency?
Are there any tools for tackling emergencies in managed cultural sites (museums, archaeological sites, castles, etc.)? If so, how can they be integrated with local planning?



TESTING & IMPROVING

6



NEXT STEP



BUILDING CAPACITY & TRAINING

TESTING & IMPROVING

Like any process aimed at structuring an action strategy, emergency planning can also benefit from an iterative, circular approach, in which what is done along the process is tested and possibly corrected, updated, and improved through use over time. This gives rise to the idea of testing the pre-arranged plans.

However, it should be remembered that, in the context of Civil Protection/Disaster Management, testing plays an even more complex role, since:

- it tests the validity of the Emergency Plan's contents, and
- it allows for verifying the preparedness of the local Civil Protection/Disaster Management system and of those involved in the implementation of the Plan.

As suggested in [Module 5](#) when discussing simulation or trial activities, technical, formal, and governance issues are to be considered.

Therefore, it will be necessary to ask the following question:



Is there any rule (or legal standard) at the national or local level that manages the organisation of training activities?

A possible outline of the contents (e.g. their definition and description) of a test/simulation for the management of an emergency that involves the safeguarding of cultural assets is shown below.

Goals of the Simulation Tests

Which parts of the benchmark Plan discussed in [Module 5](#) will be tested?

Generally speaking, we can say that those parts related to the phases of knowledge construction are subject to their own revision process from the start, but it is by no means excluded that an intervention in the field (albeit simulated) can test this knowledge (for example, as regards the accuracy of the toponymy reported in the official catalogues, compared with the maps used by the local population, on which the possibility for operators to quickly and correctly identify the places may depend).

Reference area and involved locations

Each test obviously refers to a local plan, which involves a certain territory and the assets potentially exposed to risk located therein. Hence, first it is appropriate to determine and state which is the reference area of the simulation; in addition, the test may refer to different administrations, therefore it applies to Plans with the following target levels: national, regional, provincial, municipal, or in terms of a specific site.

Types of Simulation Tests (tabletop, full scale)

Typically, the Civil Protection/Disaster Management tests can be carried out in two ways, which can also be mixed.

The first type of test, also called *tabletop*, is a virtual “command position” exercise. There is no deployment of operations teams in the field, but it essentially takes the form of “role play”, in which different actors play key roles in the command-and-control chain and try to activate the procedures that certain risk scenarios require. This type of test normally includes a “leading” function and a carefully prepared “storyboard” to guide the actors throughout the simulation. The actors can actually be the officials who hold the positions and roles that are simulated, if the goal is to test their level of preparation for actual situations, as well as verify the quality of the procedures set out in the Plan.



The other possible type of test is obviously the so-called *full scale*, that is, the one with the deployment of operators in the field. In this case, it represents both a verification of the procedures and actual training of teams. Obviously, this method also provides for the mobilisation of emergency means and may include tests requiring removal, packaging, and cataloguing of cultural assets for training operators in these specific issues.

Operational structures and stakeholders involved

The objectives established for the tests and the chosen methods will guide you in selecting structures and roles to be involved. In general, roles can be simulated, interpreted, or performed by the people who actually and currently hold that role in the structures involved.

Reference historic event & Risk scenario considered

Finally, the test will focus on a specific scenario, so the events that will be recreated and for which the response will be simulated, either starting from a historical event and retracing its unfolding or referring to one of the risk scenarios are included in the Plan under review.



BUILDING CAPACITY & TRAINING

7



BUILDING CAPACITY & TRAINING

Education and training are key factors in the context of safeguarding cultural heritage with respect to natural hazards, since, as we have seen in the previous modules of the Sourcebook, there is a considerable amount of information and expertise that must be deployed.

Much of the content presented in this Sourcebook may offer an occasion for education and, in some cases, field training and testing ([Module 6](#)).

In this module, we will just provide a list of possible contents for training courses on the theme of safeguarding cultural heritage and Emergency Planning.

However, courses, approaches, and training methods must be structured and tailored towards specific needs, as well as local regulations, especially if the training is aimed at providing and issuing a license or qualification to officials, operators, and, in general, the individuals who embark on this path.

A possible list of contents of a training course for officials or operators of Civil Protection/Disaster Management could therefore include:

- Structure of the Civil Protection/Disaster Management system: its organisation and operations.
- Federal, state, and local provincial legislation on Civil Protection/Disaster Management.
- Civil Protection/Disaster Management activities: forecasting, prevention, planning, management, and overcoming the emergency
- Structure of the competent authority for cultural heritage (e.g. Ministry, Superintendency, etc.), any specific provisions of these authorities concerning the management of emergencies from natural hazards.
- Tasks and activation procedures of the various actors involved in Civil Protection/Disaster Management during emergencies.
- Interaction and collaboration between the components and operational structures of the Civil Protection/Disaster Management system and the authorities for cultural heritage.
- The Civil Protection/Disaster Management emergency intervention model.
 - Coordination centres.
 - Activation procedures and interaction, in emergency, with authorities for cultural heritage, other bodies, and operational structures.
 - The role of Civil Protection volunteers in cultural heritage safeguarding interventions: possible areas for support activities and rules of conduct.
- Types of cultural assets that most distinguish the area of interest and risk exposure of the reference territory.
- Experiences and case studies of management of cultural assets in emergency: damage check, safety measures and management of deposits.
- Types and materials, techniques, damages on assets during an emergency. Factors of decay and deterioration processes. General rules for handling, packaging, and moving assets to temporary deposits
- Planning recovery intervention for cultural assets.
 - Rapid cataloguing systems.
 - Toolbox: materials and equipment.
 - Handling and transport techniques



- Practical demonstration of handling, packaging, and cataloguing of different types of assets by teachers, and simulation by volunteers
- Practical exercise – with the involvement of officials of the competent administrations – focused on safeguarding movable assets (recovery, cataloguing, and packaging), carried out also by simulating the operational and procedural link with the coordination structures that are activated by Civil Protection during the emergency.



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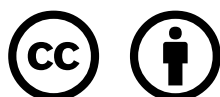
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