ARCH

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Mapping and characterization of good practices in cultural heritage resilience

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Author(s)	Veronica Rebollo (ICLEI), Vasileios Latinos (ICLEI)
Co-Author(s)	Intza Balenciaga (ICLEI), Roger Roca(ICLEI)
Contributor(s)	Daniel Lückerath, Katharina Milde, Manfred Bogen (Fraunhofer), Saioa Zorita Castresana (Tecnalia), Anna Gondová (MUOP)
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Reviewed by (if applicable)	Daniel Lückerath, Katharina Milde (Fraunhofer), Saioa Zorita Castresana (Tecnalia), Anna Gondová (MUOP),Emilio Servera (LNV), Saskia Maresch, Anne-Kathrin Schäfer (DIN), Bernd Paulowitz (Hamburg), Eleanor Chapman (ICLEI)

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Contact

arch@iais.fraunhofer.de

www.savingculturalheritage.eu

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List of abbreviations

Abbreviation	Meaning
CC	Climate change
CCA	Climate change adaptation
COE	Council of Europe
DRM	Disaster risk management
DRR	Disaster risk reduction
ICBS	International Committee of the Blue Shield
ICOMOS	International Council on Monuments and Sites
ICCROM	International Centre for the Study of the Preservation and Restoration of Cultural Property
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
NBS	Nature Based Solutions
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organisation

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Executive Summary

This report is the crystallisation of Task 7.2 *Mapping and Characterisation of experiences and good practices in cultural heritage resilience* and was conceived as a means to identify and compile initiatives and case studies on advancing cultural heritage resilience –both to natural and human-induced disasters, and to the long-term consequences of a changing climate-. This responds to the need of promoting knowledge exchange within the project consortium and beyond, providing internal and external cities with a source of references if wishing to undertake action in their own local contexts. The initiatives and case studies in this report are accompanied by a replicability assessment aimed at extracting those enabling factors that could facilitate the transfer of some of these initiatives elsewhere. Additionally, it contains a series of criteria that cities can use to evaluate the proposed initiatives, and assess their replicability potential to their own contexts.

40 initiatives were selected among a broader list (identified following extensive desk research and consultation to project partners MUOP, FRAUNHOFER and TECNALIA) and featured in this report. All these initiatives contain information on their location, biogeographical region and lead(s). 32 of them are featured as snapshots (where a brief description is provided, as well as links to relevant sources) and eight of them are featured as case studies (containing in-depth information on aspects such as main outcomes, factors of success and lessons learned, driving from the interviews conducted). They have been classified according to a series of parameters such as the type of measures featured, the main hazards they respond to and the disaster risk management's phase(s) they cover. The eight case studies were assessed and analysed using a rating system that accompanies a set of Replicability Assessment Criteria.

1. Introduction

This report has been prepared for the European Commission-funded research project ARCH: Advancing Resilience of historic areas against Climate-related and other Hazards. The ARCH project aims to enhance the resilience of areas of cultural heritage to climate change-related and other hazards. To this end, tools and methodologies will be developed with the pilot cities of Bratislava (Slovakia), Camerino (Italy), Hamburg (Germany), and Valencia (Spain), in a co-creative approach with local policy makers, practitioners, and community members. The results will be combined into a collaborative disaster risk management platform for guided resilience building, along with a range of models and methods to support decision-making at appropriate stages of the disaster risk, climate adaptation and cultural heritage management cycles.

This report is part of ARCH work package 7 (WP7) “Framework and Integration”, which establishes a conceptual framework for the project, defining the concepts and approaches that will be used throughout. The ultimate goal of WP7 is to develop a disaster risk management framework for resilience building and assessment, and to operationalise it in the form of a data and information platform (for disaster risk management), integrating datasets, tools, and methodologies from other work packages (WPs 4, 5, and 6) in order to support local resilience-building.

Specifically, this report is the outcome of task 7.2, aimed at identifying, reviewing and mapping existing European and International experiences and good practices related to making historic areas more resilient. The main goal of this report is to advance the ARCH project partners’ knowledge on existing cultural heritage resilience initiatives, by providing information on both their implementation challenges and success factors as well as their transferability potential to other urban contexts (including ARCH partner cities). Additionally, it serves the following purposes:

- To provide people working in city administrations in European cities and regions (especially in the areas of climate adaptation, disaster risk reduction and cultural heritage management) with **a source of guidance and inspiration for building the resilience of cultural heritage sites**.
- To provide deeper insights on the **lessons learned** and **factors of success** of a series of initiatives flagged as good practices/case studies on cultural heritage’s resilience
- **To evaluate the suitability** of selected practices to be replicated in (or transferred to) another context.

1.1. Gender statement

This document has been developed taking into consideration the guidance on gender in research provided in the Project Handbook (D1.2), which states that the need for gender mainstreaming arises from historical and continuing disparities in power distribution between people of different gender identities (including between men and women, but also the LGBTI community). ARCH work is based on equality. During the project completion, equal

opportunity should be provided to all members of the consortium (and external participants, if and when involved)–regardless of their sex, religion or gender–to express views, knowledge, experience and suggestions. Building from this premise, gender mainstreaming has been approached in three different ways throughout the completion of this report:

- Ensuring gender balance within the internal team involved in the current analysis, with a 1:1 ratio of men and woman as authors/co-authors of the report. Considering reviewers, the team includes five men and eight women.
- Interviewees have been given equal opportunity to participate, regarding their gender, religion or culture. Experts interviewed include four men and four women.
- Featuring a small number of case studies and initiatives incorporating an explicit gender mainstreaming agenda (see in particular 6.2.5 and 6.3.5).

1.2. **Relation to other deliverables**

This report is informed conceptually by six State-of-the-Art (SotA) reports (D7.1) completed in November 2019 within task 7.1 *Concepts, approaches, standards and technologies* and covering the following subjects:

- Historic areas, conservation practices and relevant regulations/policies [1]
- Disaster risk management, emergency protocols and post-disaster response[2]
- Building back better [3]
- Decision support frameworks and technologies [4]
- Mainstreaming gender in building cultural heritage resilience [5]
- Existing standards and regulatory frameworks [6]

Additionally, content from each pilot city's Baseline Report (Task 3.3 Identify the baseline in each partner city) has been taken into account for the classification of hazards, the review and mapping of initiatives and case studies, the replicability analysis and the resulting recommendations.

The initiatives and case studies compiled in Part 6 of this report will in turn inform other areas of work within the project, such as the development of a planned resilience options library (Task 6.1). In addition, discussion is underway as to whether (and if so, how) the replicability assessment, presented in Part 7 of this report, might be integrated in the data and information platform with respect to framing selected best practices.

1.3. **Structure of this report**

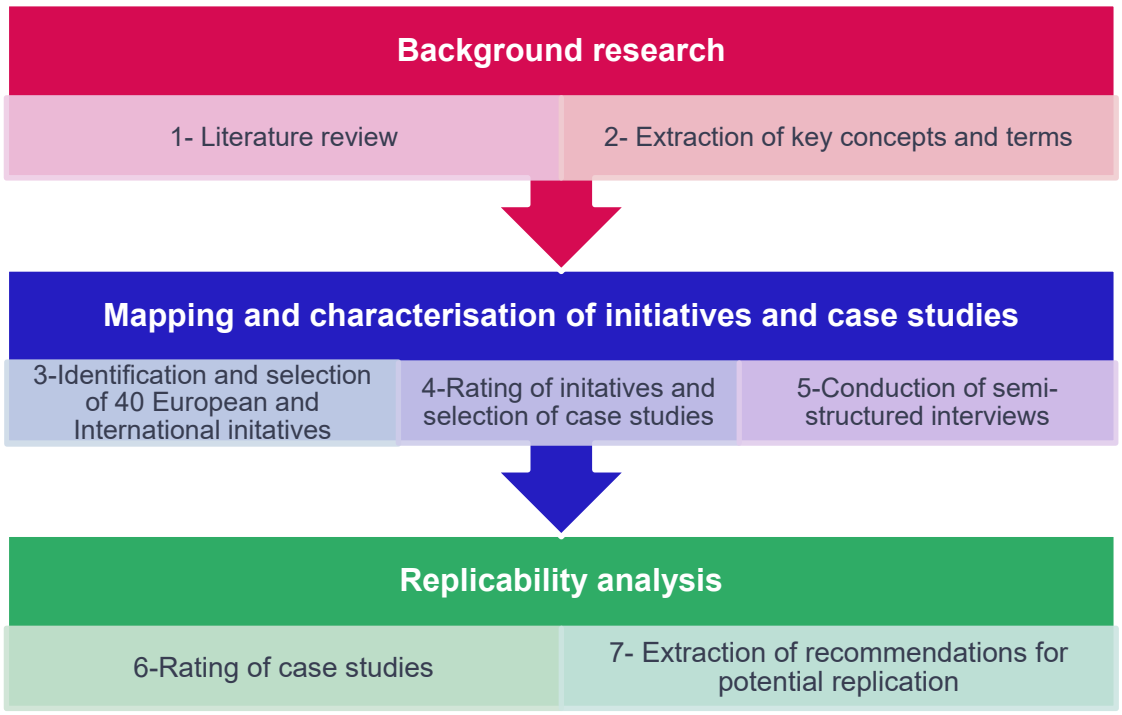
This introductory section (Chapter 1) is followed by an explanation of the methodology leading to the completion of this report, which constitutes Chapter 2. Chapter 3 outlines the key concepts and terms used, as background to facilitate the understanding of the remaining chapters. It includes aspects such as the classification of cultural heritage elements (both tangible and intangible), terminology used in disaster risk management and climate change adaptation, and a typology outlining the main hazards affecting cultural heritage at European

level. Chapter 4 reviews the international and European policy landscape with respect to cultural heritage resilience, as well as the intersection between the fields of cultural heritage management, disaster risk management and climate change adaptation. Chapter 5 provides an overview of cultural heritage resilience in practice within Europe, outlining key research projects and initiatives. Chapter 6 presents initiatives and good practices, classified according to hazards, type of measures covered, and stage(s) of the disaster risk management cycle they respond to; and includes a section summarising implementation challenges, as well as factors contributing to success or failure. Chapter 7 is dedicated to a replicability assessment and analysis of the selected case studies. Finally, Chapter 8 gathers conclusions, limitations and recommendations for further steps.

2. Methodology

In order to identify and analyse initiatives and case studies of relevance to cultural heritage resilience in Europe, a mixed methods research approach was employed, combining literature review and semi-structured interviews. The methodology is presented in general terms in Fig 1 and in more detail in the following pages.

Fig 1: Three main methodological phases (and corresponding steps) followed in the analysis



2.1. Background research

As a first methodological step, a literature review (including grey and scientific literature, EU and international projects websites and deliverables – as well as the ARCH state-of-the art reports (D7.1)) was conducted aiming to:

- Extract key information that would build the basis for Chapter 3, providing the theoretical background of the report and outlining key concepts and terms that are used

throughout the consecutive pages and are necessary to understand the mapping and classification of good practices and initiatives.

- Review main policies and frameworks (including conventions, treaties and charters) that have contributed to the protection of international and European's cultural heritage, with a particular emphasis on the intersections across the fields of cultural heritage conservation, disaster risk management and adaptation to climate change (Chapter 4)
- Identify European funding programmes and projects in the fields of cultural heritage's resilience (Chapter 5)
- Understand the concept of replication/replicability of good practices and transfer to other settings and contexts (Chapter 7)

The results of the literature review contributed to identify a series of initiatives and good practices on cultural heritage resilience (mostly related to the European context, but also international). Additional initiatives were suggested by project partners MUOP, Fraunhofer and Tecnalia. A total of 50 initiatives were compiled. These were screened by ICLEI Europe for a preliminary selection. Priority was given to those initiatives showing replicable steps and tangible outcomes (e.g. deliverables, tools and methodologies, management plans, physical interventions or educational packages), relating to urban or peri-urban settings (or interesting from an urban perspective) and featuring tangible cultural assets –which better respond to ARCH's scope of work-. Following this premise, conferences and workshops identified as good practices were left aside. Duplications were also removed from the list. To ensure geographical balance, some initiatives were added after the preliminary selection upon additional desk research. The final selection reduced the number of initiatives to 40, which was the desired milestone.

2.2. **Mapping and characterisation of initiatives and case studies**

In total, 40 European and international initiatives appear in this report, ranging from tangible restoration actions to cultural heritage management plans, monitoring tools and technologies (an overview of the initiatives can be found in Annex 1). Out of these 40 initiatives, eight have been featured as case studies, where deeper insights are provided in aspects such as their development, principal actors involved, main outcomes, challenges and factors of success or failure. The remaining 32 are featured as snapshots, with a brief description of the initiative (including leads, partners and main outcomes) and links to relevant resources.

The 40 initiatives were first classified according to the main category of hazard(s) affecting them (see Chapter 6), the disaster management cycle stage they respond to (see Chapter 3 as reference), and the type of intervention concerned (according to the categories social, structural and institutional[1]). They were then assessed using a series of criteria defined in the ARCH Initiatives Scoreboard (see Table1) developed in-house and validated by the ARCH

[1]At a later stage, these categories were replaced by *structural*, *managerial*, *behavioural* and *institutional* for more accuracy in the classification of initiatives (see Chapter 6, Section 6.1 as a reference)

partners MUOP, Fraunhofer and Tecnalia. The scoreboard presents seven criteria looking at different aspects of each initiative. Each of the criteria is accompanied by a scoring variable.

The criteria were selected, following literature review and consultation with ARCH partners; aiming to ensure that the selected case studies put increased emphasis on virtues that would enhance the resilience of cultural heritage, while they are meant to be used as a guideline to determine the usefulness, sustainability and effectiveness of an initiative. These criteria are the following: 1) type of intervention, 2) geographical coverage, 3) number of concrete sites benefited, 4) co-benefits, 5) community engagement, 6) knowledge of local situation, 7) long-term effectiveness. For each of the criteria a justification is introduced which provides further explanation on how to rate each initiative. Both the criteria and the instructions for scoring are explained in Table 1.

ARCH SAVING CULTURAL HERITAGE	**ARCH INITIATIVES SCORECARD**
Good practice	*put a short title of the good practice here*
Completed by	*put your name here*
Instructions	For each criterion (row) complete the score column by entering a score between 1 and 3 where 1 is weak and 3 is strong. You can use the score criteria on the right to see what score to give. Complete the evidence column for each indicator, by analysing why the specific score was given to the good practice

Criterion	Score awarded out of 3	Evidence for score	Criteria for scoring
Type of intervention	*0*	*This indicator refers to the type of intervention/project/initiative that is being implemented in a specific area; more specifically this refers to a measure of social, structural or institutional nature; a combination of intervention types would also be potentially achieved.*	Score 1:social only, physical/structural only or institutional only score 2: combination of social/structural, or structural/institutional or social/institutional score 3: combination of all three (social/structural/institutional)
Geographical coverage	*0*	*This indicator refers to the geographical coverage of a specific intervention/initiative/project; refers to the influence and scale of impact that the implementation within various governance levels*	score 1: impact at local level only score 2: impact at regional level, beyond local score 3: impact at national or even international level
Number of concrete sites benefited	*0*	*This indicator refers to the number of areas that are benefited from a specific intervention/project/initiative etc., aside the one that is considered the main site of the good practice*	score 1:one single site score 2: more than 2 sites score 3: more than 5 sites

Co-benefits	*0*	*This indicator refers to the additional benefits that arise from the implementation of the specific intervention/project/initiative etc, apart from the preservation of cultural heritage, e.g. Environmental: (climate adaptation benefits, improvement of air quality, water retention); Social: social integration and inclusion, health and well-being of residents, community cohesion etc.) or economic: (support of recreational activities, tourism, effective maintenance of sites etc.)*	score 1: 1 additional benefit aside cultural heritage preservation score 2: 2-5 additional benefits aside cultural heritage preservation score 3:more than 5 additional benefits aside cultural heritage preservation
Community Engagement	*0*	*This indicator refers to the active (or not) involvement of stakeholders, including residents in the implementation phase of each intervention/project/initiative. The stakeholders may be involved through direct/indirect consultation with the project team, while the residents may be involved either through open citizen participation processes or through participation in organised NGOs and associations*	score 1: stakeholders and residents are involved to the minimum (i.e. Only one event throughout the implementation phase) score 2:moderate involvement/engagement (one event every 6 months/2 per year of implementation) score 3:maximum involvement/participation throughout the implementation phase, through meetings, events and open consultation and participatory processes
Knowledge of local situation	*0*	*This indicator refers to the thorough and detailed knowledge that the responsible for the implementation group or team has on the local situation around the area (site/space) in which a specific intervention/initiative/project is being implemented. A higher level of knowledge usually results in a more effective and efficient implementation.*	Score 1: minor knowledge of local situation (this is the first intervention in the selected area) score 2: moderate knowledge of local situation (a similar intervention was successful i.e. In the past in projects in the selected area) score 3: extensive knowledge of local situation (worked in various projects in the selected area)
Long-term effectiveness	*0*	*This indicator refers to the long-term performance of the intervention/initiative/project, as well as its sustainability*	score 1: low effectiveness, compared to other traditional methods score 2: medium effectiveness, compared to other traditional methods score 3: high effectiveness, compared to other traditional methods

Table 1: the ARCH Case Study Scoreboard used to assess the 40 initiatives identified and to select the case studies

Each initiative was independently rated by the authors of the report, after which an average score was calculated for each of them. Based on those initiatives with a higher score and ensuring a balanced geographical and thematic coverage (i.e. type of hazard addressed, type of intervention) to avoid redundancy, eight initiatives were selected to profile in further detail as 'case studies' (also included in the overview in Annex 1):

- **Case study 1:** City of Regensburg Integrated heritage management planning
- **Case study 2:** Patios de la Axerquía- Regenerating historical courtyards through social innovation
- **Case study 3:** Local heritage plans strengthening local competence and capacity through planning
- **Case study 4:**Local historical knowledge to inform climate stress tests in the Netherlands

- **Case study 5:**Appignano del Tronto – How to react after a disaster
- **Case study 6:**Mikulov Urban Conservation Area
- **Case study 7:**Adopting cultural heritage monuments and buildings: an initiative from Pirkanmaa Museum
- **Case study 8:** The preservation of Tematín castle

For each of these case studies, semi-structured interviews (see interview questions at Annex 2) were conducted with an identified contact person (external to the ARCH project) directly involved in the coordination of each, in order to gather insightful and first-hand information on aspects such as the context (e.g. main hazards affecting the region, relevant policies ensuring the protection of local cultural assets, available resources for action) and implementation details(e.g. stakeholders involved, main achievements, barriers and factors of success).

There are certain limitations to the methodology used for assessment of good practices and initiatives:

- Capacity constraints limited the amount of people allocated to the rating of initiatives, task that would have benefitted from a higher number of ratings/initiative for more robustness in the results.
- The language barrier hindered the compilation of information in some of the cases, and as a consequence, there are some oscillations in the amount and quality of the information provided. However, informational gaps have been saved through later consultation and desk research.

2.3. **Replicability assessment and analysis**

As a last step, a replicability assessment and analysis was conducted, in accordance to what has been stated in the ARCH Grant Agreement that requests to 'review, map and systematically characterize existing experiences and good practices in Europe and globally, through evidence and common metrics to evaluate and establish their replicability conditions, and recommend how historic areas can be rendered more resilient and better prepared to face future disaster events'. All eight case studies were assessed and analysed using a set of replicability criteria and aiming to extract factors that could enable or hinder the potential transfer to other urban contexts. The set of the replicability criteria was selected following extensive desk research, including other HORIZON2020 projects that are working on replication (GrowSmarter, proGIreg, Replicate) and through consultation with ARCH partners that have experience on replication.

Beyond the already conducted analysis, which will be presented in the next chapters, the proposed replicability criteria could serve as support material for cities within or outside the project consortium, aiming to transfer and/or replicate initiatives in their own local context.

In more detail, to assess and analyse the replicability potential of the eight case studies that were included in this report, the following approach was adopted, combining literature review on replication and transferability and the development of a set of replicability assessment criteria (see Table 2).

ARCH SAVING CULTURAL HERITAGE		ARCH REPLICABILITY SCORECARD					
CASE STUDY		***Insert case study name***					**SCORE**
CRITERION		**SCORING**					
		1	2	3	4	5	
1	**Answer to local needs** *Does the initiative respond to a specific need or challenge of the local community?*	No important improvement of life quality for community members	Some improvement of life quality for those community members directly connected to the initiative in terms of location or work relationship	Significant improvement of life quality for some or all community members	Advanced improvement of life quality for all community members, the initiative even attracts audience from outside the city borders	Exceptional improvement of life quality for all community members that exceeds the city borders	
2	**Integration/cross-sectorial collaboration** *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	No integration aspects – the work is carried out by one department	Low potential for integration and collaboration with other departments and sectors	Moderate potential for integration and collaboration with other departments and sectors	High potential for integration and collaboration with other departments and sectors	Proven record for integration and collaboration with other departments and sectors	
3	**Flexibility** *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	No flexibility or adaptability to changes	Low flexibility or adaptability to changes (i.e. high dependence on sites or political support)	Moderate flexibility or adaptability to changes	High flexibility or adaptability to changes (i.e. changing political situation has no real influence)	Extreme flexibility or adaptability to changes	
4	**Alignment with other policies** *How possible is it to integrate the initiative into existing policies at local or regional level?*	No possibility to integrate into existing policies at local or regional level	Significant problems to integrate into existing policies at local or regional level	Moderate problems to integrate into existing policies at local or regional level	Some problems to integrate into existing policies at local or regional level	No problems to integrate into existing policies at local or regional level	
5	**Sustainability** *What is the initiative's viability over time, when it comes to implementation of goals, organizational stability and long-term benefits?*	Up to 5 years	Up to 10 years	Up to 15 years	Up to 20 years	Over 20 years	
6	**Affordability** *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	Significant cost increase on city budgets	Moderate cost increase on city budgets	Slight cost increase on city budgets	No increasing costs on city budgets	Cost reduction	

7	**Potential for direct climate mitigation benefits** *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Slight reduction of CO2 emissions (0-10% in comparison to local average)	Moderate reduction of CO2 emissions (11%-50% in comparison to local average)	Significant reduction of CO2 emissions (51%-99% in comparison to local average)	No CO2 emissions	Negative CO2 emissions	
8	**Community and stakeholder engagement** *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	Stakeholders are only informed about the initiative	Stakeholders participate in consultations, to give feedback on the design and implementation of the initiative	Stakeholders are involved in the process and their aspirations are constantly understood and considered	Stakeholders are invited to collaborate, and partner on the decision making around the initiative	Stakeholders are empowered to get deeply involved in the decision-making process around the initiative	
9	**Feasibility** *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	Low feasibility, demand for a large human and financial capital to implement the initiative	Moderate feasibility, the initiative demands specific resources for implementation	Significant feasibility, the initiative demands resources, but solutions like co-funding and/or other innovative formats can be explored and implemented	Advanced feasibility, the initiative does not demand much human and financial capital, is easy to transfer and implement	Extreme feasibility, the initiative is ready to implement and requires only minimum availability of funds or human resources	
10	**Social acceptance** *Is this an initiative that the community will embrace (or not)?*	Very limited acceptance, the community is not making or is rejecting the initiative	Moderate acceptance, some members of the community are making use or promote the initiative	Significant acceptance, the community is promoting the initiative and considers it a good addition to the city and community life	Advanced acceptance, the city and the community are promoting the initiative and seek similar opportunities	Extreme acceptance, the community has embraced the initiative, which attracts appraisal from outside the city borders; in addition, the community starts planning for similar opportunities	
11	**Visibility** *Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?*	Very limited visibility of the initiative, only at local channels	Moderate visibility of the initiative, mainly on local and some regional channels	Significant visibility of the initiative in local and regional channels, initiative ranked as good practice at least once	Advanced visibility of the initiative in local, regional and national channels, initiative ranked as good practice more than once	Extreme visibility of the initiative in national and international channels, initiative ranged as good practice in several channels	

Table 2: The ARCH replicability scoreboard – how replicable is a case study.

- As first step, a preliminary desktop review was undertaken, identifying and prioritising likely areas and concepts important to a replicability or transferability process.

- As a second step, a teleconference focusing on a draft version of the criteria was organised with project partners to discuss their applicability and their dimensions when it comes to the assessment system that was used.

- We considered possible additions to the criteria, taking into consideration learnings from previous projects that had a replication and/or knowledge transfer element, e.g. RESIN Climate Resilient Cities and Infrastructures, Smart Mature Resilience and Grow Smarter, Replicate and proGIreg projects.

- Finally, making use of the replicability assessment criteria, five ARCH representatives (two ICLEI Europe staff and three Fraunhofer IAIS staff) assessed the eight case studies and inserted a rating for each of the criteria.

A summary of the assessment score received by each case study is included in Annex 3 of this report.

There are certain limitations to the methodology used for the replicability assessment and analysis;

- In replicability and transferability processes, it is important to ascertain external validity and generalisability; it is important to keep in mind that international replicability is also problematic because of cultural and curricular differences.

- Crucially, replicability was assessed here based on criteria defined through desk research and interviews, rather than from the viewpoint of potential 'replicators' (whether the ARCH cities or other cities). As such, the replicability findings can be understood as a starting point for ongoing discussion within the project, rather than a basis for transferring initiatives to other cities.

The criteria established and applied through this study will form part of this ongoing discussion and may play a specific role in organising future city-to-city engagement (e.g. with Tier 2 cities) and design of the future ARCH tools (e.g. data and information platform).

3. Key concepts and terms

This section outlines the concepts and terms that are essential to understand the rationale behind this report. As some of these concepts have already been addressed in former ARCH reports (in particular D7.1 State-of-the-Art reports, including 1: Historic areas, conservation practices, and relevant regulations / policies[1]), 2: Disaster risk management, emergency protocols, and post-disaster response[2], and 3:Building back better [3]), we focus here on those that are most relevant to understand our identification, mapping and characterisation of the initiatives later presented in Part 6. , i.e.: the concept of cultural heritage and its various dimensions, the concept of risk, an overview of the hazards(and stressors) most relevant to cultural heritage sites, and the practice of disaster risk management.

3.1. **The dimensions of cultural heritage**

The concept of cultural heritage has varied considerably over time, with the contemporary definition including both tangible and intangible dimensions [7][8][9].

Tangible heritage is described by UNESCO [8] as "*physical artefacts produced, maintained and transmitted inter-generationally in a society. It includes artistic creations, built heritage and other physical or tangible products of human creativity, which are carriers of cultural significance within society and are considered to be worthy of preservation in the future".* **Intangible heritage** is defined as "*practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity* [8].

The ARCH project adopts the classification also proposed by UNESCO [8], later revised by the ICOMOS Climate Change and Cultural Heritage Working Group in 2019[10], where cultural heritage elements are categorised into six main groups:

- Moveable heritage;
- Archaeological resources;
- Buildings and structures;
- Cultural landscapes;
- Associated and traditional communities,
- Intangible heritage

Building on the category proposed above, as well as on other key publications [10][11][12][13]these different categories and the examples of heritage types and elements therein, are visualised in Table 3 below.
The ARCH project's scope of work is mostly oriented to protecting those heritage assets associated to the wider urban context (including peri-urban metropolitan areas), which are widely represented by tangible, immovable heritage such as historical and monumental buildings and infrastructure that constitute historic centres, as well as cultural landscapes more broadly. Nevertheless, most elements of cultural heritage are frequently intertwined, and historic centres and other cultural heritage types found in cities are strongly associated to intangible elements, e.g. traditional practices. For this reason, a wide range of elements have been considered in the current analysis, although there is a prevalence of those actions, measures and initiatives relevant to tangible cultural assets.

Cultural Heritage Categories	Cultural Heritage Types	Examples
Moveable heritage	Works of monumental sculpture and painting	Paintings, sculptures, furniture, wall paints
Archaeological resources	Archaeological finds	Pottery, artefacts, inscriptions
	Archaeological materials	Bones, textiles, ceramic
	Archaeological sites	Tombs, caves
	Archaeological monuments	Sacred places, temples, burial sites
	Stratigraphic elements	Stratigraphic tests and finds
Buildings and structures	Architecture (historic and monumental buildings)	Castles, theatres, churches, cathedrals
	Groups of separate or connected buildings	Streets, warehouse complexes, harbours
	Historical nuclei	Historic centres of towns and cities
Cultural landscapes[2]	Parks/gardens	Parks, cemeteries, botanical gardens
	Combined works of nature and humankind	Agricultural landscapes, mining landscapes
Associated and traditional communities	Traditional groups, communities and individuals	Indigenous peoples
Intangible heritage	Oral traditions and expressions	Proverbs, poems, tales
	Performing arts	Theatre, music, dances
	Social practices, rituals, festive events	Festivals, religious rituals, ceremonies
	Traditional craftsmanship (knowledge and skills)	Crafts, traditional agricultural techniques, masonry
	Knowledge and practices concerning nature and universe	Traditional ecological wisdom, traditional healing systems

Table 3: Classification of cultural heritage categories, types and examples

The ARCH project's scope of work is mostly oriented to protecting those heritage assets associated to the wider urban context (including peri-urban metropolitan areas), which are widely represented by tangible, immovable heritage such as historical and monumental buildings and infrastructure that constitute historic centres, as well as cultural landscapes more broadly. Nevertheless, most elements of cultural heritage are frequently intertwined, and historic centres and other cultural heritage types found in cities are strongly associated to intangible elements, e.g. traditional practices. For this reason, a wide range of elements have been considered in the current analysis, although there is a prevalence of those actions, measures and initiatives relevant to tangible cultural assets.

[2]The Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO, 2008) includes in this category **intentionally created landscapes** (e.g. parks, cemeteries), **organically evolved landscapes** (e.g. relic /or fossil landscape where an evolutionary process came to an end or a continuing landscape which retains an active social role associated with a traditional way of life and which exhibits significant material evidence of its evolution over time) and **associative cultural landscapes** (landscape that has value by association by powerful religious, artistic, or cultural association of the natural element)

3.2. **Risks to cultural heritage**

Understanding how cultural heritage assets are threatened requires a basic introduction to the concept of risk and its constituent elements: hazard, vulnerability and exposure. Hazards that may affect cultural heritage are of different origins – e.g. environmental, anthropogenic or biological– and most of them are mutually dependent. The impacts on cultural heritage are often a result of concatenating hazards and are aggravated by non-climatic and climatic drivers. The current section aims to review some of these concepts and the relation between them.

The IPCC [14] defines **hazard** as *"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, and environmental resources".* According to the UN [15] each hazard is further characterised by its location, intensity or magnitude, frequency, and probability. The events and trends addressed in the IPCC definition may have consequences of different magnitude, depending on the system or community's exposure to a hazard, and that system or community's underlying vulnerability (comprised of its sensitivity and its capacity to deal with the consequences, i.e. adaptive capacity).These key terms can be defined as follows:

- **Exposure:** *"The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected"*[14]
- **Vulnerability:** *"The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt"*[14][3]
- **Adaptive capacity:** *"The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences"*[14]

When these factors (occurrence of an event, exposure and vulnerability) interact they may result in a **hazardous physical event or disaster** (in this last case, especially when the adaptive capacity of a community is low and its sensitivity high). This report adopts the UNDRR [16] definition of **disaster**: *"a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources".*

Hazards may be single, sequential or combined in their origin and effects. They entail risks, which could manifest as impacts on cultural heritage: e.g. deterioration, collapse, weathering of materials, etc. Here, **risk** is understood as *"the potential for consequences where something*

[3] Note that some commentators go further to emphasise the social dimensions of vulnerability, and specifically power structures that contribute to it, defining vulnerability as 'the structural conditions, including physical, social, cultural, economic and political systems that render people and communities susceptible to the impacts of hazards, and which make it possible for a hazard to become a disaster' See: Gorman-Murray, A., & Dominey-Howes, D. (2016). 'The greatest loss was a loss of our history': natural disasters, marginalised identities and sites of memory. Social & Cultural Geography, 17(8), 1120-1139.

of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard" [14] and the **impact**, as the consequence or effects of a risk when it becomes tangible (see Fig 2 below). An initial impact can trigger other phenomena that may lead to consequences of significant magnitude (e.g. physical, social or economic disruption), known as "cascading effects" [17].

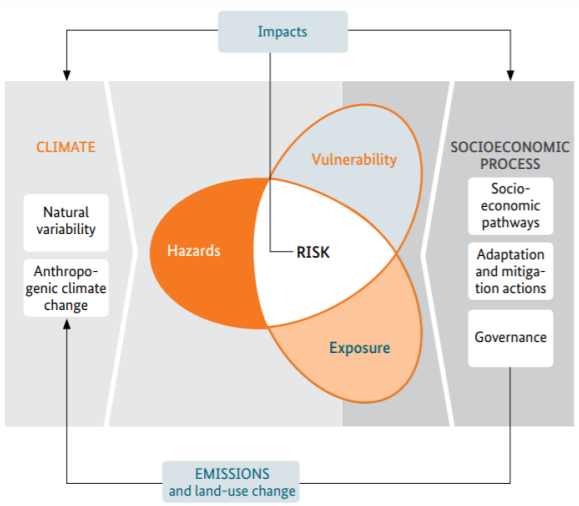


Fig 2: Schematic representation of main factors influencing a risk. Source: IPCC, 2014

Also relevant are drivers of deterioration (also called **stressors**) as a different category to hazards, referring to those factors that aggravate the impacts of a potential event. More concretely, the IPCC [18] define stressors as *"events and trends, often not climate-related, that have an important effect on the system exposed and can increase vulnerability to (climate-related) risk"*. This concept is used here to include those elements hindering the implementation of cultural heritage conservation or management measures, or accelerating the deterioration of the assets, such as neglect, lack of political or social support, lack of resources, or ineffective funding mechanisms, just to name a few.

3.3. **Most common threats to cultural heritage**

The challenges that society faces in order to successfully adapt to and resist future disasters are widely documented [19]. They come in different forms and shapes, either as natural hazards (some of which are increasingly frequent and aggressive as a consequence of climate change) or as anthropogenic –or human-induced- hazards such as those resulting from the industrial development, urban growth and overexploitation of natural resources. The combined effect of all of them frequently leads to economic and socio-political issues, augmenting inequality and triggering civic unrest in different manners (i.e. armed conflicts, terrorism).

Cultural heritage assets, as an intrinsic element of human civilisation, face particular and serious risks in this regard, including their social, cultural, historic and artistic values; the safety of their occupants and users and those whose livelihoods depend on tourism[20]. Moreover, a

heritage site or object can also be negatively affected by inappropriate emergency response and post-disaster actions, ill-conceived restoration and recovery phases, or technical and economic constraints, among others [20]. This is a major concern; partly because of the significant role that heritage plays in contributing to social identity, social cohesion and sustainable development [21].

Understanding and classifying such hazards and their consequences has been a core activity in the topical areas of disaster risk management (hereafter DRM) and more recently, climate change adaptation (CCA). Climatic hazards may have received closer attention due to the momentum the topic of climate change has been gaining in the last decades, with typologies developed by The Intergovernmental Panel on Climate Change [22], C40[4] andThe Covenant of Mayors [23], mostly targeting urban areas. The manual *Managing disaster risks for World Heritage* [21] and the more recent report *Safeguarding Cultural Heritage from Natural and man-made disasters* [20] depict the most common hazards affecting cultural heritage.

As mentioned in section 3.2 above, some of these hazards – whether climatic or non-climatic – interact with each other, giving place to complex impact chains, where new hazards emerge based on the vulnerability and exposure of the cultural heritage assets affected. Building on previous typologies, as well as on research conducted within the H2020 project RESIN, the ARCH project team proposes a schematic categorisation of the main hazards affecting cultural heritage in Europe and the main interconnections between them (Fig 3) In the current report, hazards have been classified under four main categories: “climate-related”, “human-induced”, “geological-related”, and “biological-related” (even though some of them fall under different categories simultaneously). The graph is an attempt to depict the complex nature of impact chains in a non-exhaustive way, indicating the most evident interactions. Building on previous works [10] [13] [24] [25], the table on the following page (Table 4) shows the most common impacts on cultural heritage assets as well as the main causes and related hazards.

[4]C40 developed in 2015, in collaboration with Arup, a City Climate Hazard Taxonomy, which classifies climate hazards into five key groups: meteorological, climatological, hydrological, geophysical, and biological. The Taxonomy is available here: https://www.c40.org/researches/city-climate-hazard-taxonomy

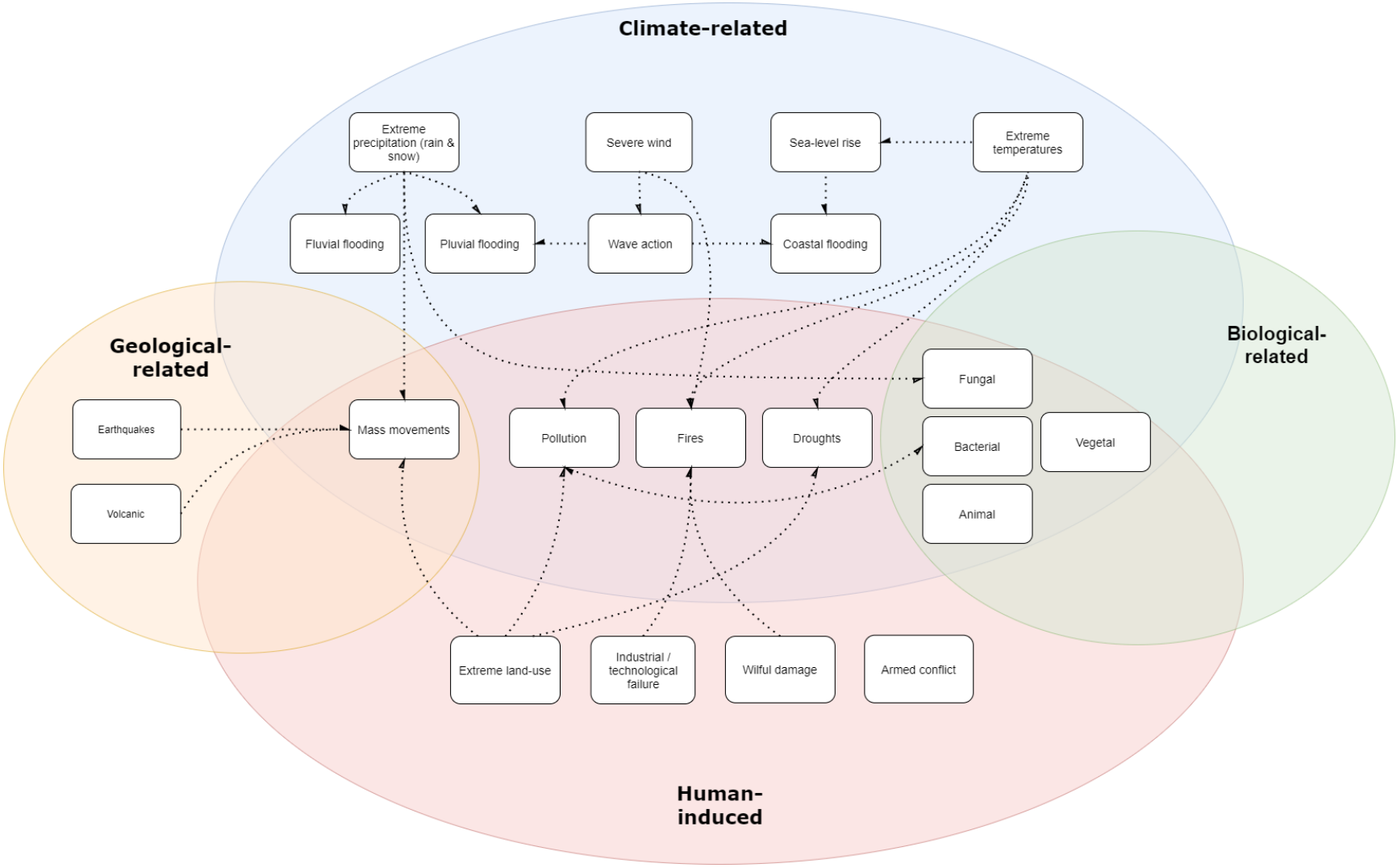


Fig 3: Schematic categorisation of main hazards affecting European cultural heritage and the interconnections in between them.

Damage to Cultural Heritage	Causes	Related hazard(s)
Physical/mechanical erosion and weathering of stone materials	Freeze/thaw cycles	Extreme temperatures
	Rain/hail impact	Extreme precipitation
	Abrasion	Severe wind
	Wave impact	Wave action Storm surges
	Bio-pitting	Fungal action Bacterial action
	Root-wedging	Vegetal action
	Tunnelling, carving	Animal action
	Weapons/objects impact	Armed conflicts Wilful damage
	Landslides, mudslides, rock falls	Mass movement Extreme precipitation Extreme land use
Chemical erosion and weathering of stone materials	Wet/dry cycles	Extreme precipitation Flooding (pluvial, fluvial or coastal)
	Salt intrusion	Flooding (coastal) Severe wind
	Inorganic and organic compounds, gases and particles	Pollution
	Lava flows and ashes	Volcanic activity
Structural damage and collapse	Freeze/thaw cycles	Extreme temperatures
	Wind impact	Severe wind
	Faulting, transient shaking	Earthquakes
	Mudflows, landslides, rockfalls	Mass movements Extreme land use Extreme precipitation
	Lava flows, lahars	Volcanic activity
	Explosions	Armed conflict Wilful damage
	Wave impact	Storm-surges
Total or partial burning, blackening, and deformation by heating	Fires	Extreme temperatures (heat) Volcanic activity Earthquakes Armed conflict Wilful damage
	Lightning	Extreme precipitation (thunderstorms)
Subsidence	Soil erosion and instability	Extreme land use Extreme precipitation
	Faulting, transient shaking	Earthquakes
Isolation and reduced accessibility	Burial and submersion of assets	Sea-level rise Flooding (fluvial) Volcanic activity

Damage to Cultural Heritage	Causes	Related hazard(s)
	Mudslides, rockfalls, and landslides	Mass movements
Loss of aesthetic value	Fading/yellowing of painted materials	Extreme temperatures (heat)
	Particulate matter deposition and crusting/soiling of surface masonry materials	Pollution
	Foxing of paper materials by fungal action or oxidation	Fungal action Extreme precipitation Extreme temperatures (heat)
	Accelerated aging of textile materials	Extreme temperatures (heat) Extreme precipitation
Corrosion of metallic materials	PH precipitation	Pollution Extreme precipitation
Timber collapse and pulverization	Organic decomposition	Bacterial action Fungal action
	Tunnelling and boring of pests	Animal action
Abandonment and/or neglect of tangible cultural assets	Desertification	Extreme temperatures
	Exodus, population migration	Armed conflict Wilful damage
Transformation of cultural landscapes	Proliferation of invasive species	Extreme land-use Pollution Extreme temperatures Extreme precipitation
	Loss of local biodiversity	Extreme land-use Pollution Extreme temperatures Extreme precipitation
	Abandonment of traditional agricultural or industrial practices	Extreme temperatures Sea-level rise Flooding (coastal) Extreme land use Pollution
Loss of traditional knowledge	Displacement or migration of local communities, crop failure and abandonment of traditional agricultural, industrial and artistic practices	Extreme temperatures Sea-level rise Coastal floods Extreme land use Pollution

Table 4: Categorisation of damages to/effects on cultural heritage and their causes and related hazards

The prevalence of the above hazards varies of course depending on geographical variables. The following paragraphs present an overview of the most common hazards in Europe (including the overseas regions) and their consequences on tangible cultural heritage assets, organised under the four main hazard categories identified above: climate-related, geological-related, human-induced and biological-related.

3.3.1. Climate-related hazards

This category encompasses all those hazards deeply influenced by atmospheric variations, whether they are sudden, abrupt or short-term (meteorological) or alternatively prolonged over time (climatic). Such hazards are especially relevant and indeed urgent globally, as their frequency and intensity is being increased by climate change, and the magnitude of consequences is still unpredictable in spite of existing models and future-scenario simulations.

Extreme temperatures, heat waves and droughts

The increase in the global surface temperature is expected to affect the frequency and intensity of heat extremes, heatwaves (and, somewhat conversely, precipitation, as warmer air can hold a bigger quantity of water) – therefore increasing the probability of storm surges or severe rainfall [26].

Prolonged extreme heat can lead to droughts, which refer to the (extreme) scarcity of water, whose origin may be meteorological (caused by rain deficiency), hydrological (caused by low discharge or low ground water level) or linked to lower soil moisture. **Drought** has been a recurrent feature of the European climate in recent times. From 2006 to 2010, on average 15 % of the EU territory and 17 % of the EU population have been affected by meteorological droughts each year [19]. Droughts translate into soil erosion, salt weathering and cracking and collapse of buildings (among them, those of cultural heritage significance), ecological disruptions and lower productivity in agricultural lands.

Abrupt variations in temperature result in changes in freeze-thaw cycles with severe impacts on cultural assets, especially if they are made of stone. Some of the most widely-recognised impacts are the deterioration of facades due to thermal stress, freeze-thaw/frost damage, fading of paintings, yellowing of materials, structural damage in mineral materials (as humidity penetrates and freezes the insides) and biomechanical deterioration[27].

Some other secondary impacts or cascading effects of temperature variations may not be as evident, but equally affect cultural heritage either directly or indirectly, e.g. through the proliferation of invasive species and the spread of native and non-native species of insects that could lead to changes in cultural landscapes, or by favouring mould infestation (whose metabolic activity is higher in warmer and more humid conditions) and other biological hazards [28]. Additionally, droughts and increased temperatures are closely linked to **wildfires** and are also associated with desertification, which can force people to migrate (e.g. where a community depends on agricultural land), leading to the abandonment or neglect of a specific area. Climate - induced migration also affects intangible cultural heritage, forcing local communities to abandon their traditional ways of living to secure livelihoods in other areas, while putting their traditions and cultural values at risk [27] [29].

Extreme precipitation, storm surges and flooding

Water-related hazards represent a serious multi-level threat with direct and indirect impacts, periodic reappearance and with complicated socio-economic impacts [30]. Heavy (or extreme)**precipitation** (i.e. rain, sleet, hail and snow) can overload structures such as roofing, downpipes, or gutters; cause pollutants to accumulate on and potentially penetrate building fabric to building's surfaces; cause physical changes to internal surfaces and objects (e.g. paintings) due to rising humidity, crystallisation and dissolution of salts from wetting and drying; cause erosion and corrosion of metals; and cause biological attack of organic materials [10]. Additionally, extreme precipitation in the form of hail can also cause erosion when impacting surface materials.

Heavy precipitation poses the risk of one of the most frequent and widespread natural disasters in urban areas: i.e. **pluvial** flooding caused by heavy rainfall (including flash flooding), and **fluvial** flooding, caused by the overflow of bodies of water. Flooding impacts are also influenced by non-climatic factors, such as population density, floodplain development and land use changes [31].

Many flooding events of alarming magnitude have taken place in Europe in the last decades, causing damage worth billions of euros, particularly in 2002 (Czech Republic, Austria, Germany, Slovakia, Poland, Hungary, Romania, Croatia) 2006 (Bulgaria, Romania, Serbia, Macedonia, Germany, Czech Republic, Hungary), 2009 (Austria, Czech Republic, Hungary, Poland, Romania, Slovakia, Turkey) and in 2013 (Germany, Czech Republic, Austria, Switzerland, Slovakia, Belarus, Poland, Hungary)[32] [33].

Cultural heritage sites can suffer considerably from these events, experiencing failures due to static and dynamic loads, impacts from floating objects, chemical erosion, saline intrusion (if located in coastal areas), rot and biological infections [20]. Even though floods are often sudden and short in duration, flood damage entails longer-term complications from a disaster risk management perspective, as they take considerable time and money to be repaired.

Severe wind

The damage caused by wind (e.g. cyclones, hurricanes and storms) poses a serious risk to infrastructure, human lives and property. Whereas cyclones and hurricanes are not so prominent in European countries, the incidence of storms and related meteorological events is increasing in number and intensity as a consequence of the climate change [34] .Wind is frequently accompanied by rain, salt and sand, all of which can have erosive and abrasive effects on the surfaces of built cultural heritage, as well as chemical change due to moisture penetrating porous surfaces [35]. Moreover, wind gusts and changes in flow direction can drive static and dynamic loading of historic and archaeological structures, unchaining rockfalls, structural damage and collapse.

Sea-level rise and wave action

Sea level rise is caused mostly by melting land ice and the expansion of sea water as it warms [36].Cultural heritage sites located in coastal areas are especially at risk from this phenomenon and the subsequent **coastal flooding**. As stated by Marzeion & Levernmann [37] in a study, 0.7% of global land area would be below mean sea level, affecting about 40 UNESCO World

Heritage sites (about 6% of all then-existing World Heritage sites) if the current global mean temperature were to be sustained for the next two millennia (not including the amount of urban areas that would also be affected, along with their historical centres).

Sea level rise can interact with other events as a consequence of climate change, such as **storm surges**, bringing increasing challenges for cultural heritage sites located in coastal areas, and vulnerable to tidal action. This manifests mostly as floods and coastal erosion, which in turn increase the future vulnerability of coastal areas to sea-related hazardous events. As a result, cultural heritage landscapes may be subject to erosion provoked by prolonged contact with water, along with salt intrusion and physical and mechanical impacts resulting from waves [38].Buildings and objects (particularly those located in low lying areas) may be permanently or temporarily submerged.

3.3.2. Geological-related hazards

Earthquakes

Earthquakes are among the natural disasters with the most devastating effects in terms of loss of life and structural damage [39]. They are frequently followed by concatenating effects, such as fire, floods, landslides or tsunamis, which can combine to multiply casualties in just one single event. Needless to say, the impacts on cultural heritage places can be equally destructive, and often result in total or partial collapse of structures, causing damage that could be irreversible.

Earthquakes are widespread in the European territory, with Mediterranean countries such as Italy, Greece, Turkey and Spain suffering the most from them [20], though Iceland, France, Albania, Bulgaria and Romania have also experienced major earthquakes.

Mass-movement

Mass movement is a complex hazard with various possible origins that can manifest in different forms. Dry landslides are solid-material mass movements which frequently result from the incidence of other hazards such as earthquakes, volcanic eruptions, mining or infrastructural failures. According to the type of materials involved, they would manifest as **rockfalls** – in which rocks or boulders are detached from steep slopes or cliffs–or avalanches – where mineral material of varying size is separated from the underlying substrate, flowing downwards. When mixed with liquid material, they may be referred as wet **landslides**. These are often associated with heavy rainfall or snowmelt, forming **debris flows** (a combination of loose soil, rock, organic matter, air and water which is mobilised as a slurry flowing down a slope) or mudflows (with higher proportion of liquid, and at least 50% of sand, silt and clay-sized particles) flowing at higher speed [20]. Even though classified as geological hazards, extreme weather and climate-related events (e.g. heatwaves, droughts and heavy precipitation) are among the most common triggers of landslides in Europe [19]. Landslides have been known to widely impact cultural heritage from countries such as Italy [40], Bulgaria [41], Austria [42] and Spain [43] leading to damage that may include total or partial collapse, weathering and structural deterioration of materials, chemical change due to humidity, or loss of aesthetic values, among others.

Volcanic eruption

Volcanic eruptions are not a major concern in Europe, with few incidences recorded in the last decades. The most vulnerable areas are located in Southern Europe, mostly in Italy, Greece and overseas territories, such as the Canary Islands and the French Antilles. In spite of the high concentration of World Heritage sites in risk-prone areas, few studies have addressed how volcanic eruption hazard affects the cultural heritage of these areas [20].

3.3.3. **Human-induced hazards**

Human-induced hazards are complex, varied and often associated with development and urban growth. For this reason, the biggest occurrence of human-induced hazards affecting European cultural heritage tends to being urban and peri-urban areas. Buildings located within or in the proximity of cities are exposed to local-scale variations of environmental parameters, such as changes in pollutants, humidity cycles, or the urban heat island effect, amongst others (leaving aside social impacts, some of which will be addressed in section 3.3.5 Drivers of deterioration). Such hazards then interact with others deriving from climate change or natural-occurring processes, unchaining bigger impacts. Since they do not occur alone, conventional risk or damage assessment models have often failed in estimating the real extent of damage.

Extreme land use

Aggressive development is considered as one of the main threats to cultural World Heritage [44]. The continuous demand for resources and space inherent to traditional urban growth has put in danger cultural assets and landscapes, leading to the demolition of historical buildings or transformation of traditional agricultural landscapes in favour of industrial development (e.g. intensive farming and agriculture practices) or simply to make more room for housing. Even though in theory cultural heritage is regarded as a useful catalyst for sustainable development, it is in reality often considered an obstacle [45]. Such is so, that governments may prioritise development over cultural heritage protection (see section 3.3.5 – lack of awareness on cultural heritage values). Sites on the periphery of growing cities are particularly at risk, and there is a need to regulate urban expansion to prevent irreparable damage.

Extractive activities have been known to pose serious risks to cultural heritage sites [46]. The exploration, prospecting and exploitation of minerals and fossil fuels and extraction of gas are considered among the riskiest, as they do not only involve the extractive activities per se, but they are also linked to the construction of roads and supporting infrastructure, all of which can damage surrounding ecosystems either directly (e.g. destruction of vegetation) or indirectly (e.g. through pollution). The deforestation and de-vegetation caused by intensive land use (may it be linked to agriculture, cattle farming, mining or other practices) can favour the incidence of events such as landslides or droughts.

Pollution

Air pollution is caused by natural or human activity that introduces in the atmosphere considerable amounts of gaseous pollutants (NO_2, SO_2, O_3,CH_2O) that can directly or indirectly (for example, through the formation of acid rain) impact on the lifetime and quality of cultural heritage places and objects[47]. With the perspective of increasing urbanisation, it is likely to persist in future. Gaseous pollutants, particulate matter and aerosol carbon fractions provoke

effects such as stone decay, chemical change (e.g. sulphur oxide, nitric acid and nitrates react with some kinds of marble), or dry deposition on stone materials and crusting, resulting in loss of integrity and aesthetic value [48].

Armed conflict and wilful damage

Armed conflict has greatly impacted on the integrity of cultural heritage worldwide, and is still a major issue in countries such as Syria, Palestine, Iraq and Mali [49] [50] [51] [52].Although in Europe, armed conflict has decreased in current times, it has caused great damage throughout the continent's history, with cities and towns being devastated, libraries burnt or communities displaced [53] [54].Some physical testimony remains from past conflicts in historic centres partially or totally rebuilt after attack (e.g. Gernika in Spain, Breisach in Germany). Armed conflict does not only lead to the damage and destruction of cultural assets, but also unchain criminal behaviours such as the looting, theft, removal or illegal trafficking of cultural elements.

3.3.4. **Biological-related**

The action of living organisms may have an impact on the structure and composition of places and objectives of cultural heritage significance. Biological agents unchain transformation processes in the affected materials as a consequence of the metabolic activity connected to their growth or other functions [24]. Many biological organisms find in historic structures (including rock, wood, textiles and paper) an excellent substrate for their growth and development. Glass and metals are less susceptible to the effects of such organisms, except in isolated cases in which buried metal elements had suffered degradation caused by bacterial activity, or underwater glass structures had been colonised by algae [24].

This biotransformation occurs worldwide, but happens with more intensity in warm-humid climates where environmental conditions are most adequate for the biological growth of microscopical beings such as bacteria to macro-organisms such as fungi, lichens, plants and animals. The main types of damage are related to physical, chemical and aesthetical mechanisms and depend on the dimensions of the organisms involved, the type of material and conservation state, the environmental conditions, climatic exposure and the presence and type of environmental pollutants [24]. Whereas some organisms, such as fungi and lichen, contribute to the dissolution and weathering of minerals and colonisation of surfaces with undesired aesthetic effects, plants and weeds can cause with their root systems physical damage such as fracturing or collapse of structures [55]. Animals may use a building or object as habitat, leading to physical transformation and chemical degradation with their secretions. Furthermore, as the climate continues to change and humans continue to modify our environment, biological agents and animals may be displaced from their usual habitats and seek new ones, resulting in the proliferation of species in (natural or agricultural) cultural landscapes where they would not normally be found, with potential impacts on existing local species [38].

3.3.5. **Drivers of deterioration (stressors)**

Besides the climatic, geological, human-induced and biological-related hazards affecting cultural heritage, there are a number of factors limiting the capacity to effectively respond to

them, or accelerating the deterioration of different assets, and these can serve to exacerbate the impacts caused. These factors can be understood as ‘drivers’ or ‘stressors’. With respect to cultural heritage, many such stressors concern insufficient or ineffective management, care and maintenance of culturally significant places ,and may be caused by a lack of awareness of what value cultural heritage really represents to society, lack of political support, lack of available capacity at administrative level or simply, or lack of available expertise. The most relevant stressors are summarised as follows:

Lack of awareness of cultural heritage values

One of the mains reasons that hamper cultural heritage protection is a lack of understanding –or acknowledgement- of what it really represents for society – and this point is closely linked to some of the other drivers below. Cultural heritage conservation is often perceived as a luxury, rather than a tool towards sustainable development, resilience-building and healthier communities. This can be illustrated using disaster risk management (see section 3.4 as a reference) as example. In face of a disaster, cultural heritage management is occasionally left aside from the first steps in the emergency response. This answers to basic needs at a certain extent, and it seems natural that most immediate efforts are directed to save people and critical infrastructure in first place. However, it also responds to a misconception of cultural heritage’s connotations and its importance for social cohesion and identity – and therefore, for social resilience as a whole-. Such misconceptions could result into **lack of political buy-in**, which is essential to secure the capacity and funds needed to undertake effective emergency, restoration and reconstruction efforts.

More generally, the lack of political buy-in could derive in policies and practices at local level that do not play in favour of cultural heritage preservation, such as unsustainable recreation and tourism or demolition of historic buildings for housing and infrastructure projects. Moreover, a municipality that does not enhance its cultural heritage may face higher risks of vandalism, theft and abandonment of cultural heritage assets. On another hand, if companies and contractors involved in maintaining and rebuilding efforts lack awareness of cultural values (and traditions) that local communities associate with “their” heritage, there is an increased risk of losing these values completely, since they might not be considered when maintaining or rebuilding heritage.

Lack of capacity or economic resources at administrative level

This point is a consequence of the former one. When cultural heritage protection is not prioritised in political agendas, the availability of resources (economic, technical or human) allocated to conservation efforts may be compromised, which could result in **neglect or abandonment** of cultural assets. The limitation of resources is overall more frequent in small municipalities and settlements, which is especially problematic since these cities would enormously benefit from the capitalisation of their cultural assets, eventually boosting local economy. Resources also imply having the relevant administrative bodies – or the relevant experts– doing conservation work. This may be challenging, as the restoration and conservation measures may be echoing those used in ancestral times, which require a very particular type of expertise. The mastering of traditional techniques is deeply connected with sustaining the cultural integrity of the heritage assets, and is also a way of safeguarding intangible heritage that otherwise may get lost. On the other hand, there is a **lack of**

integration across sectors: the culture sector lacks capacity for managing disaster risks and heritage professionals require specific training for risk mitigation, preparedness and response [56].

Relying on citizens and volunteers for cultural heritage protection or restoration actions could help overcome the scarcity of resources at administrative level, as well as promoting education on cultural heritage across all levels and ages (including across governmental sectors), which would additionally have a positive impact in raising awareness on its value.

Lack of relevant data and documentation

A key challenge for protecting cultural heritage assets is the lack of **baseline information** on their location or status. In general, the field lacks up-to-date inventories, geo-referenced data on heritage sites and their boundaries, hazard maps and other relevant resources [57]. Systematic collation of data and sharing it with relevant agencies during emergencies are some of the other challenges that have added to the complexity of the issue. There is a need for inventories of cultural heritage, specific location maps, country profiles, and socio-political data or risk maps. Moreover, there is a need to identify heritage elements that play a key role in disaster risk management and adaptation to climate change, or supporting local communities in facing and overcoming their consequences. Where it does exist, such documentation is not stored adequately or spread across different sources, and its access is often restricted or difficult to secure.

3.4. **The disaster risk management cycle**

To understand how hazards to cultural heritage are being assessed and considered within the resilience –and climate change adaptation- fields, it is convenient to review a few concepts related to risk management.

Risk management refers to the systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster [58].

Related actions and measures are structured following a stepwise approach, which ensures maximum coordination between them, commonly known as the disaster risk management (DRM) cycle.

The ARCH project adopts the DRM cycle defined by Jigyasu et al [59] [60], exclusively targeting cultural heritage in urban areas, which is depicted in Fig 4.

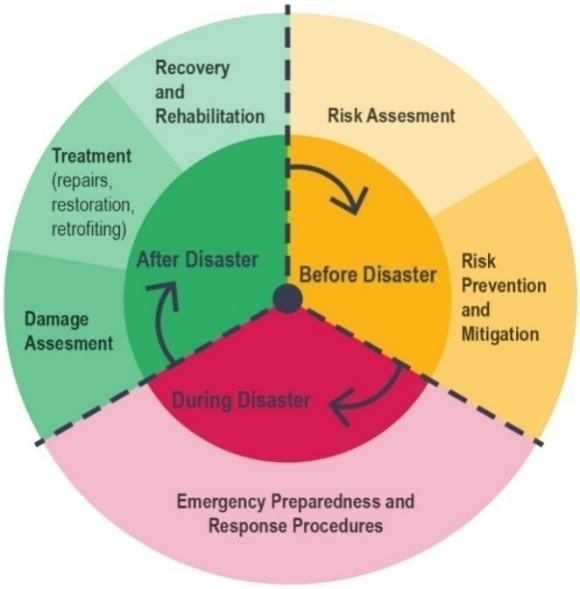


Fig 4: Schematic representation of the DRM cycle. Adapted by MUOP from the Disaster Risk Management of Cultural Heritage in Urban Areas: a training guide: 1.4 Principles for Disaster Risk Management for cultural heritage.

This cycle is characterised by three main stages:

Before disaster

This stage focuses on actions to reduce (or eliminate) hazard-related risks, including risk assessment techniques, prevention or mitigation methods and early warning systems. It typically contains two consecutive steps: risk assessment (the evaluation and prioritisation of potential hazards, vulnerabilities, exposure and impacts), and the prevention and mitigation of hazards (encompassing the elimination or reduction of hazards and vulnerabilities, the mitigation of impacts, and capacity building). Applied to cultural heritage, it involves reducing an asset's exposure and vulnerability to specific hazards, reinforcing its ability to resist impacts, applying technological systems to detect a disaster before it occurs (e.g. sensors) and conducting the necessary analysis to set up an effective emergency action plan.

During disaster

This stage encompasses both **emergency preparedness actions** and **emergency response procedures** (steps designed to manage, control or mitigate the immediate effect of an event).It implies the establishment of protocols that dictate how to act in case that an event/disaster occurs, and involves planning, organising, training, equipping, evaluating and taking corrective actions. In the case of cultural heritage sites or objects, such protocols should include potential evacuation routes (supported by maps and emergency equipment), establishing and training an emergency team, ensuring coordination across actors involved, and establishing alarm systems. All this should crystallise in an **emergency action plan** detailing the procedures to undertake in case of an emergency (including the assignment of responsibilities).

After disaster

This stage defines the steps to be followed after a disaster occurs. It involves **damage assessment**, treatment of damaged assets, **restoration**, **retrofitting** and **recovery** activities. The collective actions aimed at stabilising or reducing damages to cultural heritage assets are known as 'cultural heritage first-aid', and are usually only put in practice once the needs of people and critical infrastructure have been addressed. The **damage assessment** is based on detailed analysis and reporting by technical operators. Cultural heritage first-aid is only the first step to successful restoration and rehabilitation of assets. It needs to be followed by an action plan for recovery and rehabilitation involving detailed condition assessments, conservation methodologies for tangible heritage, future risk mitigation, restoration of services and improved use of heritage assets, and in order to ensure long-term effectiveness, all these actions need to be implemented in a coordinated, well-informed manner.

3.4.1. Integration of climate change adaptation with disaster risk management

DRM is closely related to climate change adaptation (CCA), with both demanding the assessment of risks and vulnerabilities as a basis for informed action. Both fields share a common interest in understanding and reducing the risk created by the interactions of human with their natural and physical environment. Both seek appropriate allocations of risk reduction, risk transfer, and disaster management efforts, for instance balancing pre-impact risk management or adaptation with post-impact response and recovery [61].However, each is a distinct field of practice, and at a governmental level, each is typically managed and administered by different departments, and associated people, plans and policies.

The two fields have tended to follow independent paths and have on many occasions employed different interpretations of concepts, methods, strategies, and institutional frameworks to achieve their ends [61]. The main issue seemed to be the temporal scale: where disaster risk management has traditionally foreseen the alleviation of immediate or short-term impacts, adaptation to climate change adopts a mid- and long-term vision necessary to anticipate to future scenarios of a changing climate. In the last decade, growing efforts have been conducted to integrate CCA with DRM (e.g. through the concept of iterative risk management[62][63][5]), however lack of integration between these complementary two fields remains common, risking duplicate efforts, lack of coordination and even the potential to undermine one another. While recognising the need for integration, for the purposes of this study we have chosen to adopt DRM and specifically the DRM cycle for its usefulness as a framework to organise and analyse the selected initiatives in Part 6.

[5]The most outstanding attempt of such integration crystallized as a new concept- **iterative risk management**- recognising that the process of anticipating and responding to climate change does not constitute a single set of judgments at some point in time, but rather an ongoing assessment, action, reassessment, and response that will continue – in the case of many climate-related decisions – indefinitely. An overlap of both approaches would contribute to advance – and secure- short and long-term resilience.

4. Cultural heritage resilience: international and European policies and frameworks

This chapter and the following one (Chapter 5) aim to provide the reader with the *bigger picture*, a summary of relevant policies, frameworks, funding programmes and projects for cultural heritage conservation and resilience, some of which have contributed to inform or influence the development of actions and initiatives contained in this report.

The majority of cultural heritage assets in the world are governed by three primary Conventions at the international level, all drafted and managed by the United Nations Educational Scientific and Cultural Organisation (henceforth, "UNESCO")[6]:

- **Convention concerning the Protection of the World Cultural and Natural Heritage** (1972)[7], when for the first time, heritage protection was not limited to times of war[8], as it created duties for States also in times of peace. The treaty entered into force in 1975 and currently, the title "World Heritage Convention" includes 193 State(s) parties;
- **Convention for the Safeguarding of the Intangible Cultural Heritage** (2003) [8]
- **Convention on the Protection and Promotion of the Diversity of Cultural Expressions** (2005)[64].

Over the past decades, many conventions, charters and guidelines have been developed by UNESCO and its advisory bodies, such as the **International Union for the Conservation of Nature (IUCN)**, the **International Council on Monuments and Sites (ICOMOS)**, the **International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM)**or the **Food and Agriculture Organisation (FAO)**, to correspond better to the perception of cultural heritage and evolving the conservation policies [65].

4.1. International frameworks for cultural heritage, disaster risk reduction and climate change adaptation

Several international frameworks exist with respect to cultural heritage protection, DRM and CCA. Here an overview is provided in broad terms as to how these have evolved, and to what extent these various fields have acknowledged one another. Also see related ARCH State-of-the-Art report 1: *Historic areas, conservation practices, and relevant regulations / policies* (D7.1*)*[1] for a more detailed analysis of existing frameworks for cultural heritage protection in relation to the DRM cycle.

[6]There is a fourth major UNESCO Convention on the Protection of Underwater Cultural Heritage. Paris, 2 November 2001.
[7]Significantly, the Convention outlines the risks that heritage faces in its first starting consideration (see para. 2): https://whc.unesco.org/archive/convention-en.pdf.
[8]Framework in force was The Hague Convention on the protection of Cultural heritage in times of war, The Hague, 14 May 1954

The intensity and frequency of natural hazards is exponentially increasing due to the changing climate. The human and material losses associated to these phenomena have raised international alarm, giving place to policies and action plans designed to develop possible mitigation strategies to combat them, and even mechanisms to anticipate to them. Initially, research was oriented towards disaster analysis, casualties and material (infrastructure) damage. However, more recently, the effects of extreme events on places of cultural heritage significance as a consequence of climate change has been subject to more attention, and this has now become an area of significant research and policy activity [55].

As such, the first **UN World Conference on Disaster Risk Reduction** was held in Yokohama in 1994, and five years later, the **Second Protocol to The Hague Convention** was signed, describing in detail measures to protect cultural heritage[9]. Subsequently, a number of tools were designed to address gaps in earlier frameworks. These include the **Hyogo Framework for Action 2005-2015** and its successor; the Sendai **Framework for Disaster Risk Reduction 2015-2030**[66], which currently guides the DRR-related interventions of the international community. Before these two Frameworks were adopted, the ICOMOS Conference on Conservation developed the principles for Conservation and Restoration of Built Heritage, known as the **Krakow Charter (2000)**. This was fed by the ICCROM Manual called **"Risk Preparedness: A Management Manual for World Cultural Heritage" (1998)**[67], and the **Radenci Declaration (1998)**[10] on the initiative of the International Committee of the Blue Shield (ICBS), which helped to set forth a catalogue of objectives intended to protect cultural heritage during an emergency.

Within the World Heritage Convention and following the Hyogo Framework, a policy on Climate Change and World Heritage was adopted in 2007[11], together with a **Strategy for Risk Reduction at World Heritage Properties**[12].This latter was presented by UNESCO and approved by the World Heritage Committee at its 31st session in 2007. The purpose of the Strategy was to strengthen the protection of World Heritage and contribute to sustainable development by assisting State Parties to integrate concern for heritage into National disaster reduction policies while incorporating concern for Disaster Risk Reduction within management plans and systems for World Heritage properties in their territories. Significantly, for the first time, cultural heritage was considered as an incentive for enhancing the reduction of the impact of catastrophic events, as well as to protect goods and services, which it provides to local communities [20].Nevertheless, it was in the Sendai Framework, where clear references were made to the protection of culture and heritage from disaster risks[13].

As the only UN agency with a mandate in culture, UNESCO has continuously promoted the role of culture in sustainable development and has put an emphasis on its programmes in

[9] See Chapter 2 of the Second Protocol to the Hague Convention of 1954 for the Protection of Cultural Property in the Event of Armed Conflict 1999. Available at http://portal.unesco.org/en/ev.php-URL_ID=15207&URL_DO=DO_TOPIC&URL_SECTION=201.html.

[10]The document calls on States to create legal instruments and organisational systems for risk management and makes specific mention of the need to instigate emergency plans. Available at: https://theblueshield.org/wp-content/uploads/2018/06/1998_Radenci_Declaration.pdf

[11]http://whc.unesco.org/en/series/22/.

[12]https://whc.unesco.org/archive/2007/whc07-31com-72e.pdf

[13]E.g. para. 4, 5, 14, 16, 16, 17, 19-c, d, 24-d, 29, 30-d, 33

urban development as part of the process that led to the adoption of the **2011 Recommendation on the Historic Urban Landscape (HUL Recommendation)**[68], which focuses on climate change threats (Arts. 19-20), and the integration of culture in the 2030 Agenda for Sustainable Development[69]as well as the **New Urban Agenda**[14].

Undoubtedly, international frameworks such as Hyogo and Sendai have advanced understanding of the inter-linkages between the field of DRM and cultural heritage protection. Indicative of this is the policy document for the Integration of a Sustainable Development Perspective into the Processes of the World Heritage Convention adopted by the **General Assembly of States Parties to the World Heritage Convention in 2015**. This policy document recognised increasing disaster risks and the impact of climate change, and called on the Member States *"to recognise that World Heritage represents both an asset to be protected and a resource to strengthen the ability of communities and their properties to resist, absorb, and recover from the effects of a hazard"* (Article 16)[15]. However, despite the increasing vulnerability of cultural heritage to hazards, DRR and DRM do not seem to register as a priority area for World Heritage properties, and likewise, cultural heritage has only recently been included in the overall international agenda of DRR.

4.2. European frameworks for cultural heritage, disaster risk reduction and climate change adaptation

Nearly half of listed UNESCO World Heritage Sites are located in Europe[70].Two different organisations, the Council of Europe (CoE) and the European Union (EU) have enabled preconditions to work on cultural heritage topics from diverse perspectives, resulting in a wide array of norms, guidelines and initiatives in addition to the measures taken by the EU States.

Culture has been on the CoE agenda from its inception, as demonstrated by the adoption of the European Cultural Convention of 1954 [71].In 1993 and 1997, the Committee of Ministers of the Council of Europe approved two relevant recommendations on DRM for heritage sites: **Recommendation No. R (93) 9**on the protection of the architectural heritage against natural disasters, and **Recommendation No. R (97) 2**on sustained care of the cultural heritage against physical deterioration due to pollution and other similar factors. In 2000, the CoE launched the **European Convention on Landscape** [72] in Florence. The aim of the Convention is to create an obligation to protect, plan and manage landscape, defined as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (Article 1). In2005, the **Framework Convention on the Value of Cultural Heritage for Socie**ty[73](the Faro Convention) was adopted by the Committee of Ministers of the Council of Europe, defining the concept of "heritage communities"[74] and

[14]The New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016. The full document can be consulted here:http://habitat3.org/wp-content/uploads/NUA-English.pdf

[15]See also ICOMOS's Message to the 25th meeting of the Conference of Parties to the UN Framework Convention on Climate Change (COP25) on Cultural Heritage: https://www.icomos.org/en/focus/climate-change/68239-comos-s-message-to-cop25-cultural-heritage-can-helpand the new Madrid-to-Glasgow Arts, Culture and Heritage Climate Action Plan launched by Climate Heritage Network (CHN):http://climateheritage.org/climate-heritage-network-launches-plan-to-mobilise-arts-culture-and-heritage-for-climate-action/.

promoting shared individual and collective responsibility towards heritage. In addition, through its 2009 European and **Mediterranean Major Hazards Agreement (EUR-OPA)**, the CoE issued a general recommendation on the protection of cultural heritage against climate change: Recommendation 2009-1 on Vulnerability of Cultural Heritage to Climate Change. Amongst other recommendations, it calls for the development of emergency plans for sites threatened by catastrophic events because of the effects of climate change (Art. 3).In 2012, the Congress **of Local and Regional Authorities in the Council of Europe** adopted **Resolution 399** on Making Cities Resilient. The Resolution acknowledges the need for Council of Europe Mayors and Local authorities to address urban resilience by embracing the UNDRR's campaign "**Ten Essentials for Making Cities Resilient"**, which aims to make the Sendai Framework for Disaster Risk Reduction operational at local level[75].

At the European Union, culture and cultural heritage is a competency that lies with the Member States, as the EU only has so-called "supporting competence", or the power to support, coordinate or complement national actions according to the Treaty on Functioning of the European Union (TFEU, Article 6 (c))[16]. At a strategic level, the Council of the European Union adopted the **Conclusions on the Work Plan for Culture 2019-2022**, in which "Sustainability in Cultural Heritage" has been identified as one of the five priorities for European cooperation in cultural policy making.[76] Following the legacy of the European Year of Cultural Heritage in 2018, the European Commission launched a set of **60 concrete actions in the European Framework for Action on Cultural Heritage** [77] and included the protection of cultural heritage in the **Directive 2007/60/EC** of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risk. The Directive aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity.

Overall, the EU's most significant role in cultural heritage are: stewardship; high-level comprehensive, policy-making; project and programme development; and providing funding[78].Initiatives such as the Creative Europe Programme or Horizon 2020 Funding Programme have helped further develop research to support innovation and implementation in cultural heritage, resilience and climate change adaptation. Nonetheless, as highlighted in a study commissioned by the European Parliament entitled **"Protecting the Cultural Heritage from Natural Disasters" (IP/B/CULT/IC/2006-163)**, European legislation and regulations reveal that protection of cultural heritage from natural hazards and disasters has not been yet properly accommodated. One of the reasons could lie in the geographical characteristics of the EU as well as its decentralisation, or the multiplicity of administrative competencies into which responsibility for heritage and DRM is fragmented in the different governmental systems of its Member States. However, this does not mean National governments and platforms for DRM are not supporting the advancement in heritage and building resilience to

[16] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Aai0020. See also Art. 167.4TFEU and Art. 3 of the Treaty on the European Union (TEU) as well as both Recommendation of 20 December 1974 from the Commission to the Member States on the protection of the architectural and natural heritage addressing the world heritage convention and the Council conclusions of 17 June 1994 on the drawing up of a Community action plan in the field of Cultural Heritage: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31994Y0823%2801%29.

disasters[17].There are many initiatives underway; yet these efforts seem to remain largely ad hoc.

5. Cultural heritage resilience in practice in Europe

In practice, the protection of cultural heritage in all its diversity is a constant and difficult issue, which often differs from country to country and even from region to region. Nicu [55] estimates that, considering the amount of studies on the topic, Europe is the area in the world most concerned with the protection of its cultural heritage (especially in countries such as Italy, Romania, the UK and Greece), followed up by Asia and the Americas. Indeed, Europe has assumed a leadership role in establishing research projects on the impact of climate change on cultural heritage through funding programmes such as FP7 or H2020, focusing on impact assessment at heritage sites and the implementation of tools for mitigating climate change. Some of the most prominent projects assessing the impacts of climate change in cultural heritage include the FP6 Noah's Ark Project (2004-2007)[18], the FP7 Climate for Culture Project (2009-2014)[19] or the FP7 European Cultural Heritage Identity Card - EU CHIC (2009-2012)[20].

In view of the growing impacts of climate change on cultural heritage assets, and the lack of an integrated approach between CCA and DRM, Sabbioni et al [35] suggested that research needed to be strengthened around five main themes:

1- Understanding the vulnerability of materials to climate hazards, to reliably assess future impacts,
2- Monitoring change over time, especially on decadal and even century-long time scales,
3- Modelling and projecting changes in climate at heritage sites at high spatial and temporal resolution, with an estimate of reliability,
4- Developing tools to manage cultural heritage in a changing climate, and,
5- Preventing damage by developing long term strategies.

Later, in 2014, the IPCC issued series of recommendations [79] for European Authorities to develop a common legal framework for undertaking multi-hazard assessments and management in facing climate change (to be adopted in all Member States) and to adopt inspection and diagnostic methodologies for supporting preparedness and recovery strategies, to be standardised at European level[21] (which should be then tailored to national levels). It was recommended to integrate cultural heritage needs in the priority areas where risk from the consequences of climate change is recognised, to reinforce the collection, analysis and

[17] https://www.preventionweb.net/files/19617_overviewnpeuropeefdrr20141211.pdf. See also the 'Venice Declaration on building resilience at the local level towards protected cultural heritage and climate change adaptation strategies' (APPENDIX II) adopted by mayors from cities throughout Europe (2012).

[18] https://cordis.europa.eu/project/id/501837/reporting

[19] https://www.climateforculture.eu/

[20] http://www.euchic.eu/

[21] Most important standards on cultural heritage protection can be consulted in ARCH SotA report *Existing standards and regulatory frameworks*

synthesis of data associated with damage to heritage due to climate change, and to allocate adequate resources to develop methodologies for the efficient early warning of possible climate change impacts. The IPPC also called for the exchange of good practices and knowledge concerning DRR and management of cultural heritage across all countries, the increase of awareness-raising and capacity building efforts in the relevant fields, and the adoption of an integrated climate monitoring system in cultural heritage preservation action. Some of the most recent projects in Europe reflecting such recommendations are HERACLES (2016-2019)[22] and STORM (2016-2019)[23],Central Europe ProteCHt2save (2017-2020)[24]and PROMEDHE9 (2016-2018)[25] – all funded by the European Commission.

With relation to geological hazards, major efforts have been directed to building up strategies and measures to mitigate the risk of earthquakes and plan for risk management in a holistic way, taking into account all associated cascading events. Particularly in Mediterranean areas, national regional and local policies and agencies have been established with the aim of developing strategies integrating prevention, mitigation and response to earthquakes; strengthening existing capacity; and coordinating efforts among different experts.

During the last decades, landslides have been the subject of different initiatives and frameworks (e.g. he UNESCO Conference on World Heritage Mountain Cities and Natural Hazards, the Tokyo Action Plan, 2006; and the Ljubljana Declaration on Landslide Risk-Contributing to the Sendai Framework for Disaster Risk Reduction, 2017). The European Commission has promoted the development of tools for mapping, monitoring and predicting natural disasters and their territorial impact, as well as guidelines for the protection of cultural heritage assets from earthquakes. As a consequence, there are quite a number of European projects looking into geological risk and impact assessment, such as PROHITECH (2004-2008)[26], PERPETUATE (2010-2012)[27], SHARE (2009-2012[28]) and PROTHEGO[29].

When it comes to human-related hazards, pollution (specifically air pollution) has been the most studied phenomenon in terms of cultural heritage impact. In Europe, studies and projects focusing on the topic to date (many of which have been funded through EU Commission FP programmes) have studied weathering and ageing effects on stone materials; developed multi-pollutant models and scenarios; analysed bio deterioration processes of materials; conducted archaeometric studies to reconstruct pollution and climate effects on ancient cultural heritage; and developed evaluation criteria, prediction and control methods,. Projects such as MULTI-

[22] http://www.heracles-project.eu/
[23] http://www.storm-project.eu/
[24] https://www.interreg-central.eu/Content.Node/ProteCHt2save.html
[25] http://www.fireriskheritage.net/none/promedhe-eu-project-protecting-cultural-heritage-across-borders/
[26] https://prohitech2020.org/
[27] https://cordis.europa.eu/project/id/244229/es
[28] http://www.share-eu.org/
[29] http://www.prothego.eu/project.html

ASSESS (2002-2005[30]), CULTSTRAT (2004-2007)[31] and TEACH (2008-2012) [32]have looked at the impacts on heritage assets when climatic factors interact with air pollution.

6. Mapping and classification of initiatives

Whereas chapter 4 and chapter 5 provide an overview of what can be found out there in the topics relevant to this piece of work -contributing to the identification of specific projects and frameworks- this chapter gathers the 40 initiatives included in the final selection (see Annex 1) resulting from the methodological steps described in chapter 2, which have been classified according to a series of parameters such as the type of measures featured, the main hazards they respond to and the DRM's phase(s) they cover.

All these initiatives contain information on their location, biogeographical region[33]and lead(s). 32 of them are featured as snapshots (where a brief description is provided, as well as links to relevant sources) and eight of them are featured as case studies (containing in-depth information on aspects such as main outcomes, factors of success and lessons learned, driving from the interviews conducted). Details on their classification are explained in the following paragraphs.

Each initiative contains information of the type of measure(s) covered. Following the ARCH Initiatives Scoreboard (see section 2.2), they were initially categorised under the clusters „structural", "social" or "institutional" for their rating, but this typology was later re-defined into "technological/technical", "managerial", "behavioural" and "networking" in order to provide higher accuracy in their characterisation. These four new clusters are explained as follows:

Technological/Technical

Initiatives with a technological or technical component, including software and online tools, ICT, infrastructure (i.e. grey or green-blue), but also restoration techniques and methods. This category is subdivided into:

- Sensing and monitoring tools and methods
- Structural measures
- Models and simulations
- Repair techniques
- Decision-support tools

[30]https://cordis.europa.eu/project/rcn/60386/en
[31]https://cordis.europa.eu/project/id/501609
[32]https://cordis.europa.eu/project/id/212458/fr
[33]The biogeographical regions defined by the EEA are geographical reference units for describing habitat types which live under similar environmental conditions in different countries. These can be consulted here: https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2

Managerial

Initiatives based in planning, management and governance processes, such as strategies, management plans, guidelines and governance models. This category encompasses:

- Guidance documents
- Maintenance and monitoring frameworks
- Management plans or strategies
- Governance models

Behavioural

Initiatives aimed at promoting behavioural change among residents, e.g. educational programmes or actions delivering training and capacity-building or promoting collaboration, as well as communication campaigns. This category is divided in two sub-categories:

- Awareness-raising and communication
- Training and capacity building (of residents)

Institutional

Initiatives aimed at promoting collaboration among different actors involved in decision-making, as well as networking and advocacy. This category is sub-divided into:

- Networking and capacity-building (of institutions and experts)
- Advocacy

The initiatives also contain information on the phase or phases of the DRM cycle (see section 3.4) they respond to, for which they are accompanied by a schematisation of the cycle, where relevant phases are coloured as depicted in Fig. 5.

Finally, the initiatives have been classified according to the main hazards or stressors they respond to, following the categorisation conducted in section 3.3, which also respond to some of the most common threats experienced by ARCH partner cities. Some of the initiatives do not respond to a specific hazard, but are well fitted to deal with a specific stressor –may it be lack of awareness of cultural heritage values, lack of capacity or economic resources at administrative level, or lack of relevant data and documentation.

Fig 5: Schematic representation of the Disaster Risk Management Cycle with all its phases to be used as a reference in the classification of initiatives

6.1. Climate-related hazards

6.1.1. Assessing risk for the Mellor Heritage Project

Assessing risk for the Mellor Heritage Project	Type: Technological/technical – sensing and monitoring		Main hazard(s): Extreme temperatures(cold), extreme precipitation

Location: Manchester, UK
Biogeographical region: Atlantic
Lead: Fair Dynamics Consulting s.r.l.

The H2020 STORM project (2016-2019), developed an integrated methodology of risk assessment and management for cultural heritage assets in response to the adverse effects of natural hazards and climate change-related events. This methodology was based on remote sensing and information technology (consisting of weather stations and a network of environmental sensors) tested in five pilot sites in Italy, Greece, UK, Portugal and Turkey. Sensors were used to monitor environmental parameters as well as deterioration processes in the cultural assets. The data was processed and analysed, generating risk maps made available at the STORM Collaborative Decision-Making Dashboard.

Each pilot site was analysed and matched with the most suitable technology according to local hazards and site characteristics. The outputs would serve to define appropriate risk treatment strategies (including risk mitigation, risk preparedness and recovery).

One of the pilot sites was the Mellor Heritage Project, in Manchester (UK). This complex includes three main sites with different micro-climatic conditions: a bronze-era burial site known as Shaw Cain located at the top of a hill and particularly exposed to extreme cold, precipitation and wind; Mellor Mill, a mill from an industrial period located by the river and particularly sensitive to humidity and freeze/thaw events; and the Old Vicarage Site, an iron-ditch sheltered by trees at one side of the hill. Sensors were placed in 30-40 locations throughout the complex, accompanied by weather stations. The data has proven to be effective in warning site managers and visiting archaeologists about weather events, as well as enabling monitoring of cracks, structural performance, electrical resistivity and sensitivity to freeze/thaw events.

For more information on Mellor Heritage Project, visit:

https://www.mellorheritage.org.uk/

The Archaeological site Mellor, in Greater Manchester, was one of the project's case studies. STORM proposes predictive models and improved methods of survey and diagnosis that will assess preventive actions and emergency responses in cultural heritage sites.

For more information on EU H2020 STORM , visit:
Project, visit: http://www.storm-project.eu/en/project/

Other relevant sources:

Cultural heritage Resilience Against Climate Change and Natural Hazards [80]

6.1.2. ‘Climate for Culture’s decision support tool

Climate for culture’s decision support tool	Type: Technological/technical – decision support tool		Main hazard(s):Extreme temperatures

Location: Europe and North Africa
Biogeographical region: various
Lead: Fraunhofer (IBP, MOEZ and ISC)

Coordinated by Fraunhofer (IBP, MOEZ and ISC), and involving 27 partners, the CLIMATE FOR CULTURE project (2009-2014) estimates the impacts of changing climate conditions on historic buildings and their vast collections in Europe and the Mediterranean. By assessing the risk of damage to threatened cultural heritage sites, the project aimed to encourage the development of strategies to mitigate the effects of climate change, including through policy makers and the Intergovernmental Panel on Climate Change (IPCC) reports. Furthermore, the project provided insight into the possible socio-economic impacts of climate change, given the importance of cultural heritage to Europe’s economy.

The project came up with a methodology for risk assessment based on a step-wise approach that includes the following consecutive steps: climate change simulations, building simulations, indoor climate monitoring, damage assessment from objects and prediction of future risks.

The project has produced a set of models and tools to identify the most urgent risks for specific regions, including a Decision-Making Support System "DMSS" and the software DigitChart The DMSS is a synthesis of the results of several work packages, consisting of a software module for constant evaluation of climate data using existing damage data, and allows the prediction of indoor climate change based on the simulation of outdoor climate change. The software DigitChart allows the transformation of analogue maps into digital format, to facilitate its reading and analysis.

For more information on the project, visit:

https://www.climateforculture.eu/index.php?inhalt=home

Other relevant sources:

https://cordis.europa.eu/docs/results/226/226973/final1-publishable-summary-climate-for-culture.pdf

https://heritagesciencejournal.springeropen.com/articles/10.1186/s40494-015-0067-9

6.1.3. **Guidance on risk management for collections**

Guidance on risk management for collections	**Type:** Managerial–Guidance document	**Main hazard(s):** Extreme temperatures **Stressor:** lack of awareness

Location: The Netherlands
Biogeographical region: Atlantic
Lead: Cultural Heritage Agency, Dutch Ministry of Education, Culture and Science

This guidance document, published in 2017 by the Cultural Heritage Agency of the Netherlands within the Shared Cultural Heritage Programme, aims to support collection managers, curators and conservators by offering methods, knowledge and tools to make suitable choices, set priorities and implement the appropriate measures to reduce loss of value of moveable heritage.

It offers detailed information on the main risks affecting museum collections, such as water, pests and plants, thieves and vandals, fire, light, contaminants and extreme temperature. It provides suggestions for management measures following the risk management process.

The publication can be accessed and downloaded here:

https://www.academia.edu/35377331/Risk_management_for_collections

Learn more on the Cultural Heritage Agency of the Netherlands here:

https://english.cultureelerfgoed.nl/

6.1.4. PRESIOUS: Simulating the effects of erosion on cultural heritage objects

PRESIOUS: simulating the effects of erosion on cultural heritage objects	**Type:** Technological/technical – Model and simulation	**Main hazard(s):** Extreme temperatures, pollution

Location: Trondheim, Norway
Biogeographical region: Alpine/Atlantic
Lead: Norges Teknisk-Naturvitenskapelige Universitet Ntnu

The collaborative 3-year STREP project PRESIOUS (Predictive digitization, restoration and degradation assessment of cultural heritage objects, funded under the 7th Framework Programme of the European Commission 2013-2016) aimed at estimating and predicting monument degradation as well as producing visualisation tools to facilitate the reconstruction of damaged items. The innovative ICT tools and solutions produced would enable: 1) on-the-fly auto-completion for 3d digitalisation – enabling the visual reconstruction of a damaged object/monument' shape, 2) estimation and prediction of monument degradation based on measurement of a series of parameters (e.g. present surface shape, environmental factors, material behaviour) and 3) 3D fractured object restoration and completion.

The tools for estimation and prediction of monument degradation were tested on monuments at two significant heritage sites: the Nidrados Cathedral in Trondheim (Norway) and the Demeter Sanctuary in Elefsis (Greece)

For the Trondheim case study, erosion data was obtained from erosion chambers (which simulate atmospheric pollutants, the effect of saline intrusion and the freeze-thaw effect in a controlled environment). The study utilised a prototype software application that simulates surface mesh alterations of heritage objects and allowed to imitate processes of stone degradation phenomena like surface recession and crust formation after 3D scanning of the monuments.

For more information on the PRESIOUS project, visit:
http://www.presious.eu/

The tools and software produced within PRESIOUS can be accessed here:
http://www.presious.eu/resources/software

Other relevant sources:

Simulating Erosion on Cultural Heritage Monuments [81]

PRESIOUS Final Evaluation Report:
http://presious.eu/file_downloads/PRESIOUS-D5.8-FinalEvaluationReport.pdf

6.1.5. **Case study 1: City of Regensburg Integrated heritage management planning**

CASE STUDY 1: City of Regensburg Integrated heritage management planning	**Type:** Managerial – Management plan	**Main hazard(s):** Extreme temperatures, floods

Location: Regensburg, Germany
Biogeographical region: continental
Lead(s): The City of Regensburg

Background: The City of Regensburg was inscribed on the UNESCO World Heritage List in 2006. The city administration has consciously used urban heritage to stimulate development in the sense of the improvement of quality of life for the inhabitants, with the support of an integrated heritage management plan, developed using a methodology from the project URBACT II Project HerO (Heritage as opportunity).This integrated approach has been adopted by many European projects, most recently to COMUS (Community led urban development) together with the Council of Europe. The approach fosters a holistic understanding of the historic urban fabric and the development of joint objectives and actions. With the integration of regional and national levels, funding for many proposed projects was secured. Challenges for Regensburg's urban heritage, like climate change or potential economic crisis were integrated in the concept. Today, heritage is part of the community's perception of Regensburg's identity and is diligently coordinated and communicated through an integrated governance system.


Source: David Mark @Pixabay

Source: City of Regensburg

Case description: To develop the World Heritage Management Plan for the Old Town of Regensburg, the City of Regensburg(specifically the departments on heritage and environment)started continuous cooperation with cultural operators, artists and local residents in a process to shape the future cultural landscape and lay down the conditions under which art and culture can unfold in the coming years. The resulting document is known as the Cultural Development Plan "Agenda 2020".The plan represents the action-guiding framework of cultural policy for the next few years. The cultural policy "Agenda 2020" is to be understood as part of the general urban policy. With this plan, the City of Regensburg honours its past and its cultural history and at the same time accepts current challenges. For assuring continuity and tradition on the one hand and the further development of a lively urban space on the other hand, the future role of a World Heritage title and its impact on civic life, and as part of this cultural life, had to be taken into account in the development.

The local authorities of the city prepared Regensburg's management plan together with a strong community involvement (open access public participation) to identify several priority areas, concrete principles making use of the Historic Urban Landscape approach, objectives and key measures for each field of action needed for the city. In 2012, the World Heritage Management Plan was completed and made available online. The vivid public interest and engagement during the process shows the importance of civic participation especially in the field of heritage management and World Heritage. This collaboration brought a working group and a steady communication between stakeholders, where the public stays informed about the implementation of the management plan and takes part in its revision.

The World Heritage Management Plan for Regensburg was prepared by the Management Plan Work Group and the participants in the World Heritage Dialogue in Regensburg. Diverse stakeholders were invited to participate and collaborate in the elaboration process, amongst them not only city administration departments of all kinds, but also non-governmental groups within the city. In addition, regional level stakeholders as well as the regional government were integrated into the process and are still ensuring a broad representation of different opinions and interest groups.

Main outcomes and highlights

- The World Heritage Management Plan's fundamental aim is to develop a new approach to manage historic urban areas by matching the inherited historic urban landscape and structure as well as the identity of the place with the modern demands of its users. This can be made possible by turning the cultural heritage, both tangible and intangible, into a prime resource to fulfil these competing demands, without downgrading its intrinsic qualities. All local stakeholders are to be identified and integrated into the process permanently, and a monitoring system has to further guarantee the successful implementation of the plan.
- The objective of this form of governance model of the World Heritage Management Plan of Regensburg was to not only detect and analyse the city in the spirit of the historic urban landscape (HUL) but also to entitle and capitalize on a governance system in which as many elements of the system as possible were considered. Even though the document was published in early 2012, the implementation is updated on a regular basis until now (with two updates having taken place, the most recent in 2019).
- Concrete action points were included on a range of themes including: tangible cultural heritage, culture and tourism, economic development, housing, mobility, urban planning and development, environment and leisure, awareness raising and research. With the participatory elaboration of an integrated heritage management plan, the direction for the upcoming years was recently set. Sustainability, resilience and the response to challenges and crises have been addressed following the six steps of the Historic Urban Landscape approach.

Factors of success

- The plan has put a strong emphasis on community engagement and the participation of interdisciplinary experts (participatory governance model).
- The process of developing the plan has placed cultural heritage as top political priority ensuring local and regional authorities value their heritage providing leadership to local stakeholders within their communities and helping secure the right environment to attract investment.
- The initiative has engaged politically and managerially with stakeholders and the local community to ensure public support for the cultural heritage strategy and management plan and thereby develop a coordinated and balanced approach that is sustainable over time.
- There has been a strong focus on action and project delivery ensuring consistent political and managerial support and commitment.

Lessons learned

- Effective governance of UNESCO World Heritage Sites demands a reframing of the role of management plans as a tool to significantly improve community engagement at local level and to be aware of their limitations.
- Cultural heritage may sometimes be perceived as a constraint to urban regeneration; a limiting or burdensome preoccupation with the past that stifles innovation and progress; there is a need to re-frame its importance and role for resilient development.
- Heritage needs to be seen as a strategic opportunity; locally, nationally and at the European level. This requires a new integrated approach to the sustainable management of historic towns - one that is policy-led with a clear focus on access to resources and effective project delivery.

For more information, visit: www.regensburg.de
stadt_regensburg@regensburg.de

Contact info:

Sandra Schneider
Schneider.Sandra@regensburg.de

Matthias Ripp
Ripp.Matthias@regensburg.de

Relevant sources:

- https://www.regensburg.de/welterbe/en/projects/completed-projects/management-plan
- http://obs.agenda21culture.net/en/good-practices/integrated-world-heritage-management-plan-regensburg
- Interview with Mathias Ripp, Senior Expert for Heritage and Urban Development

6.1.6. Case study 2: Patios de la Axerquía: Regenerating historical courtyards through social innovation

Patios de la Axerquía: Regenerating historical courtyards through social innovation	**Type:** Managerial – Governance model	**Main hazard(s):** Extreme temperatures, drought, desertification

Location: Cordoba, Spain
Biogeographical region: Mediterranean
Lead(s): PAX- Patios de la Axerquía

Background: With a growing tourism industry and very little industrial activity, Cordoba (a city of some ca. 300,000 inhabitants)is now transforming itself and gradually becoming gentrified .The city is rich in architectural and intangible cultural heritage, and agriculture is very relevant for the economy. The unemployment rate in Cordoba is amongst the highest in Spain (at 28.5%).


Source: Patios de la Axerqula

Case description: The historic district of Cordoba is suffering de-population as long-term residents abandon their courtyard houses seeking a more comfortable life away from mass tourism. In April 2018, PAX (Patios de la Axerquía) Association was established by local groups to regenerate the historic centre by restoring the abandoned courtyard houses (casa-patio) of the Axerquía (neighbourhood) together with resident groups constituted in housing cooperatives. An innovative operation of governance has been applied by the group fostering a change to the conventional urban development model based on speculation to one of rehabilitation of neglected areas, avoiding tourist-focused gentrification and allowing the people of Cordoba to reclaim their city's historic environment and its intangible heritage. PAX is a local experiment that is expected in the near future to evolve into a larger scale 'start-up' of urban governance facing gentrification processes.


Source: Patios de la Axerqula

PAX provides a new style of governance in relation to urban regeneration, incorporating social innovation in a heritage city by acquiring vacant houses and cooperatively using them; implementing multi-level co-management between the city administration and the local residents, and among the residents themselves. The project is pursuing urban regeneration of a specific vulnerable area by greening the city, recovering the architectural and intangible heritage value of the courtyard houses and forming a social and solidarity-based economy; therefore, the model bridges multiple concepts.

Main outcomes and highlights

- A good preservation and development of heritage communities helps to protect and enhance collective historical memory; this may happen by moving from speculation to a rehabilitation culture, while introducing a layer of resident empowerment.
- The initiative helped to repopulate and regenerate the city's historical centre; it also helped to revitalise the neighbourhoods and created a sense of built environment and public spaces that work as a 'collective courtyard': by promoting energy efficiency in the housing stock and supporting the sustainable urban rehabilitation of public buildings as well as degraded parts of the city (e.g. industrial areas that are in disuse).
- The project has so far reinforced heritage-related micro-employment, and supported the flourishing of collective projects that include refugees and migrants.
- The Courtyard Houses of Axerquía have been included on the 2020 World Monuments Watch list to place a spotlight on local efforts to repopulate the historic district and encourage further stakeholder and government engagement.
- Recognised as part of the Faro Convention Network by the Council of Europe in 2018 for applying social heritage values in an urban context, PAX was invited to the 15th International Architecture Exhibition La Biennale in Venice in 2016 and

has been declared a 'best practice' project by the Madrid City Council for improving the social economy in a neighbourhood (2018).

Factors of success

- The potential to re-use the existing city through revitalising abandoned patio-houses in a central neighbourhood that is earmarked for future gentrification, has provided the impetus to generate a bottom-up strategy in terms of housing policy, heritage, urban regeneration, and social cohesion by updating the use of the courtyards through a cooperative and inclusive process.
- The unique feature of PAX compared with other housing cooperatives that have been established as an alternative to property ownership and rental agreements is that it operates in a high-value heritage environment, reinforcing the coexistence that has traditionally characterised the Mediterranean city.
- Energy monitoring has been possible using a passive air circulation system that was made possible due to the design and treatment of the vegetation of the patios.
- This innovative urban project is transferable to other Mediterranean cities (Marseille, Sicily).

Lessons learned

- The applied process requires many efforts to achieve synergies between the interests of public authorities and those of the local dwellers based on the social value of cultural heritage.
- The acknowledgement of local stakeholders and development of the social stakeholder mapping in a co-creational, cooperative form have been demanding and time consuming processes.
- A significant implementation obstacle is the time needed to change to a culture of rehabilitation at the local level scale, as the global market and speculation are operating at a much higher speed.
- The COVID-19 virus outbreak in early 2020 is bringing uncertainty to the renovations (many of which are put currently in idle mode), while social distancing and remote working put additional stress on developing and maintaining effective working and social relationships.

For more information on PAX, visit:
Patiosaxerquia.org

Contact info:

Gaia Redaelli
gaia@patiosaxerquia.eu

Sources:

- https://www.built-heritage.net/gaia-redaelli-issue9
- Courtyard Housed of Axerquia
- El País article on Pax in the Mediterranean frame
- Interview with Gaia Redaelli, co-founder and president of PAX

6.1.7. Flood protection measures for the historic centres of Cesky Krumlov and Prague

Flood protection measures for the historic centres of Cesky Krumlov and Prague	**Type:** Technological/technical–structural measure(s)	 **Main hazards:** Extreme precipitation, pluvial and fluvial flooding

Location: Prague and Cesky Krumlocv, Czech Republic
Biogeographical region: Continental
Lead: the Czech Ministry of Agriculture, the Czech Ministry of Environment and Prague City Hall.

A flood control system based on a combination of green-blue and grey infrastructure was implemented in the historic centres of Prague and Cesky Krumlov, following up what was recognised as the most expensive weather-related disaster in the history of the area: the 2002 flooding.

Before this event, none of the municipalities had adaptation measures in place, being climate change a fringe topic in local political agendas. Measures implemented consisted mostly on grey infrastructure such as fixed and mobile barriers and safety valves in the canalisation network along the Vltava River. Such measures were combined with green infrastructure interventions as support to coping with flash-flooding. The implemented measures were assessed using a cost benefit analysis which showed that the benefits would be greater than the costs even if only one event with a return period of 50 years is considered. Measures were effectively tested in the following 2013 flood.

This initiative is one of the case studies featured in the EU FP-7 project BASE – Bottom-Up Climate Adaptation Strategies towards a Sustainable Europe.

For more information on the project BASE, visit:
https://base-adaptation.eu/

Other relevant sources:

https://climate-adapt.eea.europa.eu/metadata/case-studies/realisation-of-flood-protection-measures-for-the-city-of-prague

https://base-adaptation.eu/sites/default/files/case_studies/14_Prague_CSLD.pdf

6.1.8. Refurbishment of the International Maritime Museum in Hamburg

Refurbishment of the International Maritime Museum in Hamburg	Type: Technological/technical -Structural measure (s)	 Main hazards: Extreme precipitation, flooding, extreme temperatures (cold)

Location: Hamburg, Germany
Biogeographical region: Atlantic
Lead: International Maritime Museum in Hamburg (IMMH)

The aim of the initiative was to transform in 2006 a 10-storey historic brick warehouse into the International Maritime Museum of Hamburg (IMMH), ensuring that the requirements needed to hold its exhibits were met. The refurbishment included the integration of a new heating system and a domestic engineering system to create an appropriate climate in the building based on a low-energy consumption. Both the engineering system and an engine for an elevator were installed in the basement.

The basement had been flooded on different occasions prior to the refurbishment, so measures were implemented to make it waterproof. A new layer of concrete was installed in the inner side of the original brick wall of the basement and the ceiling. Additional concrete was also added to prevent the uplifting of the structure. The historic window frames were kept, and slit deliberately to ensure the warming of the cold air from the outside when flowing indoors. In combination with this last measure, a floor-heating system was integrated in the new ground floor to provide an adequate temperature for the collections.

For more information on the museum, visit:

https://www.imm-hamburg.de/?lang=en

This initiative is featured in the Co2olBricks Project (2010-2013), focusing on how to reduce the energy consumption of historical buildings without destroying their cultural value and identity.

For more information on the Co2olBricks, visit:

http://www.co2olbricks.eu/

Other relevant sources:

https://www.hamburg.de/hamburg-nord/planen-bauen-wohnen/4496960/co2ol-bricks/

6.1.9. Pro Monumenta: preventive maintenance of immovable cultural monuments in Slovakia

Pro Monumenta: preventive maintenance of immovable cultural monuments in Slovakia	**Type:** Managerial – Maintenance and monitoring framework	**Main risks:** Extreme precipitation, extreme temperatures

Location: Slovakia (Nation-wide)
Biogeographical region: Pannonian
Lead: Monuments Board of the Slovak Republic

Pro Monumenta (2014- 2016) was a project focusing on the preventative maintenance of immovable cultural monuments and looking into aspects such as the technical diagnostics of the state of the buildings in cooperation with their owners. Specific actions included on-site monument monitoring, the elaboration of monitoring reports, drafting of recommendations and small defect repairs. Free-of-charge inspections were carried out on state monuments, involving the use of drones.

The project was supported by the EEA Financial Mechanism, partnering with the Norwegian Monuments Board - "Riksantikvaren." The basic project aim was to build up the system of preventative monitoring of immovable cultural monuments filed in the Central List of monuments as per the section 22 of the Act No. 49/2001 Coll. Additionally, guides and manuals were produced for the owners of national monuments on how to protect the assets from various hazards. Expert training centres were provided within the administration of Monuments Board of the Slovak Republic.

For more information on Pro Monumenta, visit:

http://www.promonumenta.sk/index.php?l=en

The funding of the project was supported by the EEA Financial Mechanism, which funds projects of different topics, including a big share of initiatives involving cultural heritage protection.

More information on the initiative and the funded projects can be found here:

https://eeagrants.org/search?key=cultural+heritage

Other relevant sources:

https://www.coe.int/en/web/culture-and-heritage/-/pro-monumenta

6.1.10. Case study 3: Local heritage plans strengthening local competence and capacity through planning

CASE STUDY 3: Local heritage plans strengthening local competence and capacity through planning	**Type :**Managerial – Management Plans	**Main hazard(s):** Extreme precipitation, flooding

Location: Norway
Biogeographical region: Alpine/Atlantic
Lead(s): The Norwegian Directorate for Cultural Heritage

Background: Norway protects national cultural heritage mostly through the Cultural Heritage Act (1979) and the Planning and Building Act (2008). The latter Act defines a crucial role for Norwegian municipalities in safeguarding and managing cultural heritage assets, including to mobilise and engage local stakeholders and secure the necessary resources, tools and instruments. However, they face challenges mostly related to a lack of political buy-in on the importance of cultural heritage (which results in inefficient planning and management procedures), scarce knowledge on cultural heritage assets' status and locations, high dependency on external stakeholders (such as museums, NGOs and civil groups) for cultural heritage management and insufficient coordination of local competence to ensure proper protection.


Source: Pixabay

Case description: The Norwegian Directorate for Cultural Heritage has developed a series of initiatives to address the aforementioned challenges in municipalities. In 2011, it launched a programme to support municipalities in strengthening local competence and capacity through the production of local heritage plans. Such plans do not have to adopt a mandatory structure, but need to include the following elements: introduction, goals and targets, background information, legal and economic incentives used, historic overview, inventory of cultural assets and implementation plan. The programme was based on economic incentives (up to €10,000/municipality) granted to those municipalities holding the political authority to develop these plans and interested in establishing cooperation models with external institutions and organisations (such as museums or NGOs). Additionally, the programme would seek the establishment of local networks and arenas for knowledge exchange and promote capacity building and training through associations, web-pages, and social media and guidance documents. In 2014, the Directorate launched a campaign for more towns and cities to establish their own antiquarians and assisted with the creation of 11 new positions in a trial scheme between 2014-2016, strengthening in this way the local knowledge in relation with cultural assets [82]

Main outcomes and highlights

- By 2019, 90 % out of the 422 Norwegian municipalities were working or had already adopted a local heritage plan.
- Due to the Directorate's initiatives, there has been a notable rise in social and political awareness, participation and involvement regarding cultural heritage aspects, leading to a feeling of "social pride" for local history and cultural sites.
- The work of the municipalities and the identification and designation of new cultural sites through the development phase of their local heritage plans has created a broader and more diverse historic and cultural repertoire.
- Some urban social benefits such as, education, recreational/out-door activities, well-being and public health have been enhanced with the improvement of the local cultural heritage status.
- The Directorate's activities –with emphasis on the strengthening of local heritage plans – have been included in the European Heritage Strategy for the 21st century Golden Collection of Good Practices.

Factors of success • Economic incentives are important to motivate municipalities in taking action. • Taking into consideration how and when to involve the different agents (NGOs, citizens etc.) during the planning process to have a successful local participation process has been fundamental. • The creation of a "trust atmosphere" is another factor that has helped in the success of the initiative, by leaving the decisions to the locals and only 'nudging' from the state level.	**Lessons learned** • The preparation of the plans is time consuming, ca.2-4 years should be expected for each. • The cooperation models are also resource-intensive, requiring municipalities to coordinate dialogues across different stakeholders, arrange meetings, meet all partners, etc. It is important to consider the lack of capacity of small municipalities (e.g. where there might be just one person allocated to cultural heritage). • At first, it is recommended not to be too ambitious in the preparation of the heritage plan, and it is encouraged to compile and summarise existing knowledge before supplementing the plan with new documentation.
The Directorate for Cultural Heritage The Directorate is the Ministry of the Environment's advisory and executive body for the management of architectural and archaeological monuments, sites and cultural environments. It is responsible for the implementation of national cultural heritage policy. **For more information on the Directorate for Cultural Heritage, visit:** https://www.regjeringen.no/en/dep/kld/organisation/Subordinate-agencies/the-directorate-for-cultural-heritage/id85702/	**Contact info** **Kari Larsen** kari.larsen@ra.no
Relevant source(s): - https://www.coe.int/en/web/culture-and-heritage/-/local-heritage-plans-strengthening-local-competence-and-capacity-through-planning - Heritage and Sustainable Urban Transformations [83] - Interview with Kari Larsen, Directorate for Cultural Heritage, Norway	

6.1.11. Case study 4: Local historical knowledge to inform climate stress tests in the Netherlands

Case study 4: Local historical knowledge to inform climate stress tests in the Netherlands	**Type:** Technological/technical–Models and simulations	**Main hazard(s):** Extreme precipitation, flooding

Location: The Netherlands
Biogeographical region: Atlantic
Lead(s): The Cultural Heritage Agency of the Netherlands

Background: Located in the North-West of Europe, the Netherlands form part of the European River Delta, linked to major European rivers (e.g. the Rhine, Meuse and Scheldt). Flanked by the Northern Sea, the country has 1,275 km of coastline [84] with 26% of the national territory lying below sea level. All these geographical and climatic features, along with high levels of urban density and climate change, make the Netherlands especially vulnerable to flooding [85].

Dutch cities have been repeatedly exposed to flooding events over history, having to learn to adapt. Recent research [86] indicates that some of these cities have had in place for some time an integrated policy connecting urban water, a water board administration and even engineering projects that enabled safe living conditions. The current case study explores how Dutch cities are integrating historical knowledge to advance adaptation efforts in the face of current and future climate-related hazards.

The city of Deventer at the IJssel river by Jacob van Deventer mapped between 1557 and 1559.]. Source: Rutte, R. and B. Vannieuwenhuyze (2018). Stedenatlas Jacob van Deventer. (Bussum 2018).

Case description: In 2018, the National Government launched the Delta Plan on Spatial Adaptation (DeltaplanRuimtelijkeadaptatie) in order to render the Netherlands climate proof and water-resilient. The policy calls for cities to perform climate stress tests, which are based on GIS models to assess which areas and assets in a city have higher risks of flooding or heat stress, based on hydrological, geological and geophysical variables. Following these models, the local authorities can address the risks with specific adaptation policies. However, they only take into account present-day surface aspects, neglecting historical information.

The Cultural Heritage Agency of the Netherlands (RCE) aims to help municipal departments integrate traditional knowledge(e.g. construction techniques and historical reasons for certain construction choices) into their stress tests by looking at aspects such as historical water systems, natural landscape dynamics, climate change, urban morphology and traditional measures and knowledge of flood protection. The evolution of such aspects can be extracted by analysing historical maps such as the 'Waterstaatskaarten' (a series of 1:50,000 scale maps regularly updated from 1865 onwards providing a complete descriptive overview on polder levels, water management systems and hydrological engineering works), which are then digitalised and contrasted with the modern GIS models generated as part of the climate stress tests. The Agency offers support to municipalities by providing historical maps, generating new GIS data and advising on how to perform comparative analysis to identify gaps and existing solutions. Capacity building and training (in the form of workshops, lectures and consultations) is also delivered by RCE's experts as per the municipalities' request, without additional costs.

Main outcomes and highlights

- Cities such as Kampen and Dordrecht have so far successfully integrated historical knowledge into the climate stress tests.
- The initiative has contributed to reinforcing the cultural identity of the municipalities, resulting in adaptation policies that are tailored to their local conditions and existing heritage. Such respect for the local character has contributed to win residents' support.
- All the data generated is made free and accessible through the RCE's website.
- The initiative has contributed to establishing a more integrated approach towards adaptation, bringing together different departments that are generally not used to cooperate, such as the sewage, the archaeological departments and even the municipal police (e.g. in Dordrecht).

Factors of success

- The Netherlands has an extensive repository of historical maps (including city maps, paleo-geographical maps and engineering plans) conserved in the Water Boards, which are still operative and make the access of such documents easy.
- Municipalities have traditionally considered the protection of cultural heritage as an expensive luxury. With this initiative, cultural heritage is presented as a solution that can be integrated in other sectors and policies (for instance, adaptation and resilience), and therefore can be covered by a broader range of funding sources.

Lessons learned

- Before applying the step-by-step guidance, people working in cities need to be aware of the fact that they are already flood-adaptive and they have valid systems which have been systematically tested by history. This is important in terms of securing political and social buy-in early in the process.
- The approach towards adaptation varies enormously among different municipalities based on their specific characteristics and ways of operating. In some cases, different departments are already cooperating closely, in some others there are silos; in these last cases, broader efforts are needed in terms of bringing the different departments together.

The Cultural Heritage Agency

The Cultural Heritage Agency of the Netherlands is responsible for executing a part of the Dutch government's policy on shared heritage by means of its Shared Cultural Heritage Programme, and works on three main topical areas: Maritime Archaeology, Built Environment and Collections. It works together with ten partner countries.

To learn more about the Cultural Heritage Agency, visit: https://english.cultureelerfgoed.nl/

Contact info

MenneKosian
m.kosian@cultureelerfgoed.nl

Link to academia profile:

https://cultureelerfgoed.academia.edu/MenneKosian

Source(s):

- https://erfgoedenruimte.nl/sites/default/files/attachments/RCE_Stresstest_posterA1_594x841mm_V7_0.pdf
- https://www.chnt.at/wp-content/uploads/eBook_CHNT23_Kosian.pdf
- https://www.academia.edu/38645950/The_Importance_of_History_for_Modern_Climate_Adaptation_Strategies
- Interview with Menne Kosian, Spatial Analysis Researcher at the Landscape Department at the Cultural Heritage Agency of the Netherlands

6.1.12. Flood protection in the Venetian lagoon: Modulo SperimentaleElettromeccanico (MOSE)

Flood protection in the Venetian Lagoon: Modulo SperimentaleElettromeccanico (MOSE)	**Type:** Technological/technical– Structural measure(s)		**Main hazard(s):** Sea-level rise, coastal flooding, storm surges

Location: Venice, Italy
Biogeographical region: Continental
Lead: Venice Water Authority in partnership with Consorzio Venezia Nuova

During the last decades, the Venice lagoon has been subject of increasing natural and anthropogenic hazards and land use management has resulted in loss of 25cm of land level in the last 100 years. This, along with the prognostic of increasing temperatures due to climate change places Venice in a vulnerable spot.

The main intervention in Venice lagoon relates to the MOSE integrated system, consisting of a series of mobile gates located at the inlets of the lagoon. When floodgates are inactive, they are underwater and lie completely invisible in housings placed in the backdrop. In the event of a particularly high tide event which could cause flooding of the territory, compressed air is introduced into the sluices which empties it from the water. As the water exits the sluice gates, rotating around the axis of the hinges, they rise up to emerge and block the flow of the incoming tide in the lagoon.

MOSE is complemented with other measures designed to protect the Venice Lagoon area against flooding. Different measures include the reconstruction of the beaches along 63 km of coastline, the reinforcement of breakwaters, the local defence of urban centres (including raised pavements) and the securing of polluted sites through phyto-biopurification.

For more information on MOSE, visit:

https://www.mosevenezia.eu/lagoon/?lang=en

Other relevant sources:

https://www.mosevenezia.eu/lagoon/?lang=en

https://www.coastal-management.eu/measure/example-mose-system-mobile-flood-barriers-venice-it

6.1.13. IG-WRDRR: An international group working on wind-related disaster risk reduction

IG-WRDRR: An International Group working on Wind-related Disaster Risk Reduction	**Type:** Institutional–Networking and capacity building (for institutions)	**Main hazard(s):** Severe Wind

Location: Geneva, Switzerland
Biogeographical region: Continental
Lead: IAWE, UNISDR Secretariat, UNU, TPU Global COE, ADRC, SEEDS

The International Group for Wind-Related Disaster Risk Reduction (IG-WRDRR) was launched in Geneva (Switzerland) in 2009 at the Global Platform for Disaster Risk Reduction organised by the UN and other NGOs. The initiative was conceived to establish linkages across policy-makers, researchers and agencies responsible for carrying out DRR and DRM at local community level, implementing the Hyogo Framework for Action in the area of wind mitigation.

It is comprised by eleven different organisations, including the International Association for Wind Engineering, (IAWE), the International Center for Water Hazard and Risk Management (ICHARM), the United Nations/International Strategy for Disaster Risk Reduction (UN/ISDR), the World Metereorological Organisation (WMO) and the International Federation of Red Cross and Red Crescent Societies (IFRC).

The initiative generated a series of events, such as the International Forum on Tornado Disaster Risk Reduction at Bangladesh (Dhaka, Bangladesh, 2009, 2013), the workshop on Wind-related Disaster Risk Reduction activities and the Interorganisational Collaborations and the pre-Conference Event on Climate Change and DRR strategies in Asia-Pacific Region (Incheon, Korea, 2010), the 5th International Disaster and Risk Conference (IDRC, Davos, Switzerland, 2014), the IAWE Public Forum at the 3rd World Conference on Disaster Risk Reduction (Sendai, Japan, 2015).

For more information on the Working Group, visit:

http://www.iawe.org/WRDRR/

Other relevant sources:

https://www.sciencedirect.com/science/article/pii/S0167610512000402

https://www.preventionweb.net/files/globalplatform/519f7c6e76cd2Shuyan_GP4_IG-WRDRR.pdf

6.1.14. Monitoring deterioration processes in the Palace of Knossos

Monitoring deterioration processes in the Palace of Knossos	**Type:** Technological/technical – Sensing and monitoring tools and methods	 **Main Hazard(s):** Wind, extreme precipitation, air pollution, biological action
Location: Heraklion, Greece **Biogeographical region:** Mediterranean **Lead(s):** Consiglio Nazionale DelleRiserche Description: the Minnean Palace of Knossos (built in 1700 BC and covering an area of 22,000 sqm) was built on the top and the slopes of the low hill of Kefala. The complete excavation of the monumental complex was achieved in 1902 by Arthur Evans (Curator of the Ashmolean Museum in Oxford). The fragile building materials proved extremely sensitive to weathering. After 1925, Evans attempted the full reconstruction of the palace including a large-scale use of reinforced concrete, the reconstruction of the upper stories and main architectural elements, the revamping of timber frames and wooden Minoan columns and the restoration of the frescoes at different spots of the site. The palace has suffered since them extensive damage mainly due to the combined action of the climatic conditions, biological agents, air pollution and human's interventions. During the 1990s, the Ministry of Culture took measures for its preservation and restoration. Under the authority of the Ephorate of Antiquities a great part of the concrete slabs of Evans' restoration of the Palace was conserved, and paths for the visitors were developed, which reduced the wear of the monument and gave the visitors a more complete view of it. Main weathering agents are regularly monitored through the HERACLES Project using technologies such as a Spaceborne radar COSMO-SkyMed, UAV-Drone geometrical survey and Terrestrial Laser Scanner. A weather station was installed to measure climatic parameters.	**The Minnean Palace of Knossos is one of the four testing sites of H2020 European Project HERACLES, which aims to design, validate and promote responsive systems/solutions for effective resilience of cultural heritage against climate change effects.** **More information on the Project can be found here:** **http://www.heracles-project.eu/** **Other relevant sources:** http://www.heracles-project.eu/project-test-beds/test-bed-1-palace-knossos-heraklion-el https://meetingorganizer.copernicus.org/EGU2020/EGU2020-7010.html	

6.2. Geological- related hazards

6.2.1. Assessing seismic risk in Pompeii

Assessing seismic risk in Pompeii	Type: Technological/technical – sensing and monitoring tools and methods	Main hazard(s): Earthquakes, mass movements

Location: Pompeii (Italy)
Biogeographical region: Mediterranean
Lead(s): ISPRA, NERC, CUT, UNIMIB, IGME

PROTHEGO was conceived to monitor European monuments and sites inscribed on UNESCO World Heritage List at risk from geo hazards, using sensed information (i.e. ground stability and motion), advanced modelling and field surveying. Information is mostly collected using space technology based on radar interferometry (InSar).

PROTHEGO intervention in Pompeii, jointly led by Italian Institute for Environmental Protection ISPRA together with the POMPEII Archaeological Park, aims at the analysis and interpretation of ground motion measures obtained by satellite InSAR data, and at the evaluation of the geomorphologic processes affecting unexcavated areas. A collection of data and images with information on recent instability processes of the Park was made. The purpose of this compilation was to produce a high-resolution morphological map which could categorize types and mechanisms of phenomena since year 2005. The results underlined the potential of the interferometry satellite technique for identifying pre-collapsing deformation trends for predictive purposes.

Funded in the framework of the Joint Programming Initiative on Cultural Heritage and Global Change (JPICH) — HERITAGE PLUS, PROTHEGO aims to make an innovative contribution towards the analysis of geohazards in areas of cultural heritage in Europe.

For more information on PROTHEGO, visit:

http://www.prothego.eu/

Other relevant sources:

http://www.prothego.eu/docs/posters/PROTHEGO_Pompei_poster.pdf

https://www.researchgate.net/publication/319178970_Satellite_monitoring_applied_to_natural_hazards_and_cultural_heritage_the_PROTHEGO_project

6.2.2. Building capacity to cope with earthquakes in Central Italy: CERHER

Building capacity to cope with earthquakes in Central Italy: CERHER	**Type:** Institutional–Networking and capacity building	 **Main hazard(s):** earthquakes

Location: Central Italy Macro Region (Umbria, Tuscany and Marche)
Biogeographical region: Mediterranean
Lead(s): UNISDR, ENEA, INGV, UNICAM, LINCEI, Firenze 206 Project Coordination Committee

The CERHER - Center of Resilience on Heritage, established in 2017, is an integrated skills centre operating in the macro-region of central Italy which aims to develop the resilience of art cities to natural disasters (and apply the Sendai Framework for Disaster Risk Reduction to cultural heritage assets).

CERHER's primary objective is to act in the context that surrounds cultural heritage, building a network of active protection and risk mitigation, capable of optimising the resilience of the art cities. The Centre promotes and encourages initiatives such as the development of innovative technologies for diagnostic and structural monitoring of cultural heritage and assessment of risks and vulnerability of museum assets; creation of an open access documentation centre for the collection and analysis of scientific publications on resilience; establishment of a permanent forum for discussion on unresolved scientific and technical issues related to resilience of cultural heritage and the education and training activities for the public (including youth).

For more information on CERHER, visit:

http://www.cerher.org/

Other relevant sources:

https://www.undrr.org/news/italy-establishes-heritage-resilience-centre

6.2.3. Building resilience to cope with earthquakes: Istanbul Seismic Risk Mitigation and Emergency Preparedness Project

Building resilience to cope with earthquakes: Istanbul Seismic Risk Mitigation and Emergency Preparedness Project	**Type:** Managerial – Management plan	 **Main hazard(s):** earthquakes

Location: Istanbul, Turkey
Biogeographical region: Mediterranean
Lead: Istanbul Project Coordination Unit (IPCU)

The objective of the Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (2005-2018) was to transform Istanbul into a city resilient to a major earthquake.

The Project was based in four main components: enhancing emergency preparedness of public safety organisations to earthquakes both at provincial and municipal level, undertaking seismic risk mitigation for public facilities, ensuring their functionality through the emergency and post-disaster recovery phases (including retrofitting of hospitals, schools and other public facilities), enforcement of building codes and compliance with land use plans and provision of support to the Istanbul Provincial Administration to implement the project in an efficient and transparent manner as well as building the necessary capacity to do so.

The project managed to cover 176 cultural heritage buildings under the Directorate of Surveying and Monuments within the Ministry of Culture and Tourism, recording historical information about the assets.

The Project was financially supported by the World Bank. The World Bank Group has helped funding several projects in the theme of cultural heritage. An overview can be found here:

https://projects.worldbank.org/en/projects-operations/projects-list?searchTerm=cultural%20heritage

Other relevant sources:

http://documents1.worldbank.org/curated/en/415551468121763183/pdf/32173.pdf

https://ieg.worldbankgroup.org/sites/default/files/Data/reports/ppar_turkeyseismic.pdf

6.2.4. Reconstruction of the Emilia-Romagna Region after major earthquakes

Reconstruction of the Emilia-Romagna Region after major earthquakes	**Type:** Managerial - Governance Model	**Main hazard(s):**earthquakes

Location: Emilia Romagna Region (Italy)
Biogeographical region: Continental
Lead(s): Regional and Local Governments of Emilia Romagna Region

On the 20th and the 29th of May 2012 two earthquakes of medium intensity (magnitude 5.9 and 5.8 on the Richter scale) affected the Province of Modena, Ferrara, Bologna, Reggio Emilia (Emilia Romagna Region) and Mantova (Lombardy Region), with 28 deaths, 300 injured, 45,000 homeless and dramatic impact on buildings, houses, schools and industrial plants (damage of €13.2 billion).

A committee for emergency governance was immediately created, consisting of local and regional government authorities. The commitee designed a plan for reconstruction with the local communities at its heart, identifying a set of priorities. The main one was community cohesion (schools, workplaces and homeless shelters were main targets for reconstruction, followed by a democrative and participative governance model during emergency and post-disaster recovery phases). The model was succesful and adopted by firms and other authorities around the world.

This initiative, along with many others, is featured in the Interreg BhENEFIT project's inventory of good practices. You can access the booklet here:

http://www.central2020.eu/Content.Node/Bhenefit/BhENEFIT-D.T1.2.1-Best-Practice-Inventory.pdf

BhENEFIT focused on improving the management of historic built areas, combining the daily maintenance of historic heritage with its preservation and valorisation in a sustainable way.

For more information on BhENEFIT, visit:

https://www.interreg-central.eu/Content.Node/BhENEFIT.html

6.2.5. Case study 5: Appignano del Tronto: How to react after a disaster

CASE STUDY 5: Appignano del Tronto: How to react after a disaster	Type: Managerial – management plan	Main hazard(s): earthquakes, mass movements

Location: Appignano del Tronto, Italy
Biogeographical region: Continental
Lead(s): Appignano del Tronto Municipality

Background: The socio-economic context of the village of Appignano del Tronto presents three trends: a) a trend towards depopulation that has intensified due to earthquakes in 2016 and 2017; b) a trend towards deindustrialisation that has intensified due to the European economic crisis from 2008 to 2013; and c) an economic flourishing of small and medium enterprises (SMEs) and micro-companies (especially in the agricultural and farming sectors) which are mostly family businesses.

Case description: This case encompasses both tangible and intangible elements of heritage combined with the high risk of earthquakes. Earthquakes have shaken the village between 2016 and 2017, leaving almost 50% of homes in its historic area destroyed. This situation had a huge impact on the preservation of public and private heritage as well as leading to a significant psychological destabilisation of the residents. The Appignano del Tronto Municipality has taken a resilient and holistic approach since then, which led to a number of interventions aiming to create a new model of development through the effective and adaptive use of Cultural and Natural Heritage (CNH).

Many local stakeholders have been involved in this process (ca.40 local stakeholders); among them: local communities, farmers, local companies, residents, local authorities, policy-makers, cultural associations, non-profit associations, universities/academia, the Italian National Institute of Geophysics and Volcanology (INGV), UNESCO and many more.

These stakeholders have been working on several action plans focusing on CNH, including co-learning to build earthquake-proof buildings and choosing suitable safe areas; using seismic micro-zoning and emergency planning to safeguard the village against disasters; providing crowdfunding tools/funding together with residents; endorsing good farming practices that help to reduce geological risks; implementing a local land maintenance plan to manage physiological impacts, enhancing capacity building & training activities for community resilience and providing technological infrastructures, amongst others. The cost of the interventions has so far amounted to €5-6million.

Main outcomes and highlights

- The most tangible result at the time of writing is the Rural Heritage Hub: a community of local stakeholders as well as a physical meeting place where co-creation activities take place;
- A number of open spaces for gatherings like social and community events that involve public and community participation for local engagement have been developed and maintained;
- Local action plans and groups have emerged; this in addition involves a strong representation of women the decision-making processes.

Factors of success

- The time spent with local stakeholders during one-to-one meetings has been essential especially during the first months; a key factor to guarantee the long-term impact and sustainability of the project.
- So-called "RURITAGE Stories" (named after the supporting European Commission-funded project) have enabled preservation of stories based on oral traditions that have been known or shared in the past.
- Public consultation took place through surveys, gatherings, social and community events with educational purposes (e.g. trainings involving games), but also making use of a crowdfunding tool.
- The Rural Heritage Hub of Appignano del Tronto was created and promoted; an open space to practice innovation and organise community events in the project has been promoted among other European projects/networks.
- The adopted bottom-up approach has been fundamental to design tailored solutions for local challenges on CNH.
- International networking is very helpful to learn and adapt other successful experiences in your own context.

Lessons learned

- *Spatial:* a small village like Appignano Del Tronto has not the "critical mass" to exponentially multiply the positive effects that a co-design process can usually generate in an urban context. *Socio-cultural*: the local stakeholders' attitude towards EU funds is, mostly, not to use them as an opportunity for improving innovation, internationalisation and strategic development for their business, but it's rather an extra fund for their ordinary activity; something that is of course to be expected and valued in such contexts.
- Stakeholder involvement and community resilience can generate local awareness, a change of mind-set and social acceptance for Cultural and Natural Heritage.
- *Financial*: due to the characteristic of local socio-economic context (mostly micro companies and family business), the financial capacity to invest generating additional (private) funds is not available; to tackle this situation, the local administration has put together a plan to introduce tax incentives to incentive private investments, for example through the Impact Finance mechanism.
- Cultural events have become important to keep the local dwellers from moving out of the village.
- *Regulatory:* there have been many regulation attempts to tackle the seismic risks in the area. However, this has been delayed due to the bureaucratic procedures.
- *Transferability:* the measures and initiatives taken thus far might not be applicable in big cities, but rather in rural areas and small cities (e.g. Crete, Greece).
- This is a small community that learnt to together to achieve the same goal of making the historic area more resilient for and with its dwellers.

Appignano del Tronto Municipality is one of the 38 partners of RURITAGE, a project funded by EU Horizon2020 programme. This project turns rural areas into laboratories to demonstrate Cultural and Natural Heritage as an engine of regeneration.

In addition, Appignano del Tronto is involved in many projects funded by Local Action Group GAL Piceno and by Marche Region (i.e. agro-environmental agreement about climate change adaptation and mitigation in agriculture).

Contact info

Antonella D'Angelo
tecnicoappignano@gmail.com

Relevant source(s):

- Comune di Appignano del Tronto
- Ruritage.eu: Appignano del Tronto
- Interview with Sara Moreschini, Mayor of Appignano del Tronto

6.2.6. **Case study 6: Mikulov Urban Conservation Area**

CASE STUDY 6: Mikulov Urban Conservation Area	**Type:** Managerial - management plan	**Main hazard(s):** earthquakes, floods and fires

Location: Mikulov, Czech republic
Biogeographical region: Continental
Lead(s): TheMikulov municipality

Background: Within this project, the Mikulov municipality developed an integrated management plan, in addition to an international database (through funding from Interreg and specifically the BhENEFIT project)), based on the INSPIRE directive, designed to support European strategies for cities and communities in the Danube Region (also known as the Danube Strategy). In particular, theMPR Mikulovproject pursues the protection and the security of cultural heritage of the area around the Mikulov Municipality. The project allowed the drafting of statistics about the area's risk exposure, in particular to earthquakes, floods and fires.
The City of Mikulov has been the principal managing institution and has established effective cooperation with other actors including the private sector. Besides the building owners, the municipality also cooperated with cultural and tourism service providers, and academics (e.g. the MENDELU Faculty of Horticulture).

Within the BhENEFIT project, new approaches to sustainability as part of the program (environmental, economic and social issues) were proposed, which have met with a high level of social acceptance. The BhENEFIT project focused on improving the management of historic built areas, combining daily maintenance with preservation and valorisation in a sustainable way. The project found innovative solutions to how to evaluate the use and historic value of built areas and how to optimise building performance (improving energy efficiency and structural performance).The total cost of the MPR Mikulov regeneration has so far been€14.4 million, with an expected further cost of €3.9 million by 2020, according to the Regeneration Programme.

Case description: For the implementation, Mikulov followed the 'BhENEFIT methodology', which was validated by 12 partners, including cities, regions, researchers and SMEs in 7 different areas, and applied to specific issues (earthquake, pollution, touristic flows, energy efficiency etc.). New tools, like action plans and ICT tools, were developed to increase the cooperation among stakeholders involved in sustainable management of Historic Built Areas (HBA), enhance their awareness and skills, increase availability of data and information, and to monitor and plan more effectively. The following areas of action were implemented:

- Restoration and maintenance of technical infrastructure; urban and architectural care, particularly in compliance with approved regulations of spatial planning;
- Completion of the public areas with small architectural structures and greenery, establishment of traffic-restricted and pedestrian zones;
- Care for and restoration of existing and defunct historical greenery, and sensible establishment of new public green;
- MPR recovery, especially the Square, as a historical public centre of the city with appropriate business and public activities and operations focusing on the long-term concept and goals of the city; restoration and care of the quality of natural components of the environment and its ecological stability;
- Encouraging the city's inhabitants to participate in regeneration - to instigate and support cultural and educational activities-

Main outcomes and highlights

- Public participation was increasing during the development of the new strategic documents. A contemporary and pro-active approach to the rehabilitation process for many historic buildings was adopted, while project management was conducted in a multi-sectoral and participative way (following also the updated urban regeneration strategy of 09/2017).
- Financing establishment of a register of costs for the re-construction of the housing stock in buildings within the MPR area was not unlimited, and as a result, the city had to struggle to find and allocate other financial sources (private investment) beyond the frame of state and municipal subsidies. The project team followed existing legislation and

organisation to negotiate and approve the new local plan, which ended up in the review of the MPR Regulation Plan (assignment was discussed and approved by the Mikulov city council, 02/2017).

- The municipality's approach under the program was highlighted as a good practice for the BhENEFIT project.

Factors of success

- Funding from multiple sources (national, regional, EU, etc.), has been organisationally demanding and challenging. Projects are focused on restoration and reconstruction of monuments and public spaces; sustainability and climate change are still taken indirectly. This is actually changing, the importance of measures (sustainability, climate change, etc.) rises.
- For example, a financial instrument for projects to reduce the energy performance of buildings. So far, it is a state of intent. An obstacle is the conservative approach of the monument protection authority.
- Public funding instruments for example from the Environment Ministry, partially also Ministry of Regional Development, and Ministry of Culture were employed to combine funding streams.

Lessons learned

- Capacity, technical support and finance is never enough; constant monitoring and re-thinking of the activities was needed throughout the project design and implementation
- Processes in HBA are always more demanding, organisationally and especially financially.
- In general, the issue of sustainability and climate change is problematic in the context of HBA. This is also due to the conservative NPU (National heritage authority) approach.
- Long-term conceptual measures that exist, there are good results (especially in last 15-20 years), responses to the city's and inhabitants needs.
- Lack of (partially) population interest, cumbersome legislation in CR (very long-term approval processes, building permits, etc.), some NPU procedures, and HBA financial requirements

Contact info:

Karel Barinka, Mikulov Municipality
kbdp@volny.cz

Sofia Salardi
sofia.salardi@comune.mantova.gov.it

Relevant source(s):

-https://www.interreg-central.eu/Content.Node/Bhenefit/Urban-walk-in-Mikulov.html
- Interview with Karel Barinka, Project Manager for Interreg at Mikulov Municipality

6.2.7. Preventing landslides in the Umbria Region

Preventing landslides in the Umbria Region	**Type:** Technological/technical - Models and simulations	**Main hazard(s):** Mass movement

Location: Region of Umbria, Italy
Biogeographical region: Mediterranean
Lead(s): Regional and National Governments of the Umbria Region

The region of Umbria is especially vulnerable to landslides due to the historic development of the towns around towers, castles and medieval villages located at the top of the hills. Increased urbanisation has also brought erosion of the hill slopes.

For this critical situation, the Regional and National Governments developed the Hydrological-geological assessment Plan of the Tevere river basin, where 174 risk areas where identified (some of which correspond to historic settlements such as Orvieto, S.Eutizio or the Spoleto town) using information extracted from the analysis of a multi temporal landslide inventory map. Such map is obtained by merging landslide inventory maps prepared through the analysis of stereoscopic aerial photographs of different ages.

The plan can be consulted here (in Italian):

http://www.regione.umbria.it/documents/18/473522/Testo+Tevere/93cd786e-040d-46b0-8c0a-22ec6328682e

6.2.8. **Structural measures to prevent rockfalls in Delphi**

Structural measures to prevent rockfalls in Delphi	**Type:** Technological/technical – Structural measures	 **Main risks:** Mass movements, earthquakes

Location: Prefecture of Phokis, Greece
Biogeographical region: Mediterranean
Lead: Ministry of Culture, Education and Religious Affairs, through the Ephorate of Antiquities of Phocis

This monumental complex, designated a 'success story' by UNESCO, stands out for its integrity (it has remained practically unaltered through the centuries) and its authenticity (it coexists in harmony with its natural environment, being subject to only very minor interventions over time).

Some of the latest interventions include a fire protection system operative 24 hours per day and temporary metal fences against falling rocks. The Central Archaeological Council has approved a study for the fastening of the rock slopes in order to provide a permanent solution to this last issue. The site contains an Archaeological Museum to protect moveable heritage associated to the site. Improvements on the visitor's facilities have been carried out to enable access to visitors with disabilities. Different educational measures such as information signs have been put in practice. The restoration of the monuments is carried out on a regular basis by the Archaeological Museum.

For more information on the UNESCO DELPHI site, visit:

https://whc.unesco.org/en/list/393

This initiative, along many others, is part of the UNESCO World Heritage Sites.

You can find more about this network here:

https://whc.unesco.org/en/list/

Other relevant sources:

https://whc.unesco.org/en/soc/1676

http://www.isocarp.net/Data/case_studies/2055.pdf

6.2.9. HYPERION integrated resilience approach in Tønsberg

HYPERION integrated resilience approach in Tønsberg	Type: Technological/technical–Models and simulations	Main hazard(s): Landslides, rockfalls

Location: Tønsberg, Norway
Biogeographical region: Norway
Lead(s): Greek Institute of Communication and Computer Systems

The H2020 project HYPERION (2019-2023) aims at delivering an integrated resilience assessment platform by leveraging existing tools and services (i.e. climate/extreme events models, building materials decay models) and novel technologies (i.e. satellite imaging and machine learning), all of it aimed at the protection and sustainable reconstruction of historical centres.

By using existing tools, HYPERION will analyse the elements affecting cultural heritage in local ecosystems and the interactions among different elements, while securing community participation and supporting business models and funding mechanisms.

HYPERION will test tools and models in four demo sites: Rhodes (Greece), Granada (Spain), Tønsberg (Norway) and Venice (Italy). HYPERION will monitor from five to eight objects in three-four medieval ruins in the Viking town of Tønsberg, located under a cliff area that makes it especially vulnerable to landslides and rockfalls. The result will be a modelling of the historic area of the city, which will allow for a better risk assessment and identification of appropriate measures for its preservation and management.
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For more information on HYPERION project, visit:

https://www.hyperion-project.eu/

Other relevant sources:

https://www.hyperion-project.eu/demonstration-case-d-in-the-city-of-tonsberg-tonsberg-norway/

6.2.10. PROTHEGO: monitoring European cultural heritage at risk of volcanic eruptions

European cultural heritage sites at risk of volcanic eruptions	**Type:** Technological/technical – sensing and monitoring tools and methods	**Main hazard(s):** Volcanic activity, mass movements

Location: Southern Europe
Biogeographical region: Atlantic, Mediterranean
Lead(s): ISPRA, NERC, CUT, UNIMIB, IGME

The FP7 PROTHEGO (PROTection of European Cultural HEritage from GeO – hazards) project, Led by the Italian Institute for Environmental Protection and Research, and in collaboration with NERC British Geological Survey, Geological and Mining Institute of Spain, University of Milano-Bicocca and Cyprus University of Technology, applied InSAR techniques to monitor monuments and sites that are potentially unstable due to landslides, sinkholes, settlement, subsidence, active tectonics as well as structural deformation.

The analysis includes 450 sites on the UNESCO World Heritage List in Europe, of which 11 are at risk of volcanic eruption (one in Iceland, one in Portugal, one in Spain, one in Greece and seven in Italy). All of them are displayed on a map where additional information on their UNESCO heritage site (and their criteria), their potential hazards and available satellite data is made available to the public.

Funded in the framework of the Joint, under ERA-NET Plus and the Seventh Framework Programme (FP7) of the European Commission, the project PROTHEGO aims to make an innovative contribution towards the analysis of geohazards in areas of cultural heritage in Europe.

More information on PROTHEGO can be found here:

http://www.prothego.eu/home.html

And the Map viewer accessed here:
http://mapapps2.bgs.ac.uk/prothego/index.html

6.2.11. Turning risks into opportunities: Katla Geopark

Turning risks into opportunities: Katla Geopark	**Type:** Behavioural – Awareness raising and communication	**Main hazard(s):** volcanic eruption

Location: Skaftártunguvegur, Iceland
Biogeographical region: Arctic
Lead(s): Katla UNESCO Global Geopark

Situated within a great geographical diversity and an outstanding geological landscape that present high risks related to various natural hazards, Katla UNESCO Global Geopark, in Iceland, is one of RURITAGE project's Role Models.

Their natural wonders populated with ice-capped active volcanoes, tuff mountains, and black volcanic beaches attract a big number of visitors yearly. By making use of landscape storytelling, merging holistic concepts of protection, education and sustainable development, Katla created a network of governmental agencies that provide guidance and assistance to the local population and tourist on how to protect themselves and cooperate with rescue squads during and after a disaster event, teaching prevention and safeguard strategies, increasing awareness regarding survival of natural hazards as well as promoting the local culture by placing a strong emphasis on nature tourism. The park counts on a Destination Management Plan (DMP) result of an extensive participatory planning process with contributions of many stakeholders from the geopark.

For more information:

http://www.katlageopark.com/

RURITAGE is a 4-year EU-funded project under the Horizon 2020 programme aimed at establishing a new heritage-led rural regeneration approach, transforming rural areas into laboratories for sustainable development, building on the enhancement of their unique Cultural and Natural Heritage potential.

For more information on RURITAGE, visit:

https://www.ruritage.eu/

Other relevant sources:

https://www.ruritage.eu/role-models/katla-geopark/

http://www.katlageopark.com/news/article/2018/11/09/ruritage-cultural-heritage-as-a-driver-for-sustainable-development

6.3. **Human-induced hazards**

6.3.1. **Complete restoration of the Oka River's upper estuary**

Complete restoration of the Oka River's upper estuary	**Type:** Technological/technical – Structural measures	 **Main hazard(s):** Extreme land use, sea-level rise

Location: Urdaibai, Spain
Biogeographical region: Atlantic
Lead(s): Service of the Urdaibai Biosphere Reserve Department of the Environment, Territorial Planning and Housing of the Basque Government

This initiative sought to improve the environmental conditions of a degraded ecosystem of great ecological and cultural value located within the Urdaibai Biosphere Reserve. Main objectives were to recover the area's original landscape (greatly affected in the last decades by the agriculture, cattle raising, the construction of a shipyard and the canalisation of part of the river) and to protect the estuary from negative effects of climate change, mainly sea-level rise and alterations of the water regime. The area has a strong cultural value as it hosts antique buildings and structures, and it is linked to local legends, traditions and myths.

Actions taken included the environmental recovery of a flooded area (Barrutibaso) and the functionality of part of the lower section of the Oka River's channel, the establishment of a 14 km network of pedestrian footpaths –including a cycling bridge- to enhance connectivity between urban areas, the development of resources for interpretation and dissemination (including informative panels and an app containing info on local habitats, species and cultural elements), and the eradication of invasive alien species.

For more information, on the project. visit:

https://www.euskadi.eus/informacion/proyecto-de-restauracion-del-estuario-superior-de-la-ria-del-oka/web01-a2ingurd/es/#5770

Urdaibai's Biosphere Reserve is part of the UNESCO's Biosphere Reserves, an international network of 688 sites of outstanding ecological and cultural value.

Find out more on the network here:

http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves

Other relevant sources:

https://climate-adapt.eea.europa.eu/metadata/case-studies/restoration-of-the-oka-river2019s-upper-estuary-part-of-the-urdaibai-biosphere-reserve

6.3.2. Monitoring natural and human-induced driven deterioration in Koules fortification

Monitoring natural and human-induced driven deterioration in Koules Fortification	**Type:** Technological/technical–Sensing and monitoring tools and methods	 **Main hazard(s):** Pollution (air), wave action

Location: Heraklion, Greece
Biogeographical region: Mediterranean
Lead(s): CONSIGLIO NAZIONALE DELLE RICERCHE

This fortification, built by the Venetians in the early 16th century, has been exposed to the action of the sea for centuries. Since then, its stonework and foundations have been constantly damaged and repaired, until restoration works stagnated in the 1970s.The Greek Ministry of Culture resumed restoration works in the 2000s through the Ephorate of Antiquities and more recently setting a National Strategic Reference Framework Project concerning the Restoration and Conservation of the Fortress (2011-2016).

Actions included the removal of former interventions in the masonry, consolidation and preservation of the lions relieves, replacement of cannon openings' old frames with new stainless ones and the removal of salt crusts and bio deterioration signs from the Stone surface, among others. Climate change and air pollution are likely to affect the fortress in the near future, accelerating deterioration processes. The HERACLES Project is supporting the anticipation to future risks through frequent, high-detailed analysis and monitoring of climatic conditions, material composition and the source of weathering features using optical and laser streptoscopic analysis, as well as a meteorological station.

For more information on the interventions, visit:

http://www.heracles-project.eu/project-test-beds/test-bed-2-sea-fortress-koules-heraklion-el

Koules is one of the four testing sites of H2020 European Project HERACLES, which aims to design, validate and promote responsive systems/solutions for effective resilience of cultural heritage against climate change effects.

For more information on HERACLES, visit:

http://www.heracles-project.eu/

Other relevant sources:

http://www.heracles-project.eu/project-test-beds/test-bed-2-sea-fortress-koules-heraklion-el

6.3.3. Rosia Montana mobilises against industrial mining

Roșia Montană mobilises against industrial mining	**Type:** Institutional – Advocacy action	**Main hazard(s):**Extreme land use, pollution

Location: Rosia Montana, Romania
Biogeographical region: Anatolian, continental
Lead(s): Pro Patrimonio and Cultura Nostra

The landscape of Roşia Montană (covering 2,500 km^2 approx.) is well known for its rich deposits of precious metals (mostly gold and silver) and has been subject of mining activities since Dacian and Roman times. These activities have left many sites and buildings from different historical periods, including a gallery network of 150km^2.

A major threat to the site has been a more recent large-scale open-cast mining project promoted by a Canadian company, which is the main shareholder of the Roşia Montană Gold Corporation (RMGC). In December 2015, the Romanian Ministry of Culture put an end to the proposed mining project by classifying the town of Roșia Montană and its surroundings as a Category A historic monument. The region was officially inscribed on Romania's Tentative List of UNESCO World Heritage Sites in October 2016. In January 2017, the nomination dossier for World Heritage inscription was submitted for consideration. In June 2018, Europa Nostra also supported ICOMOS' recommendation to inscribe Roșia Montană both on the World Heritage List and on the List of World Heritage in Danger.

The local association Alburnus Maior is leading strong advocacy efforts in collaboration with other local actors such as the Association ARA. Together, they have created a programme for the conservation of local cultural heritage fuelled by voluntary participation and contributions from individuals and small grants from public organizations.

For more information on the initiative, visit :

https://www.wmf.org/project/ro%C8%99ia-montan%C4%83-mining-landscape

The submission as UNESCO World Heritage Site and its progress can be consulted here:

https://whc.unesco.org/en/tentativelists/6082/

As well as the Nomination for Inscription:

http://rosiamontana.world/wp-content/uploads/2016/12/Rosia-Montana-Executive-Summary.pdf

Other relevant sources:

https://www.europanostra.org/europa-nostra-appeals-romanias-parliament-opt-alternative-sustainable-development-rosia-montana/

https://www.wmf.org/blog/ro%C8%99ia-montan%C4%83-birth-movement

6.3.4. **Preventing fire risks at Serra de Xurés Natural Park**

Preventing fire risks at the Serra de Xurés Natural Park	**Type:** Technological/technical – Structural measures	**Main hazard(s):** Fires, wildfires

Location: Galicia, Spain
Biogeographical region: Atlantic
Lead(s): Tecnalia

The Natural Park Serra do Xurés in Galicia, conforms together with the Peneda-Garés National Park, the nucleus of the Geres-Xurés Transfrontier Biosphere Reserve. With a total of 267.958 ha, this area marks the transition between the Mediterranean and Atlantic climates and host a vast amount of habitat and species of outstanding ecological value, as well as an extensive collection of tumuli (mámoas) and archaeological sites from the Romanisation period. Unfortunately, the area is at great pressure from the incidence of forest fires, especially during summer period.

The H2020 project SHELTER (2019-2023) will particularly focus in providing tools and methods to increase the park's natural and historical elements' resilience by fostering local communities' participation. Two tools will be developed; one to hinder the progress of large fires (prevention) and another focused-on restoration after the fire (recovery). With the help of different government levels (regional and local), the academia, local research institutions and business, the project will design nature-based solutions against fires' risk including prevention, preparedness response and recovery phases including landowners for testing and validation. Interventions will include humidity of thalwegs by hardwood species as limiters of fire, identification of species in soil restoration and community-led silviculture practices. Thermos-cameras and soil humidity sensors will provide early warning signals in case of fire, give indications on critical situations (periods of draught) and monitor post-event restorations.

Serra do Xurés is one of the five European Open Labs featured in SHELTER. The project aims at developing a data-driven and community-based knowledge framework bringing together the scientific community and heritage managers, to reduce vulnerability and promote better and safer reconstruction and management of historic areas. SHELTER framework will be implemented in multi-scale and multi-source data driven platform aiming to provide the necessary information for adaptive governance.

For more information on the project, visit:

https://shelter-project.com/

Other relevant sources:

https://shelter-project.com/openlab/4/serra-do-xures-natural-park-in-galicia/

6.3.5. Female military trained by the UNESCO in protecting cultural heritage

Female military trained by the UNESCO in protecting cultural heritage	Type: Behavioural – Training and capacity building	**Main hazard(s):** armed conflict
Location: Beirut, Lebanon **Biogeographical region:** Mediterranean Lead(s): UNESCO This initiative led by UNESCO looked at securing the protection of cultural heritage in areas where armed conflict is still prevalent, while at the same time integrating a gender perspective in cultural heritage resilience. 40 female members of the armed forces of Lebanon, Iraq and Jordan (as well as female peacekeepers from the United Nations Interim Force in Lebanon [UNIFIL]) were brought together in Beirut to discuss how to advance women's participation in cultural heritage protection in face of an armed conflict event. The training took place as a workshop from the 1st to the 3rd of October 2019. Participants visited a UNESCO World Heritage site in Tyre, where they reviewed on-the-ground scenarios of securing and protecting a cultural site and artefacts. The training course provided a platform for both international and local experts and female officers to deliberate on the protection of cultural heritage in the course of military operations.		**For more information on this initiative, visit:** https://whc.unesco.org/en/news/2047 Other relevant sources: https://unifil.unmissions.org/unifil-female-peacekeepers-join-military-officers-region-protecting-cultural-heritage

6.4. **Biological-related hazards**

6.4.1. **Coping with deterioration of mineral materials: BioDAM**

Coping with deterioration of mineral materials: BioDAM	**Type:** Technological – Treatment measures	 **Main hazard(s):** biological

Location: Scotland, Spain and Germany
Biogeographical region: Various
Lead(s): ICBM

BioDAM aims to safeguard movable and immovable cultural heritage from biological hazards such as biofilms (layers of microorganism that are aesthetic and can cause degradation of the stone). Traditional biocides used against biofilms impact negatively the environment and other organisms, among them humans. BioDAM was in charge of searching more environmentally friendly methods to face this issue. The main goals of this project were: 1. Identifying the damage potential of biofilms (Physical damage, Chemical damage, Aesthetic damage) 2. Finding ways to inhibit biofilms 3. Keeping mineral surfaces clean for extended time periods.

Several treatments were tested (against bacteria, fungi and algae commonly found in deteriorated stone materials) in the laboratory and in the field (Scotland, Spain and Germany) on different substrates like sandstone and lime stone. The results showed that the combination of biocides with permeabilizers and photodynamic treatments is a very useful conservation tool, enabling a considerable reduction of applications of poisonous chemical compounds.

For more information on BioDAM, visit:

http://www1.biogema.de/biodam/htdocs/index.php?choosenmenu=objective&choosenlang=EN

Other relevant sources:

http://www1.biogema.de/biodam/htdocs/download/BIODAM_Ex._Sum_Website.pdf

6.5. **Stressors**

6.5.1. **Education for cultural heritage protection: the Autumn School of Architecture 2019**

Education for cultural heritage protection: the Autumn School of Architecture 2019	**Type:** Behavioural – Training and capacity building	 **Main stressor(s):** Lack of awareness on cultural heritage values

Location: BanskáŠtiavnica (Slovakia)
Biogeographical region: Pannonian
Lead(s): Faculty of Architecture, Slovak Technical University in Bratislava

The main goal of this activity is to give additional education to students in order to participate in research, protection and presentation of cultural heritage (departments of history, archiving, art history, architecture, archaeology, restoration and geodesy) and at the same time raise the awareness of the citizens about cultural sites with a relevant historic value. Part of the workshop is dedicated to the presentation of results - in the form of presentations and an exhibition of posters destined to a professional public. This is complemented with a cultural program (professional lectures, excursions, etc.). These workshops are held in cooperation with ICOMOS Slovakia.

For more information on the initiative, visit:

https://www.fa.stuba.sk/sk/dianie-na-fakulte/aktuality/jesenna-univerzita-architektury-2019.html?page_id=6955

Other relevant sources:

https://www.fa.stuba.sk/sk/dianie-na-fakulte/aktuality/jesenna-univerzita-architektury-2019.html?page_id=6955

6.5.2. Involving youth in World heritage conservation: an educational kit

Involving youth in World Heritage conservation: an educational kit	**Type:** Behavioural – Training and capacity building	**Main stressor(s):**Lack of awareness on cultural heritage values

Location: Slovakia
Biogeographical region: various locations
Lead(s): Foundation for Cultural Heritage Preservation in Slovakia, Slovak National Commission for UNESCO (in Slovakia)

Developed in 1998, the World Heritage in Young Hands Educational Resource Kit for secondary school teachers is one of the main tools of the UNESCO World Heritage Education Programme. The kit is an attempt to incorporate world heritage in the school curricula. It is based on creative and participatory methods of teaching, involving students in aspects such as data collection and analysis, role-plays and simulation exercises, information and communication technologies and field trips.

Currently the World Heritage in Young Hands Kit exists in 38 national languages, including versions with two interactive DVD versions of the Kit in English and French.

Kits can be downloaded here:

https://whc.unesco.org/en/educationkit/#downloadkit

The kit is part of the UNESCO World Heritage Education Programme initiated in 1994. Learn more about it here:

https://whc.unesco.org/en/wheducation/

6.5.3. Making forgotten heritage visible: CierneDiery

Making forgotten heritage visible: CierneDiery	**Type:** Behavioural – Awareness raising and communication	**Main stressor(s):** Lack of awareness on cultural heritage values

Location: Slovakia
Biogeographical region: Pannonian
Lead(s): ČierneDiery

The association ČierneDiery aims to popularise the forgotten monuments and sites of (not only) industrial architecture (19th-20th century) in Slovakia by enthusing the general public for the history of factories, mines and lost settlements. It documents places that may not be able to be experienced by the generations yet to come. In addition to articles and photographs, they create artistic graphic sheets (illustrations), magazines and books in cooperation with Slovak designers and artists.

The project was included in the Forbes 30 ranking under 30, won the National Design Award for series of Maps of Technical Monuments. The Graphics were exhibited in the Council of the European Union building in Brussels during the EU Slovak Presidency in 2016 and recently in SOGA art auction house. Profit gained from the selling of the art is further invested to the publication activities, preservation and saving of the endangered monuments.

For more information, visit:

https://www.ciernediery.sk/

Other relevant sources:

https://spectator.sme.sk/c/20454499/new-map-shows-industrial-past-of-bratislava.html

6.5.4. Case study 7: Adopting cultural heritage monuments and buildings: an initiative from Pirkanmaa Museum

CASE STUDY 7: Adopting cultural heritage monuments and buildings: an initiative from Pirkanmaa Museum	**Type:** Behavioural – Capacity building and training	**Main stressor(s):** Lack of awareness on cultural heritage values, lack of capacity or economic resources at administrative level

Location: Pirkanmaa, Finland
Biogeographical typology: Boreal
Lead(s): Pirkanmaa Museum

Background: Regarding cultural heritage, Finland faces several challenges that are common in other European states and cities, among which the misuse and neglect of existing cultural sites is one of the most important ones (for instance, changes in agricultural policies and land-use have resulted in the misuse and removal of traditional rural buildings and structures. Moreover, some cultural sites are unknown to the public, or present difficult access, which translates into lower public interest towards them. Altogether, the neglect of cultural sites and the decreasing interest of citizens results in a loss of identity of local communities.

Case description: The 'Adopt a Monument' scheme was conceived by the Pirkanmaa Museum to help communities become actively involved in the conservation and interpretation of their local archaeological and cultural heritage sites. It is based on the training and involvement of volunteers ("adopters") in aspects such as the monitoring, maintenance and promotion of a cultural asset of their choice, which may correspond to any site with historic or aesthetic value (e.g. an archaeological site, a traditional farm or other type of historic building). The initiative is led by the Museum, which provides the necessary training to volunteers through meetings, technical support, shadowing opportunities or workshops, and is supported by landowners, local communities, schools, associations and private companies.

The initiative, which originated elsewhere in the City of Tampere, has been adopted across the country by different museums. Once the museum assesses that a monument is suitable for adoption, a management plan is developed (including a description of the site, its natural surrounding and historical background, and detailed maintenance instructions) and an agreement is signed between the owner, the museum and the adopters (including suitable uses of the site, safety issues and Contact info).The adoption can be long- or short-term. Maintenance actions may include the trimming or removal of vegetation, litter picking, painting or simple restoration actions (among others) and the organisation of voluntary work events by the adopters' can also be considered a programme activity. On its origin, the project received a grant of €30,000 from the Finish National Heritage Agency, to conserve and maintain archaeological sites. After that, between 2014 and 2016, the Ministry of Cultural Dedication granted the project with €90,000 to also include built heritage. Nowadays, the Adopt a Monument programme runs as part of the regular duties of the museum, with permanent staff allocated.

Main outcomes and highlights

- Currently, 6 regional museums are part of the Adopt a Monument initiative. The number of adopted sites in the whole of Finland is 48, with more than 3,000 volunteers involved.
- Over 12 years in operation, not a single adoption contract has been cancelled. The programme has fostered the understanding, assimilation and acceptance of Finnish culture while promoting social inclusion and tolerance towards other cultures.
- The activities that volunteers perform help to give more visibility and accessibility to monuments that had in some cases been left vacant for years.
- The initiative contributes to strengthening elements such as well-being, public health and social inclusion within the benefited communities

- The initiative has won awards including the European Heritage Awards/Europa Nostra Awards in 2016, Finland Annual Award in Museum Pedagogy in 2015 and the Finish Green Year Medal and Recognition Award.

Factors of success

- The project is based on soft measures, which are not linked to restrictive regulation and allow for flexibility, which makes people more open to collaborate.
- The proposed activities are very attractive because they save money to public actors thanks to the voluntary labour, solving in that way capacity issues in the city administration.
- The idea of this project has its origin in Scotland, "Adopt a Monument" running there since 2007. Tampere was able to replicate and adapt the idea and methodology according to the Finnish needs, using 'softer' protective guidelines.

Lessons learned

- Throughout the development of the initiative, it was observed that searching for suitable adopter groups first and then looking for a site to adopt was more efficient than doing it in the opposite way, which requires more time and persuasion.
- At the beginning there was a top-down approach with the museum adopting a "do-gooder" role, with not much space for flexibility. This view was changed and the organisers adopted a listening and facilitating role, respecting people´s different need and wishes.
- By allowing volunteers to have some flexibility and ownership regarding methods and rules, the Museum contributed to build trust among them, which translated into more effective commitment.

Contact info:

Tuija-LiisaSoininen
tuija-liisa.soininen@tampere.fi

Relevant sources:

- https://adoptoimonumentti.fi/?lang=en
- https://www.coe.int/en/web/culture-and-heritage/-/adopt-a-monument
- Interview with Tuija-LiisaSoininen, Project manager at the Pirkanmaa Regional Museum

6.5.6. **Volunteer camps for heritage conservation in France: the Union Rempart**

Volunteer camps for heritage conservation in France: the Union Rempart	**Type:** Behavioural – Training and capacity building	**Main stressor(s):** Lack of capacity or resources at administrative level, lack of awareness on cultural heritage values

Location: France (different sites across National Territory)
Biogeographical region: Atlantic, continental, alpine and Mediterranean
Lead(s): local REMPART member association and local partners

The Union Rempart, founded in 1966, is a union of heritage protection and community education associations whose role is the restoration of monuments. The 180 associations in the Union all share a common aim: to restore and protect a heritage item and give it a new lease of life, contributing to local and regional development, particularly in rural areas. Most of them organise worksites for volunteers, enabling thousands to take part in voluntary-sector projects each year to protect and revitalise heritage

Some of the activities sustained by Rempart include: the sustainable restoration and preservation of buildings, education and training of volunteers, networking opportunities and funding support. Until today, the Union has led to the restoration of 800 heritage sites, collaborating with 50 partner organisations in 30 different countries. It is estimated that 3500 volunteers are involved in worksites every year.

For more information on the initiative, visit:

https://www.rempart.com/en/rempart/who-we-are/values/

The Union Rempart is featured in the Strategy 21 – Good practices section, along with many other initiatives seeking to preserve and restore cultural heritage assets.

Other relevant sources:

https://www.coe.int/en/web/culture-and-heritage/-/heritage-mission-international-volunteer-worksites-union-rempart

6.5.7. Applying traditional reconstruction methods in Medieval castles: CHAM

Applying traditional reconstruction methods in Medieval castles: CHAM	**Type:** Behavioural – Training and capacity building	**Main stressor(s):** lack of resources, lack of awareness

Location: France (different sites across National Territory)
Biogeographical region: Atlantic, continental, alpine
Lead(s): C.H.A.M - Chantiers Histoire& Architecture Mediévales

Chantiers Histoire & Architecture Mediévales (C.H.A.M) is a national non-profit association founded in 1980 whose mission is to promote the conservation and preservation of historical buildings through educational and volunteering activities involving voluntary worksites, summer schools, integration programmes, technical training courses and lectures. It trains volunteers in ancient arts such as traditional stonemasonry and bricklaying techniques while at the same time provides them an understanding of what are the mayor risks to cultural heritage assets.

C.H.A.M is approved by the Ministry of Culture, with national Youth and Popular Education certification and the endorsement of the Civic Service Agency. In 2018 it was awarded the European Year of Cultural Heritage seal of approval. It currently operates in more than 150 sites.

For more information on C.H.A.M, visit:

https://www.cham.asso.fr/les-chantiers-cham

C.H.A.M makes part of the Fondation Du Patrimoine, a French foundation currently supporting 1891 restoration and conservation projects in national and international locations. More information can be found here:

https://www.fondation-patrimoine.org/fondation-du-patrimoine/qui-sommes-nous

Other relevant sources:

https://www.coe.int/en/web/culture-and-heritage/-/promoting-an-active-commitment-to-heritage-mediaeval-history-and-architecture-worksites-chantiers-histoire-et-architecture-medievales-cham-

6.5.8. The Urban Heritage Observatory: neighbours managing cultural heritage

The Urban Heritage Observatory: neighbours managing cultural heritage	**Type:** Managerial – Governance Model	**Main stressor(s):**Lack of awareness on cultural heritage values, lack of capacity and resources at administrative levels

Location: Lyon, France
Biogeographical region: Continental
Lead(s): The City of Lyon

The Urban Heritage Observatory was set up in 2016 with the following main objectives: 1)To develop an observation as well as a decision-making tool based on qualitative and quantitative data to feed the management and evaluation processes that have been developed as part of the CH Management Plan of the City of Lyon, 2) To provide more visibility and coherence in the analysis of the situation on UNESCO-listed site allowing the definition and implementation of future appropriate sectorial urban planning policies and actions and 3) To develop an information base for decision making of urban planning stakeholders and exchanges with the public.

The Observatory is meant to be a living initiative, evolving with the public participation, flexible and not expert-oriented.
The focus group of ten people approx. will hold five meetings a year, allowing temporary guests to attend. New ideas, challenges and solutions will be analysed and integrated throughout the process, and precise actions are to be defined after each meeting. The monitoring will be carried out considering quantitative and qualitative parameters. An auto-evaluation tool will be also put in place.

The Focus Group on new usages that complements the traditional work of the Urban Observatory has been set up and coordinated as part of the H2020 ROCK project.

For more information on H2020 Rock Project:

https://rockproject.eu/

Other relevant sources:

http://nws.eurocities.eu/MediaShell/media/2019_ROCK_CaseStudies-Governance-Lyon.pdf

https://rockproject.eu/uploads/news/documents/RzEZphYEVjh0TreKEt9U6I2FB1KFEL6iHWD6gviX.pdf

6.5.9. Case study 8: The preservation of Tematín castle

CASE STUDY 8: The preservation of Tematín castle	**Type:** Managerial – Management plan	**Main stressor(s):**Lack of capacity and resources at administrative level, lack of awareness on cultural heritage values

Location: Trenčín Region, Middle Považie, Slovakia
Biogeographical region: Pannonian
Lead(s): OZ HradTematín

Slovakia is among the countries with the highest concentration of castles in Europe (Gúčik & Marciš, 2018), a total of almost 300, of whichwhich109 are listed as sites of National Cultural Heritage significance (Ižvolt & Smatanová, 2014). Since the beginning of the 20th Century, national castles have received attention from the tourism sector and later by the State as a means to preserve the country's character and boost local economy.

Despite the State's increasing efforts to conserve these castles, some of them are still in poor condition due to lack of maintenance, and lack of specialists experienced I nmedieval building techniques (Ižvolt & Smatanová, 2014). In the case of Tematín castle, these initial challenges were aggravated by the monument's reduced accessibility.

Case description: The Tematín castle is located at the top of the side ridge of PovažskýInovec hill and is one of the most remote castles of the country. Built around 1250, it used to guard the western borders of the Kingdom of Hungary, adopting the role of an important signalling point. The castle was greatly damaged in 1710 and remained unoccupied from 1726 onwards. Currently, it is mainly constituted by torsal architecture, subject to erosion caused by winds and freeze/thaw cycles.

The castle is protected since 2007 by OZ HradTematín, a local non-profit organisation led by MojmirChoma in collaboration with a core group of experts. The activities performed are greatly based on volunteer work. The pool of experts gathers regularly (mostly during weekends) in the castle to discuss conservation priorities and measures, which encompass masonry, carpentry works, general maintenance and monitoring of the conservation status; complemented with awareness-raising actions.

OZ HradTematín forms part of a network of 28 organisations known as Save the Castles, which benefit from a State-led initiative that promotes the inclusion of unemployed people in the protection of national heritage (Programme 1.4[34]). OZ HradTematínis in charge of employing staff from municipalities and villages nearby, whereas their salaries are covered by the Slovakia Ministry of Labour, Social Affairs and Family upon approval. Candidates are trained by Mojmir to undertake conservation work using traditional techniques, which helps them acquire technical and interpersonal skills that could be

[34]The Governmental **Programme 1.4**was launched in 2011 after being successfully implemented in three pilot projects, as a partnership between the Slovakia Ministry of Culture and the Slovakia Ministry of Labour, Social Affairs and Family. The programme was an attempt to promote local economy by attracting tourism and creating job opportunities, and by bringing communities closer to the conservation of their cultural heritage. The Ministry of Culture is responsible for expenditure related to material and technical support to the amount of approximately €800,000 in every year of the programme. The salaries of the workers are covered from the resources of the European Social Fund, with a total budget of €3,272,000for the three years of the programme's duration

applied in other contexts, increasing their employment chances. Additionally, OZ HradTematín is cooperating with the European Heritage Volunteers Project, which organises two-week training camps for young volunteers, mostly students or recent graduates that want to acquire new skills or develop a dissertation or thesis in the field. In exchange for their work, volunteers in Tematín castle are offered food and accommodation. Some of these volunteers, through their universities, help advance research on aspects such as the main drivers of the castle's degradation and associated risks, or the effectiveness of the applied restoration techniques.

Main outcomes and highlights

- OZ HradTematínhas managed to preserve the existing architecture against further damage, enabling safe conditions for visitors, since the beginning of its work in 2007. Special emphasis has been put on the perimeter walls, to minimise falling rocks.
- Since 2014, Oz HradTematín has employed 10 new people as part of the Programme 1.4.
- Since 2015, Oz HradTematín has been working on the restoration of the neglected Očkovská mound together with residents.
- All the work performed is assessed and approved by the Monuments Board of the Slovak Republic.

Factors of success

- A constant and committed core of volunteer experts has been essential.
- The integration of local unemployed people in OZ HradTematín's activities contributed to positively change local people's perception towards the initiative. The organisation has managed to connect local populations with the castle, which is now perceived as a key element of cultural identity. So far, up to ten new people have been hired to perform conservation work in Tematín castle.
- As OZ HradTematin has gained acceptance among the locals, some of them have suggested selling their products in the castle as a means to obtain funds for its conservation.

Lessons learned

- According to current legislation, the maintenance of National Cultural Heritage assets shall be provided by their owner. However, the process of restitution and 'de-nationalisation' of land and properties caused a situation in which many of the castles were not even listed in the Land Register, did not have a recognised owner, or were listed just as forestry lands. In practice this meant that no one had the responsibility to care for these monuments, but, at the same time, no one had the right to maintain the castles either. Currently, OZHradTematín is in the process of solving property issues.
- Since OZ HradTematín's interventions to improve the castle's condition, increased tourist numbers have started to become a conservation challenge as well. Currently, the NGO is in the process of establishing a tourism management process.

For more information, visit OZ HradTematín website: http://www.tematin.eu/

Contact info:

Mojmír Choma
+421 908 532 766

Relevant source(s):

- http://www.tematin.eu/
- https://www.hs-rm.de/fileadmin/persons/ckausxxx/European_Heritage_Volunteers_Programme_2019.pdf
- Interview with MojmarChomir, Head of OZ HradTematín

6.5.10. Promoting sustainable tourism in the Historical Centre of Florence

Promoting sustainable tourism in the Historical Centre of Florence	**Type:** Managerial – management pan	 **Main stressor(s):** lack of awareness on cultural heritage values, unsustainable tourism
Location: Florence, Italy **Biogeographical region:** Continental **Lead(s):** SiTI – IstitutoSuperiore sui SistemiTerritoriali per l'Innovazione **Description:** This project has a two-fold objective. On one side, it sought to identify alternative ways of managing tourist flows within the city in an attempt to relieve the most crowded places from mass-tourism undesired effects. On the other side, it aimed at improving and enhancing the value of underused areas. The project included aspects such as a supply-and-demand analysis and a Cartographic Touristic Offer Analysis via statistics and data analysis, field research (including a questionnaire), a communication products analysis and a GIS analysis. Main outputs were three updated guidelines for the protection, conservation and dissemination of heritage value. One of them was focusing on training to offer broader knowledge of the opportunities of the cities and different sites of interest. Another focused on communication to raise attractiveness of certain areas and another on valorisation to promote actions to make the tourism experience more engaging. The guidelines feed into a strategic plan for tourism use and effective management of tourism flows		**For more information on the Tourism management plan, visit:** http://www.firenzepatrimoniomondiale.it/destinazione-firenze/ **This initiative along with many others are featured in Interreg BhENEFIT Project, focusing on improving the management of historic built areas, combining the daily maintenance of historic heritage with its preservation and valorisation in a sustainable way.** **For more information on BhENEFIT, visit:** https://www.interreg-central.eu/Content.Node/BhENEFIT.html **Other relevant sources:** https://www.academia.edu/40197591/The_Management_Plan_of_the_Historic_Centre_of_Florence_UNESCO_World_Heritage_Site

6.6. **Findings**

Of the initiatives selected, there is a prevalence of those corresponding to Mediterranean regions, followed by continental and Atlantic regions, where Italy, Slovakia, France and Greece are the countries more represented in the current analysis. This may be linked to the fact that some of these countries (e.g. Italy, Spain, France or Greece) correspond to the regions with higher amount of cultural assets documented (including those registered in the UNESCO's World Heritage List[35]) among which Italy is number one in Europe. This inevitably reflects on the literature consulted, as well as on the European projects working on the topic (e.g. SHELTER, PROTHEGO, ROCK, RURITAGE, BhENEFIT). Another factor may be the geographical location of some of the partners involved in the identification of practices, who were asked to provide initiatives they are familiar with. Such could have been the case for Slovakia. Lastly, and even though there was an intention to ensure geographical balance during the initiative's selection process, those initiatives relatable to ARCH partner cities (e.g. by addressing similar threats) were prioritised – probably provoking a bias in the biogeographical regions covered, as some of these threats are linked to prevailing climatic conditions.

Most initiatives addressed correspond most closely to technological/technical measures, followed by managerial and behavioural processes and actions, with institutional measures among the least prevalent – although, in reality, some of these categories overlap (e.g. some managerial measures include technological/technical measures)-. Among the initiatives, there is a prevalence of those featuring management plans and strategies – which tend to cover all or many stages of the disaster risk management cycle-, structural measures and sensing and monitoring tools and methods – with a good deal of these last ones designed to evaluate and measure risk vulnerability to a hazardous event or disaster occurring, as well as to monitor its consequences over time – and training and capacity-building actions involving educational packages and volunteer coordination in restoration actions.

Institutional measures were intentionally left aside in the selection process, to be covered in more detail in Chapter 4. Nevertheless, it was considered necessary to illustrate some concrete examples in order to provide insights on their consolidation and potential outcomes (e.g. the process of advocating for a new World Heritage Site in Montana Rosia). The prevalence of managerial measures responds to the need to provide ARCH partner cities with methodologies and frameworks that cover all stages of the disaster risk management cycle and are well suited to be applied to urban settings and historical centres, which at the end, is a strong component of ARCH's scope of work. Whereas the high number of technological/technical measures could reflect the ample character of this category (covering a wide array of techniques) and the crescent amount of European-funded projects looking into tools and methods to assess risk, vulnerabilities and potential damages – as outlined in Chapter 5.

[35]The updated list can be consulted following this link: http://whc.unesco.org/en/list/search=&search_by_country=&type=&videos=&region=1&order=&order=year

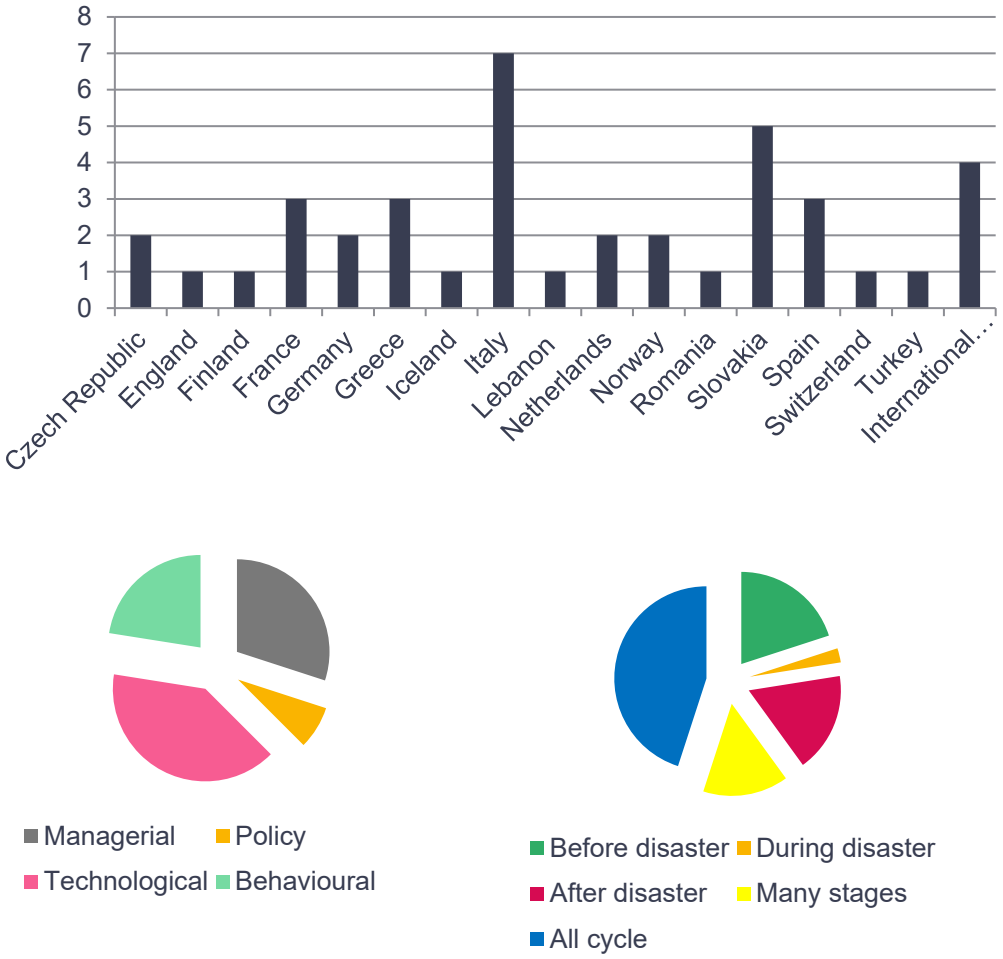

Fig 6: Overview of initiatives and case studies collected according country, type of initiative and phase of the disaster risk management cycle

Analysing the eight case studies developed as part of this task, we have identified patterns that have contributed to making them successful (enabling factors) as well as implementation challenges extracted from the lessons learned. In the following table (Table 5) there is an overview of the most recurrent ones.

	Implementation challenges	Enabling factors
Stakeholder engagement and citizen participation	- Cooperation models are often time and resource consuming, requiring great efforts of coordination and continuous communication. Not all municipalities (and especially, small municipalities) have enough resources allocated to warrant an effective cooperation model, and often rely on externals for this process.	- The involvement of different stakeholders in the decision making, planning and implementation of initiatives from an early stage, adopting a flexible approach that invites for participation and builds an atmosphere of trust, is essential to secure the commitment and motivation of those involved. Regular face-to-face meetings, dialogues and events help in the process. - Driving in external actors, such as local NGOs, institutions or civil associations is a way of gaining citizens' support in CH conservation actions, as well as to overcome capacity issues within the city administration. - A constant and committed core of volunteers and people interested in the topic can be essential for the long-standing implementation and maintenance of a project. - People tend to accept what they know and perceive as their own. Building new narratives on how cultural heritage is communicated to the citizens, highlighting aspects such as the cultural and social identity, is essential to drive citizens into conservation actions.
Funding resources	- Bureaucratic procedures to obtain funding from external sources is burdensome for municipalities (especially, for smaller ones). - Due to the lack of political-buy in, the conservation of cultural heritage does not receive adequate funding. - Projects and initiatives where financial resources are from multiple sources (national, regional, EU, etc.) can be organizationally demanding	- The use of financial incentives has proven to be instrumental to motivate municipalities in taking action, as it is the case of Norway municipalities drafting local heritage management plans incentivised by The Norwegian Directorate for Cultural heritage. - The mainstreaming of cultural heritage in other areas and sectors of the city administration (beyond the cultural) has helped securing financial resources for its conservation and management.
Documentation and baseline information	- Prior to any initiative, it is necessary to develop a good baseline. Cultural heritage assets are often not appropriately identified or mapped, or there is scarce information on their status and deterioration over time. Some of this information (e.g. old maps, registers) is not accessible for the municipality, or stored in different locations and its collection consumes time and effort. - Property issues emerge when managing privately or publicly the cultural assets – the situation is unclear, and documentation may have been lost over time.	- Historic cities have a long history of adapting to natural and human-made hazards. Their history should be perceived as a source of knowledge, and some practices from the past should be considered in contemporary urban planning and management.
Political buy-in and mainstreaming	- In some cases, cultural heritage is perceived as a burden, which requires a great deal of economic resources to be taken care of. This is in part because CH is still perceived as an aesthetic good, whereas other benefits (e.g. social cohesion, well-being) tend to be overlooked. Moreover, it is in some cases considered as a hindrance for urban regeneration.	- Cultural heritage receives more attention in policy agendas when it is perceived as a tool to achieve results in other fields beyond conservation. For instance, in the Netherlands, cultural heritage in the form of maps and documentations has proven to be a tool for better adaptation to flooding in current cities.

	Implementation challenges	Enabling factors
Capacity	- Cultural heritage conservation has been traditionally siloed, being the competence of a single department within the city administration. This has led to problems such as lack of adequate financial and technical resources, or simply lack of time to undertake large-scale projects. - The approach towards adaptation varies enormously among different municipalities. In some cases, different departments are already cooperating closely, but most of the cases remain working independently. - Access to specialists in traditional techniques can be difficult, as they sometimes are scarce.	- Cultural heritage conservation greatly benefits from a transdisciplinary approach. This is especially relevant in terms of ensuring CH resilience, where experts from the fields of CCA and DRM should be trained on CH management, and experts in the field of CH should be trained on CCA and DRM. - Educational packages and training programmes delivered by cultural institutions and organisations – at school or adult level- have contributed to build capacity in the relevance of cultural heritage, and traditional methods. - Volunteer camps and programmes that are trained in traditional methods of cultural heritage reconstruction (i.e. masonry) have contributed to safeguard intangible heritage.

Table 5: Overview of main implementation challenges and corresponding enabling factors identified in the case study analysis

6.7. **Relevance for the ARCH cities**

The City baseline reports (D3.3) conducted by ARCH partner cities as part of WP3 provide an overview of main demographic and socio-economic trends of the municipal areas, as well as main hazards affecting local cultural assets, vulnerable areas and groups of population, national, regional and local frameworks influencing CH protection, main tools and methodologies put in place to advance cultural heritage resilience-building efforts; and gaps and needs for strengthening local cultural heritage's resilience, among others.Driving from the results of such reports, the following table (Table.6) proposes initiatives and case studies that could offer some added value in ARCH cities' efforts to advance their actions in safeguarding their cultural heritage, as they specifically address shared challenges and hazards, and present some tools and methodologies that would be worth exploring in further knowledge exchange processes (i.e. the Tier-2 Cities Learning exchange). This table is only meant to be used as a suggestion, and further exploration should be undertaken to evaluate the suitability of the initiatives mentioned here for the ARCH cities scope of work.

ARCH city	Target CH assets	Description	Challenges identified	Main local hazards				Initiatives/case studies suggested	Points of interest	Reference
				Climate-related	Geological-related	Human-induced	Other			
Bratislava	**Old Town City Borough**	Historical centre of Bratislava, pedestrian zone surrounded by medieval fortification walls (under reconstruction)	Becomes increasingly crowded during the day due to the affluence of commuters. Especially vulnerable to climate change due to the high population density, high concentration of impervious surfaces, cultural heritage sites and underground monuments vulnerable to pluvial flooding. Lack of greenery.	Extreme precipitation, wind, extreme heat	Mass movements	Pollution	Biological (pests and plagues, fungal action)	Case Study 1: City of Regensburg Integrated heritage management planning	The co-creation of an integrated World Heritage Management Plan that safeguards the historic value of the city, while promoting urban development. Similar hazards encountered.	6.1.5
								Case Study 6: Mikulov Urban Conservation Area	Action plans and ICT technologies o increase the cooperation among stakeholders involved in sustainable management of Historic Built Areas	6.2.6
	Devin City Borough	Rural area of quick growth located between the Danube river and the Davinska Koyla Natural Reserve, contains Devin Castle, one of the most visited castles in Bratislava and a National Cultural Monument	The castle is experiencing rockfalls due to erosion of cliffs and castle walls, especially vulnerable to climatological hazards, due to inadequate reconstruction materials, caves and chambers prone to flooding and ineffective indoor air-drying systems					Case Study 8: The preservation of Tematín Castle	Traditional conservation techniques to safeguard a castle prone to wind erosion and rockfalls (while creating job opportunities)	6.5.8
								Flood protection measures for the historic centres of Cesky Krumlov and Prague	A combination of green and grey infrastructure to protect historical centres from flooding	6.1.7
								Climate for culture	Methodology for risk assessment based on climate change and outdoor and indoor damage simulations in historic buildings	6.1.2

Camerino	**The Ducal Palace** **Santa Maria in via Church**	It is one of the notable buildings by the Varano family, nowadays hosting the local university. It shows a combination of architectonic styles from the 13th to 15th centuries Emblematic church that has incorporated different architectonic elements over time and has suffered the consequences of consecutive earthquakes	Both case studies form part of Camerino Old Town. There is a high density of CH monuments embedded in irregular and compact medieval streets, which makes the area especially vulnerable to seismic activity, common in the region. The 2016 earthquake had devastating consequences in buildings and population, some of which had to be relocated. Most of the buildings were not reconstructed following seismic standards. The City of Camerino is interested in mapping risk areas, and making the information accessible to the public.	Extreme precipitation, storm surges	Mass movements, earthquakes			Case Study 5: Appignano del Tronto - How to react after a disaster? Assessing seismic risk in Pompeii Reconstruction of the Emilia-Romagna Region after mayor earthquakes Hyperion integrated resilience approach in the Municipality of Tønsberg	Creation of an earthquake-proof model of development through the effective and adaptive use of cultural and natural Heritage. Development of a monitoring mechanism of geological-related hazards and potential damages in cultural heritage Elaboration of a participatory plan for the reconstruction of damaged areas after an earthquake Development of an integrated resilience assessment platform to cope with mass-movements	6.2.5 6.2.1 6.2.4 6.2.9

Hamburg	**Speicherstadt**	A former warehouse complex of the port of Hamburg, part of the newly developed HafenCity district since 2008 bordering on Hamburg city centre. It is the largest port warehouses complex in Europe, containing 15 warehouse blocks.	Built by the River Elbe and in close contact with water, the complex may be especially vulnerable to sea-level rise and is affected by severe storms and flooding in the winter period, which can also affect the Kontorhaus district. Wet dry cycles are also a problem for the building materials. The City of Hamburg plans to work on monitoring the deterioration of materials over time, especially with regards to the masonry, the foundations, and facades to identify proper refurbishment mechanisms.	Extreme precipitation, sea-level rise, storm surges, extreme temperatures (heat), flooding			Biological (pests and plagues, fungal action)	Assessing risk at Mellor Heritage Project	Methodology based on sensors to monitor environmental parameters as well as deterioration processes in the cultural assets, including the development of risk maps and definition of effective treatment techniques. Focus on extreme cold, precipitation and wind	6.1.1
								PRESIOUS: simulating erosion on cultural heritage collections	Development of tools for the estimation and prediction of monument degradation due to extreme temperatures and pollution	6.1.4
	Kontorhaus district	A cohesive, densely built area featuring eight very large office complexes that were built from the 1920s to the 1950s to house and businesses engaged in port-related activities. Early modernist brick-clad architecture.						Monitoring natural and human-induced driven deterioration in Koules fortification	high-detailed analysis and monitoring of climatic conditions, human-induced pollution, material composition and the source of weathering features	6.3.2
								Inhibitors of biofilm damage on mineral materials (BioDAM)	Testing of treatments against bio-deterioration of stone materials	6.4.1

Valencia	**La Huerta**	An agricultural landscape that extends beyond the municipal boundaries, which is irrigated by a medieval system of Islamic origin. Such system is governed by the Water Tribunal, declared Intangible Heritage of Humanity. La Huerta has been declared "Historical, cultural, natural and agricultural heritage of Valencian people"	The urban growth and industrial development have considerably reduced La Huerta's area.	Extreme precipitation, storm surges, extreme temperatures (heat), sea-level rise, wave action, flooding		Pollution	Biological (pests and plagues, bacterial action)	Case Study 5: Appignano del Tronto - How to react after a disaster?	Establishment of a new model of development involving very diverse stakeholders through a series of dialogues, meetings and working sessions to reach consensus	6.2.5
								Complete restoration of the Oka River's Upper Estuary	Green infrastructure and strong awareness-raising activities to restore degraded areas and build resilience against sea-level rise, while safeguarding a highly valuable ecological and cultural landscape	6.3.1
								Preventing fire risks at Serra de Xurés Natural Park	Prevention and recovery actions against wildfires in a Natural park with high historical value, with strong collaboration from diverse local stakeholders	6.3.4
								RoșiaMontană Mining Landscape	Collaboration with strategic stakeholders to safeguard cultural landscapes against industrial development	6.5.9

	La Albufera	A combination of agricultural areas and natural areas protected under the Ramsar convention and designated Natura 2000 site. It has an outstanding ecological value, and also results especially valuable in terms of cultural value as the agricultural areas have remained relatively unaltered over time, presenting rare species of local rice.	Due to its unique characteristics, La Albufera is subject to conflict of interests regarding land-use and management. Las Naves are trying to come up with an effective governance and regulatory framework able to ensure effective management and minimise conflicts.					

Table 6: Table connecting ARCH partner cities with initiatives that could be of their interest, attending to aspects such as shared challenges, hazards or tools and methodologies needed

7. Replicability assessment and analysis

This chapter outlines the results of the replicability assessment and analysis of the eight case studies.

7.1. What is replication and why 'replicate'?

According to **ICLEI Europe**, and based on relevant work in various projects, replication can be understood as:

"Copying the specific features of a sustainable urban development approach that made it successful in a pilot setting and re-applying these in the same or another setting, taking into account that the framework conditions could be quite different from those in the piloted community or region. Replication may also encompass the management process that was used in the pilot scheme or the cooperation structure between critical stakeholders."

7.1.1. Definitions of replication and replicability

Different definitions of replication and replicability exist, for example:

The **World Health Organization**[36] defines replication as *"to implement new, innovative or good practices in other, more or less independent organizations and settings."*

The **Pacific Integrated Water Resource Management Programme** defines it as *"The activity of copying the specific features of a water resource or wastewater management approach that made it successful in one setting and re-applying these as part of an Integrated Water Resource Management process in the same or another setting."*

The EU Smart Cities Information System[37] defines replicability as *"the possibility of transporting or 'copying' results from a pilot case to other geographical areas, albeit with potentially different boundary conditions. In other words, if a pilot was proven to work in one community or region, it could be exported to other communities or regions (indigenously or abroad), but taking into account that the boundary conditions could be quite different from those in the piloted community or region. Replication may also encompass the management process that was used in the pilot scheme or the cooperation structure between critical stakeholders."*[38]

The debate about replication and replicability, and how effective such a process can be, is complicated by the fact that there is still no firm consensus on how exactly to define the terms used in this debate [87] [88] [89]. What is clear is that 'replicability' and 'replication' are related,

[36] https://www.euprevent.eu/wp-content/uploads/2016/09/Scaling-up-reports-projects-concepts-practice.pdf

[37] https://smartcities-infosystem.eu/sites/default/files/document/the_making_of_a_smart_city_-_replication_and_scale_up_of_innovation_across_europe.pdf

[38] https://smartcities-infosystem.eu/sites/default/files/document/the_making_of_a_smart_city_-_replication_and_scale_up_of_innovation_across_europe.pdf

but refer to different concepts: a replication is an actual attempt to reproduce an earlier finding/experiment (or the outcome of such an attempt), whereas 'replicability' is a quality of an experiment/observation or a scientific finding. Importantly, replicability is often also turned into a norm, i.e. the assumption that a finding or experiment should be replicable in order to be reliable. Scientists and other commentators have identified a variety of replication types over the years. Two types that have come to dominate the discussion are 'direct' and 'conceptual' replications.

Both terms have received somewhat differing definitions and there is in particular no consensus on what 'direct' means in the context of replication. However, there are some key features that many authors seem to agree on, namely 1) that in a direct replication the same experimental protocol should be applied to the same kind of materials (for instance, individuals taken from the population originally studied, or the antibodies or cell lines used in the original experiment) and 2) that such an experiment should give an outcome that is the same or at least similar to that originally obtained. A 'conceptual' replication, on the other hand, is often defined as an attempt to see an effect in the same direction as that originally reported using a different experimental protocol and/or material. This type of replication is often linked by commentators to the goal of generalizing a finding or of testing its robustness, rather than assessing its reliability [87]. Some have suggested that such experiments should therefore be labelled as 'extensions' rather than 'replications' [90].

For the purpose of our study, we consider replication to be: assessing and evaluating the specific features of initiatives, projects and other activities with regard to approaches followed, methods used and lessons learnt, which made each case successful in a pilot setting and re-applying these in a different contexts, taking into account that the framework conditions could be very different from those in the piloted case.

The cities that have implemented successful activities have learnt a lot in the process and their learnings should be passed on to other cities facing similar challenges and working on similar goals. Successful replicability depends on the following two inherent qualifications:

- The landscape circumstances in the city/region looking to replicate
- The characteristics of the process, the specific measures and the qualities of the technology to be replicated

Replicator cities can benefit from replication by transferring successful initiatives to their context, rather than reinventing the wheel each time; especially when lacking proved record of achievement or experience on a topic or sector. They can learn from and avoid mistakes, gain easily political support for solutions that have not been tested locally and avoid investing in unsuccessful experiments.

7.1.2. **Results of replicability assessment and analysis**

The eight case studies were assessed and analysed using a rating system that accompanies the Replicability Assessment Criteria. A summary of the ratings each of the case studies received is included in Annex 3 of this report. Key findings are briefly described below.

Almost all case studies were rated very high when it comes to cross-sectoral collaboration and integration of various departments in the development and implementation processes. In the cases of Mikulov and Regensburg in particular, aside from a large involvement of municipal departments in the development of the integrated management plans, diverse stakeholders were invited to participate and collaborate in the elaboration process, including non-governmental groups within the city. In addition, regional level stakeholders as well as the regional government were integrated in both cases.

All case studies, aside from *Case Study 2 –Patios de la Axerquía Urban Regeneration and Social Innovation in a Heritage Context*, were rated high when it comes to community involvement and participation. In the case of the programme 'Cultural history to inform the climate stress test' the low rating can be attributed to the awareness-raising goal of the initiative; citizen awareness and engagement is key for effective conservation of cultural heritage. The programme aimed at strengthening awareness about the importance of cultural heritage, but did not actively involve stakeholders in the methodological process required to integrate antique maps into current models, which can be seen as a shortcoming.

It was difficult to rate the case studies based on their direct climate change mitigation benefits, as inadequate information was obtained due to the limitation of the set of questions used for the interviews. In the case of long-term sustainability of the interventions, in some cases it was difficult to rate the initiatives; this was another limitation of the set of questions used, but also because many of the initiatives featured in the case studies were quite recent; therefore, long-lasting effects are not yet demonstrable.

Many case studies were rated high when it comes to affordability (*Case studies: 4 –Local history knowledge to inform the climate stress test* and *5 - Appignano del Tronto – How to react after a disaster*) and to feasibility (*Case studies: 3 - Local heritage plans strengthening local competence and capacity through planning, 4 –Local history knowledge to inform the climate stress test, 5- Appignano del Tronto – How to react after a disaster*).In the case of affordability, this concerns initiatives involving management plans that received funding from multiple sources (municipal funding, EU project funding streams etc.), therefore it was feasible to design and publish the management plan without making compromises and at minimal cost for the city, but also involving many stakeholders. This is of course only referring to the cost of the management plan itself, and not the actions and activities that are defined therein.

Feasibility is considered also high in similar cases, especially in the case that awareness raising campaigns and programmes are developed as support to the initiative. Cities tend to support high-level, easy to implement and positive buzz receiving initiatives, especially when they follow the transferability of a good practice (*Case study 8 - The preservation of Tematín castle*).

Finally, all case studies received a very high rating when it comes to social acceptance, apart from the case of Mikulov (Case study 6); in this case, it needs to be highlighted that there were limitations when conducting the interview. However, while social acceptance may be relatively lower than other case studies, the co-benefits of the initiative are high for the city and region

(environmental benefits, awareness raising on the importance of cultural heritage, and an economic boost).

For more detailed information on the exact scoring for each initiative please refer to Annex 3
The following lessons learnt could be extracted from this analysis;

7.2. **A framework to assess replicability**

Each city that would be interested to replicate and transfer an initiative or parts of it in their local specific context should consider the following lessons learnt, outcomes of the replicability assessment and analysis and of a thorough look into the design and implementation details of each case study. The following lessons learnt are grouped per topic.

Knowledge transfer: there are definite knowledge transfer mechanisms that have been proven quite effective in different settings; these include multi-stakeholder workshops, and co-creation or co-design meetings that involve citizens in public participation processes. Important for an effective knowledge transfer process is the creation of a common understanding of what can be replicated and transferred on cultural heritage resilience from city to city or region to region and how this would actually improve the overall, long-term resilience of the area.

Community and stakeholder engagement: key aspects identified as critical for a successful replicability process include amongst others the involvement of stakeholders in early stages of planning, the development of internal capacity building processes, the adoption of innovative ways to initiate projects, and the transparent communication to citizens about the goals and measures implemented. But, how can a city and its representatives ensure the replication process encourages followers to stay committed? Evidence is still needed to support this activity as the direct benefits of a successful replicability process, but also its underlying conditions are context, sector and conditions specific.

Stakeholders involved in a replicability process should represent multiple sectors, disciplines, and related areas of expertise. The city should consider including representatives from neighbouring cities, regional bodies, and higher levels of government. Also, it is important to engage with less obvious stakeholder groups, in example, gender and youth and organisations, indigenous and local communities and their organisations, professional associations, as they all have much to contribute to local resilience and city planning and subsequent action no cultural heritage preservation.

Importance of community commitment and political support: Internal and external variables are able to influence a replicability process. Political, technical, financial and social challenges need most of the times to be overcome during the assessment and planning phase of implementation.

Importance of visibility: a project or initiative that brings the necessary buzz and publicity to the city is always welcome by politicians, stakeholders and citizens.

Importance to align with other processes and plans: Clear frameworks and strategic documents can solve problems of complexity and confusion in which cities are tending to be

stuck. Additionally, the interview and desk research results have shown that complex situations in some cases combined with chronic stresses or other simultaneous hazards cannot be solved by implementing simple or narrow technical solutions. Also, cities that are more advanced when it comes to resilience planning may have be faced with competing strategies; therefore, they would need to identify which plans are those that can incorporate effectively cultural heritage and urban resilience considerations.

Direct climate change mitigation benefits are always very crucial for the success of a replicability process; the potential for significant CO2 reductions, but also, as an add-up, co-benefits through strengthening public investment management, and policy reforms may maximize the replicability potential of an initiative or project. Important here is to note that there are context specific variations in the control of local air pollutants and in the proved evidence for economy-wide benefits from climate change mitigation (Hamilton et al, 2017**).**

For projects that would require a Public-Private Partnership to be introduced and implemented, which means that they would be fully or partially relying on availability payment schemes, an affordability analysis before deciding upon pursuing a replicability process is needed.

Flexibility is important for resilient systems in general; good practices that are flexible enough, are able to enable and allow for re-organizing and integrating existing context/ specific practices, plans and strategies under one guiding principle for resilience planning processes while systemizing work, boosting efficiency and providing a multitude of positive outcomes[39].

To summarize, after assessing the replication potential of an initiative or action, and taking the decision to replicate, **the replicator city should consider**:

1) if there is enough political support, which can go beyond traditional political cycles;
2) if there is adequate support from the public, combined with enhanced citizen engagement;
3) if the city has the necessary financial means to enable a successful process, but also to make sure that the project will receive proper implementation requirements and maintenance;
4) if there are enough enabling, location specific factors, such as composition of the city, natural landscape, geographical position, climatic conditions; and finally
5) if the city has the necessary skills and knowledge within the implementing team.

The European Commission has devoted substantial efforts to fostering scale-up and replication of innovation in European cities[40]. The analysis around replication and replicability that has been provided in this report aims to provoke and support ongoing discussion around the topic that may result in the replication of innovative solutions and practices from cities in

[39] https://www.din.de/blob/297796/8e4862e244910feb6d12d620a2b87211/cwa-17300-standards-series-flyer-data.pdf
[40] https://www.eusew.eu/scale-and-replication-smart-cities-what-lies-beyond-buzz

the upcoming years which will enhance the resilience of cultural heritage sites and not only; aiming always at creating a sustainable and resilient vision for European cities.

8. Conclusion and recommendations for further work

8.1. Recap of objectives and limitations

In this report, we identified and mapped existing initiatives of relevance to building the resilience of places of cultural heritage significance, with a focus on Europe. This report serves to advance the ARCH project team's knowledge of existing relevant initiatives, as well as to provide people working in city administrations in European cities and regions (especially in the areas of climate adaptation, disaster risk reduction and cultural heritage management) with a source of guidance and inspiration. Of the 40 initiatives identified through desktop research and presented here, we profiled eight of these in greater detail, supplemented with data from interviews with individuals involved first-hand. These eight case studies were also evaluated for their suitability to be replicated in (or transferred to) another context. This evaluation is intended to be a reference and starting point for cities wishing to undertake similar actions in the fields of cultural heritage management, disaster risk management and climate change adaptation, primarily in a European context. It sets a preliminary basis for future, more in-depth discussion and exploration of replicability.

Prior to identifying initiatives for review, a framework for mapping the 'landscape' of cultural heritage resilience in practice was developed. Our framework is composed of 1) key hazards and stressors and2) the three stages of the DRM cycle, and 3) the type of intervention (technological/technical, managerial, or institutional).Our aim was to collect a broad range of initiatives spanning these various dimensions. In addition, we defined a series of seven performance criteria to assess each initiative, using these to select from our 'long-list' of initiatives those to profile in greater detail.

In order to assess those factors that could be easily transferable to other contexts, we defined a second set of eleven criteria, driving from the experience collected throughout other projects exploring the topic of replicability (GrowSmarter, proGIreg, Replicate). We rated the eight case studies featured in this report, to find out which could host higher potential for replicability when looking at aspects such as their feasibility, affordability, community and stakeholder engagement.

The framework and criteria defined here to structure our mapping and analysis is itself a key output of this study, as it can be used as a basis for further work in WP7, in particular the structure of the planned data and information platform. The 40 initiatives profiled here can serve as an input to the resilience options library to be developed in WP6. Of the mapped initiatives, a preliminary selection has been made, identifying those likely to be of most interest to the ARCH partner cities Bratislava, Camerino, Hamburg and Valencia. This may inform future local actions to be supported as part of WP3, as well as fostering future exchange with cities external to the project.

Nevertheless, our study points to certain limitations, as follows:

- The ARCH cities' baseline reports provided insightful details on the hazards faced, type of local heritage, needs and gaps to advance their resilience. Nevertheless, they were still under-development during the first stages of Task 7.2. Therefore, they could not be used to inform the selection process, which would have been more valuable for ARCH cities at the end. It would have contributed to define questions for more targeted interviews and to extract key information – that would then be used to conduct a more detailed replicability assessment.

- Capacity constraints limited the amount of people allocated to the definition of the criteria and the rating of initiatives for selection of case studies, and secondly, for the replicability assessment. This task would have benefitted from the participation of ARCH partner cities, as this would have probably contributed to the selection of criteria designed to obtain the information that could most suit their needs.

- The language barrier hindered the compilation of information in some of the cases, and as a consequence, there are some oscillations in the amount and quality of the information provided. However, informational gaps have been saved through later consultation and desk research.

- Intangible heritage has been neglected, yet it is a fundamental component of the "urban culture", as it contributes to define a sense of identity as much or even more than tangible assets. This sense of identity is essential to build communities' resilience. Due to the character of ARCH's work, priority was given to measures focusing on buildings, infrastructures and other cultural assets.

8.2. **Recommendations for further work**

- The replicability assessment and analysis will be used within the ARCH project in order to further engage with the group of a second tier of cities, which have been contacted during proposal development-. At the time of writing, the group of cities had yet to be confirmed, but may include cities contacted at the time the proposal was developed: i.e. Alba, Zadar, Glasgow, Warsaw, Salerno, Amman, Thessaloniki and Sydney. These cities will get the chance be the first ones to make use of the replicability assessment criteria, and will also consider if some of the case studies and initiatives included in this report will be useful and applicable in their own city context. This analysis will be revisited, during the first workshop with the tier 2 cities; all these cities will be asked to provide their feedback on the criteria.

- The present deliverable will be used to further identify cities to join the tier 2 group, based on expression of interest from their side, but also potential linkage to the ARCH partner cities when it comes to common climatic hazards or similarities in cultural heritage and resilience related processes; i.e. the city of Regensburg that was featured as one of the case studies in this document has already expressed interest to join the group. Other cities that may show potential for replication of the ARCH outcomes will be considered to be included in the tier 2 cities group.

- Tier 2 cities may also act as ambassadors of the ARCH project in their countries. Each city will be encouraged to organise an online seminar on the results and lessons learnt from the project and their experience in implementing the ARCH results themselves.

- Ongoing replicability and transferability work and considerations may be keeping the tier 2 cities further engaged. This can be done via regular exchange, e.g. online seminars and training events focusing on specific aspects i.e. the resilience assessment framework or the establishment of the ARCH Hub. The ARCH partners will consider describing the case studies and good practices in a common format and let users of the ARCH Hub to interactively “assess their replicability”.

- The replicability assessment criteria may be also used from cities outside the ARCH consortium and project, in order to assess their own initiatives and projects and evaluate the potential to transfer them to other parts of the city, or in other local/regional contexts.

- The replication criteria were defined with a focus on positive qualities of the case studies profiled to consider for transferability. Further work could look at the conditions that made these positive outcomes possible.
- Further work on replicability could also look more explicitly at city-to-city transfer, which would demand a much closer analysis of context-specific conditions that support uptake. This was beyond the scope of the current analysis.

9. Annexes

9.1. **Annex 1 – Overview of initiatives and case studies considered in the current analysis**

Reference and name of initiative	Country	Biogeographical region	Type of initiative	DRM Cycle stage	DRM Cycle step	Project
6.1.1: Assessing risk for the Mellor Heritage Project	England	Atlantic	Technological/technical - Sensing and monitoring tools and methods	Before disaster	Risk assessment	STORM
6.1.2: Climate for Culture's decision support tool	Many locations	Many regions	Technological/technical - Models and simulations	Before disaster	Risk assessment	CLIMATE FOR CULTURE
6.1.3: A guidance on risk management for collections	The Netherlands	Atlantic	Managerial - Guidance document	All cycle	All Steps	Shared Heritage
6.1.4: PRESIOUS: Simulating the effects of erosion on Cultural Heritage Monuments	Many locations	Many regions	Technological /technical - Models and simulations	Before and after disaster	Risk assessment and risk prevention and mitigation, damage assessment, treatment	PRESIOUS
6.1.7: Flood protection measures for the historic centres of Cesky Krumlov and Prague	Czech Republic	Continental	Technological/technical - Structural measures	Before and during disaster	Risk prevention and mitigation	BASE
6.1.8: Refurbishment of the International Maritime Museum in Hamburg	Germany	Atlantic	Technological/technical - Structural measures	After disaster	Treatment	Co2olbricks
6.1.9: Pro Monumenta: preventive maintenance of immovable cultural monuments in Slovakia	Slovakia	Pannonian	Managerial - Maintenance framework	Before and after disaster	Risk assessment, risk prevention and mitigation, damage assessment, treatment	ProMonumenta
6.1.12: Flood protection in the Venetian Lagoon: Modulo SperimentaleElettromeccanico (MOSE)	Italy	Continental	Technological/technical - Structural measures	Before and during disaster	Risk prevention and mitigation	MOSE

6.1.13: IG-WRDRR: An International Group working on Wind-related Disaster Risk Reduction (IG-WRDRR)	Switzerland	Continental	Institutional-Networking and knowledge transfer	All cycle	All steps	N/A
6.1.14: Monitoring deterioration processes in the Palace of Knossos	Greece	Mediterranean	Technological/technical - Sensing and monitoring tools and methods	Before disaster	Risk assessment	HERACLES
6.2.1: Assessing seismic risk in Pompeii	Italy	Mediterranean	Technological/technical - Sensing and monitoring tools and methods	Before disaster	Risk assessment	PROTHEGO
6.2.2: Building capacity to cope with Earthquakes: CERHER	Italy	Mediterranean	Institutional - Networking and knowledge transfer	Before, during and after disaster	All steps	N/A
6.2.3: Building resilience to cope with Earthquakes: Istanbul Seismic Risk Mitigation and Emergency Preparedness Project	Turkey	Mediterranean	Managerial - Management plan or strategy	Before, during and after disaster	All steps	Istanbul Seismic Risk Mitigation and Emergency Preparedness Project
6.2.4: Reconstruction of the Emilia-Romagna Region after mayor earthquakes	Italy	Mediterranean	Managerial - Governance model	Before, during and after disaster	All steps	BhENEFIT
6.2.7: Preventing landslides in the Umbria Region	Italy	Mediterranean	Technological/technical - Models and simulations	Before disaster	Risk assessment	N/A
6.2.8: Structural measures to prevent rockfalls in Delphi	Greece	Mediterranean	Technological/technical - Structural measures	Before, during and after disaster	All steps	UNESCO World Heritage Sites
6.2.9: HYPERION integrated resilience approach in Tønsberg	Norway	Boreal	Technological/technical - Sensing and monitoring tools and methods	Before, during and after disaster	Risk prevention and mitigation, preparedness response, recovery and rehabilitation	HYPERION
6.2.10: PROTHEGO: monitoring European Cultural Heritage at risk of volcanic eruptions	Many locations	Many regions	Technological/technical - sensing and monitoring tools and methods	Before disaster	Risk assessment	PROTHEGO
6.2.11: Turning risks into opportunities: Katla Geopark	Iceland	Artic	Behavioural - Awareness raising and communication	Before, during and after disaster	All steps	RURITAGE

6.3.1: Complete restoration of the Oka River's upper estuary	Spain	Atlantic	Technological/technical - Structural measures	Before and after disaster	Risk prevention and mitigation and recovery and rehabilitation	UNESCO's Biosphere Reserves,
6.3.2: Monitoring natural and human-induced driven deterioration in Koules Fortification	Greece	Mediterranean	Technological/technical - Sensing and monitoring tools and methods	Before disaster	Risk assessment	HERACLES
6.3.3: RoșiaMontană mobilises against industrial mining	Romania	Many regions	Institutional - Advocacy action	Before disaster	Risk prevention and mitigation	Cultura Nostra
6.3.4: Preventing fire risks at the Serra de Xurés Natural Park	Spain	Atlantic	Technological/technical - Structural measures	Before, during and after disaster	Risk prevention and mitigation, preparedness response, recovery and rehabilitation	SHELTER
6.3.5: Female military trained by the UNESCO in protecting cultural heritage	Lebanon	Mediterranean	Behavioural - Training and capacity building	During disaster	Preparedness response	N/A
6.4.1: Coping with deterioration of mineral materials: BioDAM	Various locations	Many regions	Technological/technical - treatment techniques	After disaster	Treatment	BioDAM
6.5.1: Education for cultural heritage protection: the Autumn School of Architecture 2019	Slovakia	Pannonian	Behavioural – Training and capacity building	Before, during and after disaster	All steps	N/A
6.5.2: Involving youth in World Heritage conservation: an educational kit	Slovakia	Pannonian	Behavioural – Training and capacity building	Before, during and after disaster	All steps	N/A
6.5.3: Making forgotten heritage visible: CierneDiery	Slovakia	Pannonian	Behavioural - Awareness raising and communication	Before, during and after disaster	All steps	CiernyDieri
6.5.6: Volunteer camps for heritage conservation in France: the Union Rempart	France	Many regions	Behavioural – Training and capacity building	After disaster	Treatment, recovery and rehabilitation	N/A
6.5.7: Applying traditional reconstruction methods in Medieval castles: CHAM	France	Many regions	Behavioural – Training and capacity building	After disaster	Treatment, recovery and rehabilitation	N/A
6.5.8: The Urban Heritage Observatory: neighbours managing cultural heritage	France	Continental	Managerial – Governance Model	Before, during and after disaster	All steps	ROCK
6.5.10:Promoting sustainable tourism in the Historical Centre of Florence	Italy	Continental	Managerial - Management plan or strategy	Before, during and after disaster	All steps	N/A

Reference and name of case study	Country	Biogeographical region	Type of initiative	DRM Cycle stage	DRM Cycle step	Project
6.1.5: CASE STUDY 1: City of Regensburg Integrated heritage management planning	Germany	Continental	Managerial - Management plan or strategy	Before, during and after disaster	All steps	URBACT
6.1.6: CASE STUDY 2: Patios de la Axerquía – Regenerating historical courtyards through social innovation	Spain	Mediterranean	Managerial - Governance model	After disaster	Recovery and rehabilitation	N/A
6.1. 10: CASE STUDY 3: Local heritage plans strengthening local competence and capacity through planning	Norway	Many regions	Managerial - Management plan or strategy	Before, during and after disaster	All steps	N/A
6.1.11: CASE STUDY 4: Local historical knowledge to inform climate stress tests in the Netherlands	The Netherlands	Atlantic	Behavioural – training and capacity building	Before, during and after disaster	All steps	N/A
6.2.5: CASE STUDY 5: Appignano del Tronto – How to react after a disaster	Italy	Continental	Managerial – management plan or strategy	Before, during and after disaster	All steps	RURITAGE
6.2.6: CASE STUDY 6: Mikulov Urban Conservation Area	Czech republic	Continental	Managerial - management plan or strategy	Before, during and after disaster	All steps	INTERREG CENTRAL EUROPE STRENCH
6.5.4: CASE STUDY 7: Adopting cultural heritage monuments and buildings: an initiative from Pirkanmaa Museum	Finland	Boreal	Behavioural - Capacity building and training	After disaster	Treatment	N/A
6.5.9: CASE STUDY 8: The Preservation of Tematín castle	Slovakia	Pannonian	Managerial - Management plan or strategy	Before and after disaster	Risk prevention and mitigation, treatment, recovery and rehabilitation	N/A

9.2. Annex 2 - Questionnaire for the conduction of semi-structured interviews

Guidance to conduct semi-structured interviews

Suggested format: GoToWebinar. Do not forget to mention beforehand that the interview will be recorded. Approx. time: 40-60 minutes. You can use the template to take notes. You can share it in advance with the interviewee if they ask for it.

Please inform the interviewee of the following points:

- *The information collected will serve to draft one of the eight case studies that will be highlighted in ARCH deliverable 7.2 "Mapping and characterization of experiences and good practices on cultural heritage resilience"*
- *The project will not publish any information without consent of its providers, including partners internal and external to the project. Do we have your permission to include your Contact info with the case study? Do we have your permission to share your data among project partners for future research purposes, or in case some information is missing?*
- *Your identity will be anonymised if you wish so.*
- *You have the right to review, edit, and clarify issues raised during interviews if you wish so. We will share with you a draft version of the case study before publishing it, for your approval.*

Contact info	
Name	
Role	
City/Organisation	
Department	
Contact info	

1- Personal information

a. What is your area of expertise?

b. Do you consider your work linked to:
   - cultural heritage □
   - urban resilience □
   - adaptation to climate change □
   - To more than one of these topics □

c. What did motivate you (and when) to become involved with issues around urban resilience and/or cultural heritage in the city you live in?

d. How did you get involved in this case study?

e. Do you live in the city of the case study? (If the answer is NO, please ask the following) Would you consider that you would be more engaged/attached to the activities within this case study, if you lived in the city?

2- General information about the case study and the city - the urban context

a. Are you aware of any local/regional or national frameworks/policies/strategies for the protection and preservation of local cultural heritage?

b. Do you consider that there is the necessary capacity, technical and financial support allocated to cultural heritage projects within the city administration? Why?

c. Is specifically the funding that is allocated to the resilience (or preservation or protection) of cultural heritage adequate in your opinion? Is this funding local or is there a top-down distribution from national to local level? More specifically, on funding; has your city ever funded integrated resilience and adaptation actions? Also potentially, combining climate mitigation?

d. If so, which kind of financial tool did you implement and did you achieve the goal

e. If not, do you have any financing tools you can apply and why did not/could not you use them?

f. Are you aware of any public or private instrument that acts to fund resilience/adaptation/mitigation actions? Indicate the most relevant ones.

g. What are the main hazards (environmental, geological and human-induced) affecting (severely or continuously) cultural heritage in your area?

h. Would you say that there is increased awareness among the municipality and/or the population about issues related to cultural heritage and how it can be affected from climate change? Which were the issues with the most significant progress towards protection of cultural heritage in the previous 5 years?

i. Who are the local actors, which have already gained the reputation for promoting this kind of solutions?

3- The case study

a. Is the case study part of a broader project or initiative? Can you briefly describe it? Which was the leading organisation and what are the major partners?

b. What is/are the type of the assets addressed? (i.e. Moveable heritage, archaeological resources, buildings and structures, cultural landscapes, natural heritage, associated and traditional communities, intangible heritage).

c. What are the main achievements? (in terms of benefits to local heritage resilience, but also indicate highlights, awards and recognitions)

d. Besides the protection or restoration of cultural heritage, can you think of any co-benefits brought by this case study? (I.e. community involvement, social inclusion, improvement of air quality, effective maintenance of public spaces, community empowerment, reclaiming of public space etc.)?

e. International standards distinguish five levels of public participation: Inform, Consult, Involve, Collaborate, and Empower. How far is the public already involved in the co-design (potentially), but also the implementation of the case study?

f. How would you rate the community involvement from 1 (very low, the implementation of measures was mostly top-down) to 5 (very high, the measures were implemented following a bottom-up approach, many actors were involved from different backgrounds)?

g. How would you also rate the social acceptance around the case study (incl. the design and implementation process) from 1 (very low acceptance) to 3 (Neutral) to 5 (wide/catholic acceptance)?

h. What do you consider the main factors of success (those elements that really helped making this case study successful)?

i. Have you identified any specific barriers during the design, but also the implementation process? What kind of barriers were these (financial, technical, institutional, political, socio-cultural, spatial, etc.) What would you do differently if you had the chance?

4- Transferability of case study

a. Do you believe that good practices related to this case study could be transferred to other cities or regions? Are there similarities or common processes identified with other cities that could support this?

b. Which aspect, process or part of the initiative could be transferred effectively? What could work out well and what not?

c. Each solution applied to a city consists of a combination of measures and processes, adapted to the need of the specific city and affected by many factors, for example, simple financial considerations, number of users, climatic conditions and stakeholder

engagement and uptake. What would be the key requirements to replicate experiences in other cities?

d. Has this model/measure already been transferred to other sites of the city or other cities?

9.3. Annex 3 –Replicability assessment ratings for each of the case study analysed

CASE STUDY		1 – City of Regensburg Integrated heritage management planning				
CRITERION		SCORING				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	4	Not sufficient information for rating	3	Not sufficient information for rating
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	5	4	5	5	5
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	3	3	3	2	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	4	4	Not sufficient information for rating	5	Not sufficient information for rating
5	Sustainability *What is the initiative's viability over time, when it comes to*	Not sufficient informatio	3	Not sufficient informatio	Not sufficient informatio	Not sufficient informatio

	implementation of goals, organizational stability and long-term benefits?	n for rating		n for rating	n for rating	n for rating
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	4	3	3	4	4
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient information for rating	1	Not sufficient information for rating	Not sufficient information for rating	Not sufficient information for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	5	5	5	5	5
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	4	3	3	3	3
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	5	4	5	5	5
11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the*	3	5	2	3	3

	city at national and international channels?					

CASE STUDY		**2 –Patios de la Axerquía – Regenerating historical courtyards through social innovation**				
CRITERION		**SCORING**				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	3	3	4	3
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	5	5	5	5
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	5	3	3	4	4
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	3	N/A	4	4	4
5	Sustainability *What is the initiative's viability over time, when*	Not sufficient informati	5	Not sufficient informati	2	Not sufficient informati

	it comes to implementation of goals, organizational stability and long-term benefits?	on for rating		on for rating		on for rating
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	2	2	1	2	2
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient informati on for rating	2	Not sufficient informati on for rating	Not sufficient informati on for rating	Not sufficient informati on for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	4	5	5	5	5
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	3	2	3	3	3
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	5	5	5	5	5
11	Visibility *Is this an initiative that will bring a lot of positive*	4	4	5	5	5

	buzz and visibility to the city at national and international channels?					

CASE STUDY		**3 –Local heritage plans strengthening local competence and capacity through planning**				
CRITERION		**SCORING**				
ARCH Partner		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	4	3	2	4	3
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	4	3	4	4
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	4	2	3	3	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	Not sufficient information for rating	5	Not sufficient information for rating	5	Not sufficient information for rating
5	Sustainability *What is the initiative's viability over time, when it comes to*	5	2	Not sufficient information for rating	Not sufficient information for rating	Not sufficient information for rating

	implementation of goals, organizational stability and long-term benefits?					
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	4	2	3	Not sufficient information for rating	4
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient information for rating	N/A	Not applicable	No sufficient information for rating	Not applicable
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	4	4	5	5	5
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	4	2	3	4	4
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	3	3	4	4	4
11	Visibility	3	3	2	4	3

	Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?					

CASE STUDY		**4 –Local historical knowledge to inform climate stress tests in the Netherlands**				
CRITERION		**SCORING**				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	2	2	4	1	1
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	5	5	5	5
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	4	5	3	2	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	2	3	4	4	4
5	Sustainability	Not sufficient informatio	5	5	No sufficient informatio	Not sufficient informatio

	What is the initiative's viability over time, when it comes to implementation of goals, organizational stability and long-term benefits?	n for rating			n for rating	n for rating
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	2	4	1	No sufficient information for rating	Not sufficient information for rating
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient information for rating	1	Not sufficient information for rating	No sufficient information for rating	Not sufficient information for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	2	3	3	2	1
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	2	2	2	2	2
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	Not sufficient information for rating	3	5	No sufficient information for rating	Not sufficient information for rating

11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?*	3	3	5	3	2

CASE STUDY		**5 – Appignano del Tronto – How to react after a disaster**				
CRITERION		**SCORING**				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	4	2	3	3
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	5	5	5	5
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	3	3	2	2	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	3	4	3	4	3

5	Sustainability *What is the initiative's viability over time, when it comes to implementation ofgoals, organizational stability and long-term benefits?*	Not sufficient informatio n for rating	2	Not sufficient informatio n for rating	Not sufficient informatio n for rating	Not sufficient informatio n for rating
6	Affordability *What are the costs for the transfer to your own city's context and the potentialimplementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	4	3	3	3	3
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient informatio n for rating	1	NONE	Not sufficient informatio n for rating	Not sufficient informatio n for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	4	5	5	5	5
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	4	3	3	3	4
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	4	4	4	4	3

11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?*	3	5	2	3	2

CASE STUDY		**6 – Mikulov Urban Conservation Area**				
CRITERION		**SCORING**				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	3	2	3	2
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	5	5	5	5
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	3	3	2	3	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	3	4	3	3	3

5	Sustainability *What is the initiative's viability over time, when it comes to implementation ofgoals, organizational stability and long-term benefits?*	Not sufficient informatio n for rating	2	Not sufficient informatio n for rating	3	Not sufficient informatio n for rating
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	3	1	1	3	2
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient informatio n for rating	1	NONE	1	Not sufficient informatio n for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	3	3	4	4	4
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	3	2	3	3	3
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	2	3	3	3	2

11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?*	3	3	2	3	2

CASE STUDY		**7 – Adopting cultural heritage monuments and buildings: an initiative from Pirkanmaa Museum**				
CRITERION		**SCORING**				
ARCH PARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	2	3	4	3
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	4	2	4	4	4
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	3	4	2	2	3
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	4	N/A	1	4	4
5	Sustainability	3	4	3	2	4

	What is the initiative's viability over time, when it comes to implementation of goals, organizational stability and long-term benefits?					
6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	5	5	4	5	5
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	3	N/A	Not applicable	Not applicable	Not applicable
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	3	3	3	5	4
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	4	4	3	4	4
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	3	3	2	4	3
11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the city at*	5	5	5	5	5

	national and international channels?					

CASE STUDY		**8 – The preservation of Tematín castle**				
CRITERION		**SCORING**				
ARCHPARTNER		A	B	C	D	E
1	Answer to local needs *Does the initiative respond to a specific need or challenge of the local community?*	3	2	3	2	2
2	Integration/cross-sectorial collaboration *Does the initiative promote the integration of various departments to the design and implementation phase? Does it promote and support cross-sectorial collaboration?*	3	3	3	3	3
3	Flexibility *Is it an initiative that can be easily adapted to changing circumstances (due to physical, institutional or governance changes)?*	2	2	2	3	2
4	Alignment with other policies *How possible is it to integrate the initiative into existing policies at local or regional level.*	3	N/A	3	3	3
5	Sustainability *What is the initiative's viability over time, when it comes to implementation ofgoals, organizational stability and long-term benefits?*	3	3	4	5	4

6	Affordability *What are the costs for the transfer to your own city's context and the potential implementation of the initiative (when it comes to upfront capital cost and/or future maintenance expenditure)?*	3	N/A	4	3	4
7	Potential for direct climate mitigation benefits *Does the initiative contribute to the city achieving climate targets for 2030/2050?*	Not sufficient information for rating	N/A	Not sufficient information for rating	1	Not sufficient information for rating
8	Community and stakeholder engagement *How involved are stakeholders from the quadruple helix (public, private, academic civil society) in the design and implementation of each initiative?*	5	4	5	5	5
9	Feasibility *How feasible is it to consider the transfer to your own city's context and the potential implementation of an initiative when it comes to availability of time and capacity, financial and other resources, market demand, as well as technical aspects?*	3	3	3	3	3
10	Social acceptance *To your knowledge, has the community embraced (or not) the initiative?*	2	3	3	3	2
11	Visibility *Is this an initiative that will bring a lot of positive buzz and visibility to the city at national and international channels?*	2	4	3	3	2

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