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Risk Management for Urban Heritage Sites

Report of the OWHC Workshop in Vilnius on Disaster Risk Management for natural hazards and in armed conflict environments

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Preface

Cities are constantly changing and subject to a wide variety of different challenges. This applies even more so to UNESCO World Heritage Cities, given their high density and the special value of heritage assets which is relevant for their outstanding universal value. Their urban management, future development and resilience aspects are prone to special challenges.

The recent Covid-19 pandemic, but also the war in Ukraine and the meta-challenge of climate change with its increasing impact on our daily lives have stimulated the idea to better connect the spheres of cultural heritage and Disaster Risk Management and Preparation. Following a tradition of successful trans-regional cooperation, the OWHC Regional Secretariat for Northwest Europe and North America (based in Regensburg/Germany) together with the Central and Eastern Europe Secretariat (based in Warsaw/Poland) took the initiative to develop a joint training workshop for (World) Heritage Site Managers and urban decision makers to learn and apply practical tools about Disaster Risk Management (DRM).

On the urban level, cultural heritage frequently is integrated into a DRM processes at a very late stage, if at all. Most often, the narration is that cultural heritage is an object and it only needs to be protected and preserved. It was the intention of this workshop to open up this notion and embrace also the qualities that (urban) cultural heritage has to contribute: for example, built heritage plays a major role when it comes to resilience and urban recovery. We also felt the strong need to expand Disaster Risk Preparedness and include the topic of “War” as another man-made disaster following the immanent suffering the war in Ukraine has caused in 2022.

This report shall enable Site Managers worldwide to benefit from the lessons learnt in the OWHC Workshop and expand their knowledge. We want to thank Gediminas Rutkauskas and Jurate Raugaliene from the Vilnius Old Town Renewal Agency for the great organisation and hosting and Luca Arbau and Elena Petsani from ICLEI Europe for their fantastic work in preparing and facilitating the workshop and the development of this report.

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How to use this document

This document is the outcome of the workshop “Heritage cities building resilience. Managing the risk of disasters in a changing world” and it is aimed at Heritage managers around the world (and particularly from Europe and North America) to collect inputs on how to mainstream disaster risk management in heritage management.

Readers will be guided through different sections to approach urban resilience from a very concrete and easy-to-understand perspective, focusing on historic areas. The experience from different EU-funded projects, and in particular from ARCH – Saving Cultural Heritage, have informed the development of the workshop, thus this document.

The report begins with the definition of key terms recurring throughout the narrative and needed to understand disaster risk management in a heritage context. In an introductory part, the setting of the workshop will be explained, including the work of its organisers, the need to address this specific topic in this specific moment, and a presentation of the ARCH project as a referent. An essential part of the report consists of a step-to-step guidance to integrate disaster risk management in the heritage managers’ everyday work. This section includes a checklist of actions to be taken within each step. In order to understand how the guidance applies in a real context, case studies on disaster risk reduction in 3 different cities are presented to highlight solutions in case of:

- A conflict situation
- An environment affected by earthquakes
- A context heavily affected by climate change

Following this section, the document will draw on some conclusions and way forward and will briefly present international initiatives that may be relevant for readers to support their work on resilience. Finally, managers are suggested some important readings to continue their learning experience in this sector.

Key terms

Before approaching this document, it is important that readers get familiar with the following terminologies and definitions:

- **Adaptation to climate change:** the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (*IPCC: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report*).
- **Climate Change:** refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (*IPCC: Annex III: Glossary [Planton, S. (ed.)]. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*).
- **Disaster:** a serious disruption of the functioning of society, causing widespread human, material or environmental losses, which exceed the ability of affected society to cope using

only its own resources (*United Nations International Strategy for Disaster Reduction: UNISDR Terminology on Disaster Risk Reduction. UNISDR, Geneva, Switzerland, 2009*).

We define disasters as climate-related if they result from climate events such as rainstorms, droughts, snowfall, river/sea or pluvial flooding, wildfires etc.

- **Disaster risk management:** is 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 (*United Nations International Strategy for Disaster Reduction: UNISDR Terminology on Disaster Risk Reduction. UNISDR, Geneva, Switzerland, 2009*).
- **Disaster risk reduction:** The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (*United Nations International Strategy for Disaster Reduction: UNISDR Terminology on Disaster Risk Reduction. UNISDR, Geneva, Switzerland, 2009*).
- **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 (*IPCC: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report*).
- **Hazard:** The potential occurrence of a natural or human induced physical event or trend, or physical impact, that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (*IPCC: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report*).
- **Historic area:** any groups of buildings, structures and open spaces including archaeological and palaeontological sites, constituting human settlements in an urban or rural environment, the cohesion and value of which, from the archaeological, architectural, prehistoric, historic, aesthetic or sociocultural point of view are recognized. Among these 'areas', which are very varied in nature, it is possible to distinguish the following 'in particular: prehistoric sites, historic towns, old urban quarters, villages and hamlets as well as homogeneous monumental groups, it being understood that the latter should as a rule be carefully preserved unchanged (*UNESCO: Recommendation Concerning the Safeguarding and Contemporary Role of Historic Areas. Nairobi, 1976*).
- **Preparedness:** the knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions (*United Nations International Strategy for Disaster Reduction: UNISDR Terminology on Disaster Risk Reduction. UNISDR, Geneva, Switzerland, 2009*).
- **Resilience:** The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (*United Nations Office for Disaster Risk Reduction: UNDRR Terminology*).
- **Resilience (of a historic area):** the sustained ability of a historic area as a social-ecological system (that includes institutional, social, cultural, physical, economic and environmental dimensions) to cope with hazardous events by responding and adapting in socially just ways

that maintain the historic area's functions and heritage significance (including identity, integrity, authenticity) (*ARCH project: ARCH Hub glossary*).

- **Resilience planning:** a holistic approach that takes into consideration future economic, social and environmental developments, including climate change (*ICLEI, 2019*).
- **Resilient development:** to anticipate, prevent, absorb and recover from shocks and stresses, in particular those brought about by rapid environmental, technological, social and demographic change, and to improve essential basic response structures and functions (*ICLEI: Montréal Commitment and Strategic Vision, 2018*).
- **Risk:** the potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing 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 (*IPCC: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report*).
- **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 (*IPCC: Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: Climate Change 2014: Synthesis Report*).

1. Introduction: the workshop

This document reports on the development and main outcomes of the workshop titled “Heritage cities building resilience. Managing the risk of disasters in a changing world”. The workshop is an initiative by the Northwest Europe and North America Secretariat and the Central and Eastern European Secretariat of the Organisation of the World Heritage Cities (OWHC), and it was organised together with ICLEI Europe and in collaboration with the city of Vilnius.

1.1 The organisers

The **Organisation of World Heritage Cities (OWHC)**

Founded on the 8th of September, 1993 in Fez, Morocco, the Organization of World Heritage Cities (OWHC) is a collaborative body that shares expertise on all issues related to the urban management of a World Heritage property. The OWHC interconnects more than 300 cities that incorporate sites inscribed on the UNESCO World Heritage List. Combined, these cities have a total population of over 164 million people. They are represented in the Organization by their mayor, with the active participation of elected municipal officials and heritage managers.

The primary objectives of the Organization are to facilitate the implementation of the World Heritage Convention, to encourage cooperation and the exchange of information and expertise on matters of conservation and management, as well as to develop a sense of solidarity among its member cities. To this end, the OWHC organizes World Congresses, conferences, seminars and workshops dealing with the challenges faced in the area of management and it provides strategies for the preservation and development of historic cities. Six Regional Secretariats support the work of the OWHC General Secretariat which is based in Québec/Canada.



Figure 1. Co-creation activities during the “Heritage cities building resilience” workshop

A Regional Secretariat represents the link between member cities of a given region and the General Secretariat and organizes activities in the region to publicize and share the values, goals, and objectives of the OWHC. In this report, you find the results of a cooperation of the Secretariats for Northwest Europe and North America AND Central and Eastern Europe.

Find all about the OWHC and its activities under www.ovpm.org

ICLEI Europe

ICLEI - Local Governments for Sustainability is a global network of more than 2500 local and regional governments committed to sustainable urban development. Active in 125+ countries, it aims to influence sustainability policy and drive local action for low emission, nature-based, equitable, resilient and circular development. Its members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability. In particular, ICLEI's European Secretariat provides its members in Europe, the Middle East and West Asia with a voice on the European and international stage, a platform to connect with peers and tools to drive positive environmental, economic and social change. ICLEI Europe works closely with an extended network of local and regional governments and partners on a broad range of topics, including urban resilience and climate change adaptation as well as culture and cultural heritage. Founded in 1990, ICLEI has a long history and strong experience in European and international projects development on the topics of resilience and adaptation, but also cultural heritage. Among others, ICLEI Europe has participated in EU-funded projects such as ARCH, Open Heritage, RURITAGE, RAMSES, RESIN, ROCK and Smart Mature Resilience. In particular, it has been one of the leading partners of the ARCH project, aiming to better preserve areas of cultural heritage from hazards and risks, where ICLEI Europe managed the co-design and co-creation activities (*more details below*).

You can find more information about ICLEI Europe at www.iclei-europe.org

Vilnius Old Town Renewal Agency

Revitalisation Strategy for Vilnius Historic city centre was developed by the group of international experts with the support of the World Bank. The Strategy foresees setting up of an Old Town Renewal Agency, to be founded by the Ministry of Culture and by Vilnius City Municipality. In 1998 the Agency was set up by the Municipality only in 1998. It continuously implements provisions and of the World Heritage Convention. Financed by Vilnius Municipality the Agency informs, consults and financially supports the local community on historic properties' maintenance issues, implements monitoring of World Heritage site and its' objects, promotes the WH site and its outstanding universal value through awareness-raising activities, Co-operates with EC, UNESCO WHC, OWHC and other organisations implementing regional, international projects.

Agency's priorities for 2019-2023: creation of open data base of research, projects and other related to history and maintenance of the WH site, youth awareness-raising, strengthening of public consultations and engagement into planning and maintenance processes, continuous financial support for heritage property owners, establishment of WH Research and Communication Centre in co-operation UNESCO WHC, OWHC and the Baltic Sea region partners.

1.2 The context: needs, target group and objectives

Cities around the world are living a crucial historical period when climate and other human induced risks are threatening urban development and the preservation of historic areas. While Russia's attack to Ukraine has brought back an instable conflict situation in Europe, climate change is undeniably challenging local governments. As of October 2022, more than 2.290 administrations in 39 countries around the world have declared a climate emergency, affecting over 1 billion citizens.

The increased frequency of flooding and heatwaves, but also the devastating effects of sea level rise, increased water acidity and humidity, as well as war, earthquakes and many other events is indeed changing the way historic cities can and should be managed. In addition, overlapping threats - in the same region at the same time – increases the complexity of the situation, making problem-solving a cross-sectoral issue that affects different components of the city, including infrastructural, social, environmental and economic aspects.

The most affected elements in this case are the most vulnerable: irrefutably, historic buildings suffer more than other constructions from the consequences of natural and men-made threats. Their construction techniques and materials were often conceived for an urban environment that is very different from ours (in terms of contamination, use of space, technological settings and facilities, etc) and for less extreme climate conditions. At the same time, in many cases, they were not thought to be exposed to intensive usage and touristic flows. If this makes historic sites particularly vulnerable to contemporary threats, their extraordinary management for conservation and preservation makes the transformational adaptation of these buildings a long and often unsuccessful process.

In this context, World Heritage cities' managers are key figures whose everyday work and understanding of historic areas represent a major asset for the design, development and monitoring of integrated strategies for the resilience of a heritage environment. At the same time, they often lack capacities to deal with natural - and other - threats. Raising awareness, increasing knowledge and providing enabling tools for climate change adaptation and urban resilience is key to better manage historic sites. In particular, informing about preparedness and disaster risk reduction enables a discussion on stakeholder engagement and inter-departmental collaboration that is fundamental to resilience building.

For these reasons, the 2 full-days' workshop "Heritage cities building resilience" presented a unique opportunity to explore the intersection between disaster risk management, urban resilience and heritage management. The in-depth training aimed to challenge heritage managers with disaster risk management concepts and methodologies, while discovering free online tools and exchange experiences from different parts of Europe and North America. The specific topics of discussion ranged from vulnerability assessment to risk preparedness and transformational resilient development, all with a historic area focus.

1.3 The ARCH project as a framework

Experts from ICLEI which co-organised the “Heritage cities building resilience” workshop decided to adopt the recently developed ARCH framework for disaster risk management in heritage context as a knowledge basis for the main activities and discussions. In fact, the ARCH project represents an important research innovation in Europe for concretely investigating the intersection between disaster risk management, climate change adaptation and heritage management. In this section, the ARCH project is presented to offer readers an overarching understanding of the methodologies and practices that brought to the development of some important tools on disaster risk management and resilience for heritage managers.

ARCH is a European-funded research project that run for 39 months from June 2019 to August 2022 and aimed to better preserve areas of cultural heritage from hazards and risks. The ARCH team with the cities of Bratislava (Slovakia), Camerino (Italy), Hamburg (Germany) and Valencia (Spain) co-created tools to help cities save cultural heritage from the effects of climate change and other natural hazards. The work with diverse European cities holding important heritage sites served to concretely test place-based solutions for preparedness and building back better.

ARCH developed a disaster risk management framework for assessing and improving the resilience of historic areas to climate change and natural hazards. Tools and methodologies were designed for local authorities and practitioners, the urban population, and national and international expert communities. The project presented various models, methods, tools and datasets to support decision-making. ARCH’s expert interdisciplinary team included the four above-mentioned European municipalities; research scientists, the city network ICLEI Europe and the standardisation organisation DIN. Importantly, in order to achieve the project’s objectives and ensure applicability, acceptance and replicability of results, researchers, city practitioners, local policy makers, community members and other stakeholders collaborated closely according to a co-creation framework and through the establishment of local partnerships.

The main output of the ARCH project is a coherent and unified Disaster Risk Management Framework ([accessible here](#)) for historic areas that takes climate change adaptation, heritage management, and social justice into account. The framework is synthesized in figure 01, which includes steps to increase local resilience in a historic area context both in normal operating and emergency phases (i.e. either before, during and after a disaster occurs).

In order to assess how well the disaster risk management framework is implemented, the project developed a web-based tool, the ARCH Resilience Assessment Dashboard (ARCH RAD – [accessible here](#)). The ARCH RAD enables end-users to perform thorough or quick resilience self-assessments for historic areas. The framework and RAD complement and build on the Ten Essentials for Making Cities Resilient, the Sendai action plan and the RAMSES Transition Handbook. Based on the Disaster Resilience Scorecard for Cities, they are tailored for historic areas and take into account chronic stresses from climate change, as well as acute shocks from natural hazards.

On the other hand, measures to build resilience are needed to respond to the results of the impact and risk assessment. For this, ARCH Resilience Measures Inventory (ARCH RMI – [accessible here](#)) provides end-users with access to harmonised information about resilience-building options. It enables end-users to identify suitable opportunities to increase resilience for heritage areas. Importantly, it provides a check-list for different stakeholders to ensure a multidisciplinary and historic area specific perspective is considered in local (climate) action.

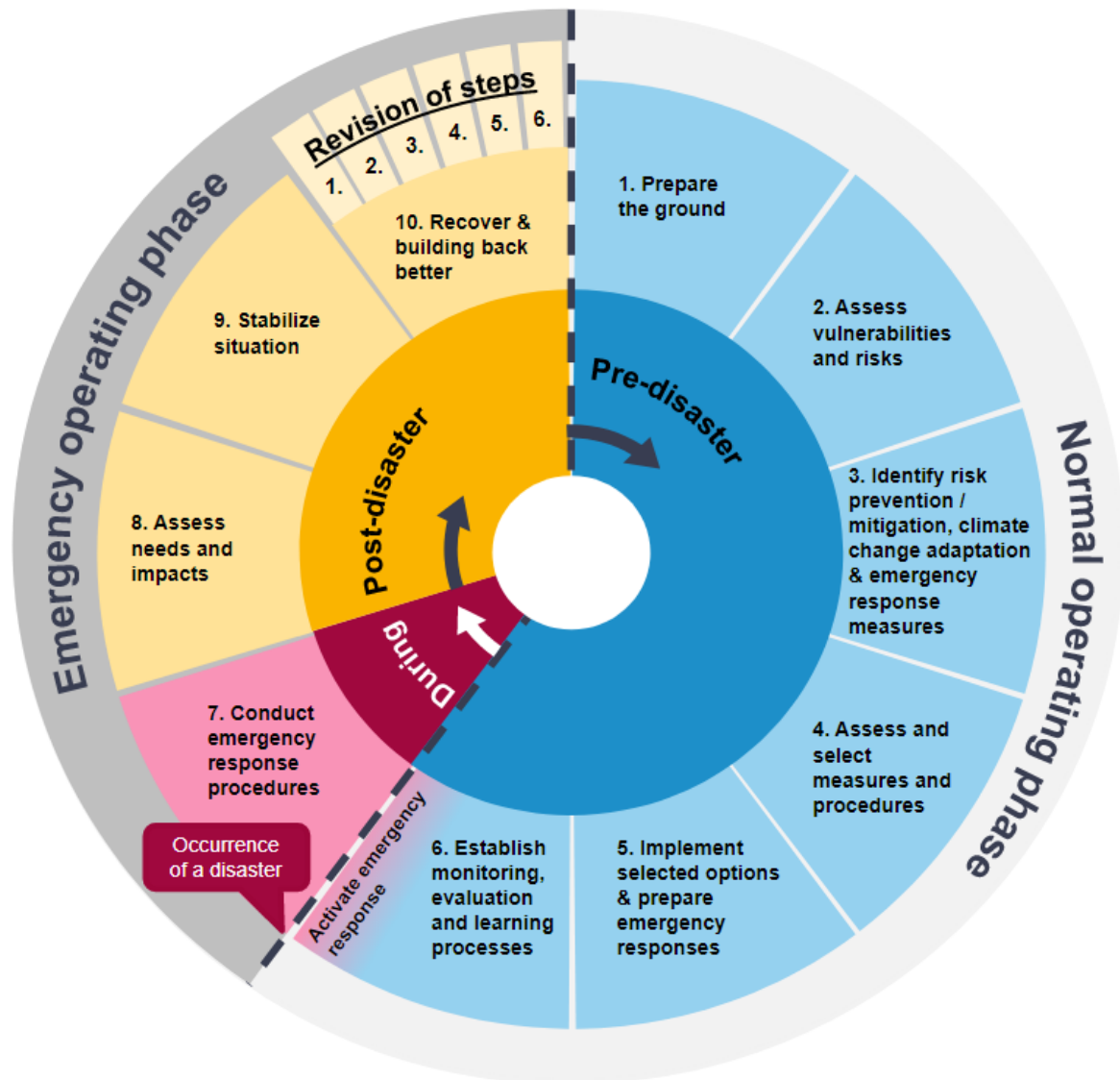


Figure 2. ARCH Disaster Risk Management Framework

More city-specific tools were created and used to systematise and elaborate local data, in order to support decision making and increase resilience.

The ARCH project has collected all tools developed, together with case studies and its disaster risk management framework in the so-called ARCH Hub ([accessible here](#)). This aims to be the resilience knowledge base to support practitioners from municipal administrations, service providers, policy makers, and other local and regional actors with resilience building at the cross section of disaster risk management, climate change adaptation, and heritage management.

Links to the main ARCH portals are reported here:

- ARCH project: www.savingculturalheritage.eu
- ARCH HUB: websites.fraunhofer.de/arch
- ARCH RAD: arch.iaais.fraunhofer.de
- ARCH RMI: rmi.savingculturalheritage.eu

2. A step-by-step guidance to integrate disaster risk management into heritage management

Based on the ARCH Disaster Risk Management Framework, this chapter offers a simplified step-by-step guidance to mainstream disaster risk management in the world heritage cities' managers daily work. As the aim of the workshop conducted and of this document is to kick-start a risk prevention and resilience-building process in World Heritage contexts, the following guidance will only focus on a normal operating phase, where ideally no disasters occur.

Step 01. Prepare the ground

In the case of a heritage manager, preparing the ground to disaster risk management means to understand why and how is resilience important to the specific historic context and kick-start coordination within a multi-disciplinary team in the municipality.

This step can be further explained by a series of subsequent points:

- First, it is needed **to identify a cross-sectoral resilience team** or office that works on the resilience building process and will be responsible for mainstreaming resilience into traditional community practices and communicating about resilience building activities to local stakeholders. The heritage manager should understand if a resilience office already exists in the city, and start liaising with it, or identify relevant people to be engaged.
- Then, **initial key information and data** need to be gathered in order to define the objectives and scope of the resilience building process. This includes information about the **community and historic area**, data about relevant climate change related and natural hazards, data on relevant aspects of sustainability, climate change adaptation and resilience, as well as information about available funding and personnel resources.
- After that, a **stakeholder mapping and analysis** needs to be performed. This shall result in an external communication and stakeholder engagement process that describes how and when to communicate with stakeholders on hazards and impacts, as well as how to involve them in the resilience-building process. The best outcomes for the resilience building process can often be achieved through a highly consultative, participatory and flexible approach. The engagement process should take advantage of the possibilities heritage management and cultural activities can provide for these activities due to their high value for the local community. In order to map and analyse relevant local stakeholders, the resilience team should answer the following questions:
 - Who holds important information needed to define the resilience of your historic area within and beyond the local administration (i.e. who needs to be involved in resilience planning and implementation?)?
 - Who is impacted by resilience policies aiming to adapt the historic area?
 - Who is vulnerable to disasters that may occur in the historic area?
- At this point, **objectives and scope of the resilience building process** need to be defined. This includes specifying which hazards will be examined, which parts of the historic area will be examined (either spatially or based on other considerations), which **stakeholders will be involved** to what extent, and what the overall **timing** of the process is. When developed as part of the whole city resilience building process, the role of the heritage manager is to

highlight the peculiarity and importance of the historic assets and/or area and define a specific scope for its adaptation, based on possible administrative and legal barriers.

- Based on the previous actions, and as an outcome of this first step, the resilience team will be able to undertake a **resilience baseline review**, to evaluate the initial situation of the community and historic area. This baseline review should be repeated at regular intervals by the cross-sectoral resilience team and can take the form of a quick resilience assessment (e.g. using the [ARCH Resilience Assessment Dashboard](#)). You can find an example of baseline review from 4 different historic cities [here](#).

CHECKLIST

Step 1 will be completed if...

- A cross-sectoral resilience team is created
- Key information and data are gathered
- Stakeholders mapping and analysis is performed
- Main aim and goals are defined
- A baseline review is undertaken

Step 02. Assess vulnerabilities and risks

The objectives of this step are to better understand the vulnerabilities and exposure of the community and historic area to different hazards and identify impacts from those hazards in order to:

- steer resilience building activities towards those parts of the community and historic areas that are most in need
- ensure the right resilience actions are taken and receive appropriate funding.

Within these steps, the following actions should be taken:

- First, it is needed to **select the (combination of) hazards** to be analysed, based on the initial information gathered in step 1. This should not only include existing (historic) hazards, but also future (expected) hazards, based on information from climate change scenarios. The heritage manager should highlight which hazards are most likely to affect historic assets and places.
- Then, a **vulnerability and risk analysis** needs to be conducted. This can be done through different approaches, and for example by using the [IVAVIA methodology](#). In any case, the vulnerability and risk analysis needs to cover:
 - the identification of the main **exposed elements**, including all those elements of the social-ecological system that constitute the historic area and the community
 - the identification of **sensitivities and capacities**, i.e. the factors of the community and historic area that increase or decrease the vulnerability
 - the identification of **impacts** resulting from the hazard (combination).

Note that, the resilience team can decide to undertake an initial rapid assessment to identify risks and vulnerabilities, which might cover fewer elements or use a less time consuming approach. If this way is chosen, the resilience team should plan to repeat the risk analysis process – in detailed

format – later. The role of the heritage manager in this case is to shade light on the most important (i.e. vulnerable) historic elements to be analysed first.

CHECKLIST

Step 2 will be completed if...

- the hazards to be analysed are selected
- a vulnerability and risk analysis is performed

Step 03. Identify measures

With this step, portfolio of risk prevention and mitigation, climate change adaptation and mitigation, emergency response, and rebuilding/recovery measures as well as strategies to lower the risk and increase the resilience of the community and historic area is built.

As part of this step:

- The resilience team needs to review and **analyse the results from the risk and vulnerability analysis** done in step 2. This must be done with a multi-disciplinary group of stakeholders, including local residents and building owners, non-government organisations, academic institutions, cultural associations, and local businesses, but also representatives from disproportionately affected stakeholder groups.
- A portfolio of **potential resilience measures** for the analysed context must be identified. Particularly important for historic areas is to ensure that the resilience team and the involved stakeholders take note of local, traditional practices, and knowledge systems when identifying potential resilience measures. There exist extensive databases for resilience measures (e.g. the [ARCH Resilience Measures Inventory](#)) that should be used when identifying measures. Importantly, the ARCH RMI can represent a checklist to be provided by heritage managers to other colleagues working on resilience to make sure all important aspects of the historic area are considered when drafting a resilience strategy. It must be highlighted that the RMI does not pretend to include detailed solutions for a specific context, but it is a general overview of measures that, according to specific resilience needs, can be adapted and applied to any historic environment by taking into consideration its peculiarities.
- When identifying potential resilience measures, the resilience team should also already try to identify **first ideas for suitable funding opportunities and financing measures**, including using public-private-partnerships.
- The final action to be taken in this step is to define a **criteria catalogue** that allows ranking and selecting resilience measures in step 4. These measures can include effectiveness, benefit-cost, potential co-benefits, long-term effect on the historic area (including enhancing the significance of historic areas), compatibility with heritage management practices, compliance with existing regulations and standards, long-lasting effects on the local communities, including the most vulnerable ones, and other measures.

CHECKLIST

Step 3 will be completed if...

- The risk and vulnerability analysis is analysed
- Potential resilience measures are identified
- Funding and financing opportunities are investigated
- A criteria catalogue is defined

Step 04. Assess and select measures

The aim of this step is to prioritise resilience measures that could be later implemented.

To this end:

- All identified measures (in step 3) must **assessed** according to the criteria catalogue defined. Then, they must be **classified and prioritised**, according to the individual community case. The selection and assessment process should include those stakeholders that will later also be involved in the implementation of the measures as well as local communities and other stakeholders affected by the measures, in particular those in vulnerable positions (e.g. through open consultation meetings and workshops). The assessment should also include barriers to implementation
- At the same time, the resilience team should also **analyse in detail the potential funding sources** that were mapped in step 1 and evaluated in step 3.

CHECKLIST

Step 4 will be completed if...

- Measures from step 3 are assessed, classified and prioritised
- Funding sources are analysed in detail

Step 05. Implement measures

In this step, a resilience action plan is drafted and set in motion.

The following actions must be implemented within this step:

- The resilience team defines a **resilience action plan** by identifying **which** resilience measures will be implemented, **who** is responsible, and what the **timing** for implementation is. The plan must include a **prioritization for implementation** of different measures, taking into account special needs of disproportionately affected population groups as identified and mapped in step 2.
- **Available resources** (i.e. funding and personnel) are allocated to the activities planned in order to ensure their feasibility.
- When the resilience action plan is completed, the measures need to be **openly communicated to the local community and stakeholders** affected by them, using appropriate and different communication channels (e.g. stakeholder workshops, leaflets, school visits, social media, podcasts, ...).

- The resilience team should include community groups (especially nearby the historic area), businesses, NGOs, the responsible units for the historic area, regulators on national/EU/international level (e.g. UNESCO) and emergency response teams from neighbouring cities/regions in the **implementation of resilience measures**. Stakeholders can be organised in subgroups for different actions.

CHECKLIST

Step 5 will be completed if...

- A resilience action plan is defined and funded
- The scope and actions within the plan are communicated to stakeholders
- Stakeholders are involved in implementation

Step 06. Establish monitoring, evaluation, and learning processes

As a last but not least important step, the resilience team needs to establish a process for monitoring and evaluating the implementation progress for the measures from the resilience action plan (“**are we doing the right things?**” or **output-oriented** monitoring) and at the same time establish a process to monitor and evaluate if the resilience building process is working as intended (“**are we doing the things right?**” or **process-oriented** monitoring).

To this end:

- The resilience team must **review the objectives** from step 1 in light of the following steps (some time may have passed at this point).
- According to it, **indicators** are to be defined. For output-oriented monitoring processes, these indicators can, e.g., focus on implementation progress. For process-oriented monitoring, the resilience teams will need to develop [a theory of change](#), i.e. a set of testable hypotheses about how a set of measures is expected to lead to achieving the objectives of the resilience building process. The monitoring process should not only cover implementation of measures and progress towards the objectives of the resilience building process, but also a continuous monitoring of vulnerabilities, risks, and impacts from climate change, natural hazards, as well as development pressures.
- At this point, the monitoring framework can be added to the resilience action plan, including information about who is responsible for overseeing the monitoring, evaluation, and learning process. The **heritage manager should be one of the responsible persons** of the monitoring.
- As a last action in this step, the resilience team should start the process of a **detailed resilience assessment** (e.g. using the [ARCH Resilience Assessment Dashboard](#)), based on the resilience baseline review undertaken in step 1. This will help to establish how far along the ‘resilience journey’ the team and historic area already are and support the process-oriented monitoring.

CHECKLIST

Step 6 will be completed if...

- Step 1 objectives are reviewed and updated
- Indicators for the monitoring are defined
- The monitoring framework is included in the resilience action plan
- A detailed resilience assessment is performed

3. Managing disasters in World Heritage Cities: case studies

Lviv, Ukraine: Protecting the cultural heritage from the war

Description

Lviv is the largest city in western Ukraine and the sixth-largest city in Ukraine, with a population of 717,510 people. It is the administrative centre of Lviv Oblast and Lviv Raion, as well as one of Ukraine's major cultural centres.

Lviv's history is as vibrant and fascinating as the city itself. Today, Lviv is over 760 years old and has many stories to tell! The city, located at the crossroads of two profitable trade routes, grew and flourished quickly, becoming one of the most important trade centres in medieval Europe. It later evolved not only into an architectural masterpiece, but also into the modern capital of scientific, spiritual, and artistic life.

In 2022, the war in Ukraine posed among others a risk also on the cultural heritage of the city. Hence, the city of Lviv mobilised all the possible resources in order to be prepared in the event of an attack to preserve as much as possible the cultural heritage sites of the city. The preventive protection of monuments from the risks of damaging in Lviv is the main priority of the Office for preservation of the historical environment of Lviv City Hall. First, the most valuable monuments were selected, among others Latin Cathedral, Boim chapel, Golgota altar, fountains on Rynok Sq., renaissance Black stone house, Mickiewicz monument, Saint Jan from Duklia sculpture, Ioan Zolotoustyi church and the iconostasis in Paraskeva-Piatnytsia church. The protection materials were provided by Polish heritage organisations, including Polonika and Instytut Dziedzictwa Narodowego.

Action Taken

The city's collective efforts and reflections on how to take action and preserve the cultural heritage in case of military aggression are summarised as follows:

It is important during the pre-disaster phase to develop a strategic plan for the cultural heritage preservation in the case of a military aggression event. This plan can support at the local level to coordinate action and provide the framework for decision-making processes. In the case of Lviv such a plan was not in place which led to certain obstacles in decision making processes and appointing the responsible departments for taking the lead.

It is important that are mechanisms and frameworks in place that support rapid decision making processes in the event of a war, as a quick reaction and coordination is required with all the relevant stakeholders in the city. In the case of Lviv, different stakeholders had to take personal responsibility in order time sensitive tasks related to saving the cultural heritage to be implemented.

The social media channels played a significant role for the coordination of action among the different stakeholders and volunteers in the city. This approach had supported the cultural heritage department of the city to disseminate their action and gain support from different actors and citizens. In the case, Lviv the cultural heritage department developed an extended network of volunteers who supported greatly the experts in applying the protective measures to the cultural monuments around the city. The respond of the volunteers was quick, whenever planned or immediate action was required.



Figure 3. Preventive action to protect the cultural monuments in the city of Lviv, Ukraine

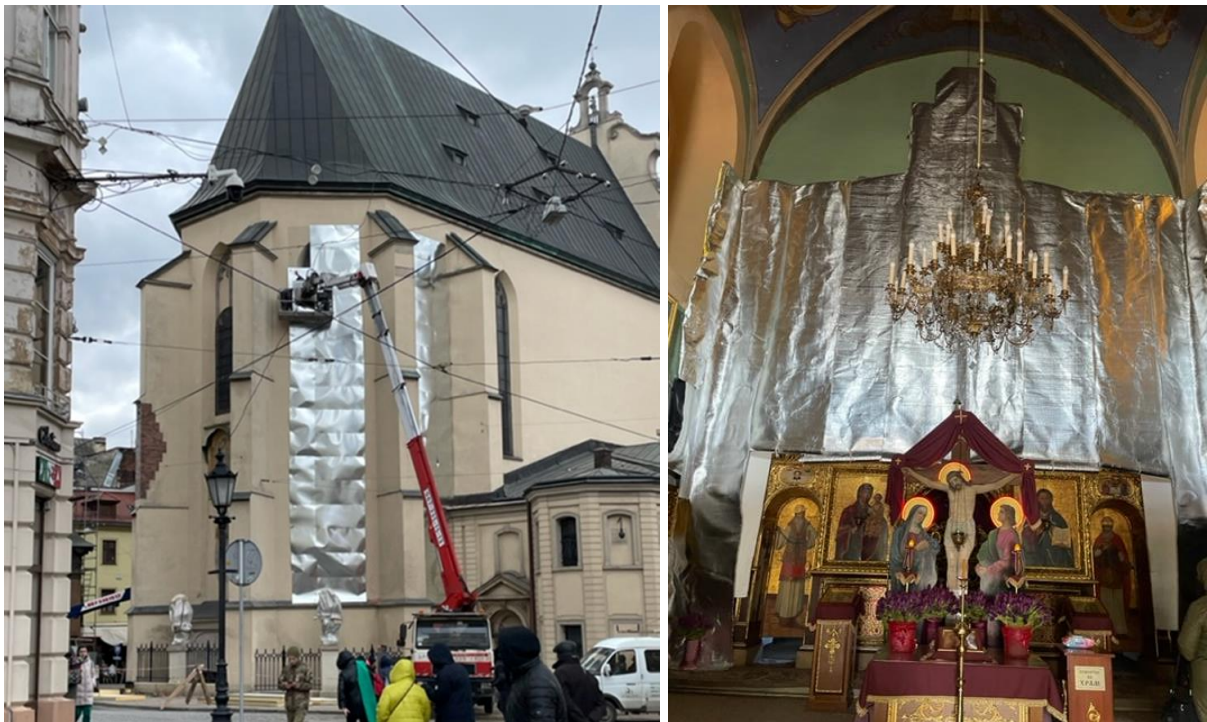


Figure 4. The renaissance Kampian and Boim chapel (left) and Paraskeva-Piatnytsia church (right)

Another important element is the involvement of diverse stakeholders. In the case of cultural preservation in the event of a military aggression, it is important that experts specialised in cultural heritage, representatives of the local authorities and the relevant departments as well as volunteers are involved. This can result to the effective development, support and implementation of the relevant preventive measures on the cultural heritage monuments or sites. In the case of Lviv, the coordination of action among a diverse network of stakeholders enabled an environment for uniting everyone's effort and achieving immediate results.

Finally, another important aspect is expanding the network beyond the city in order to request support but all to share experience and support other cities. In the case of Lviv, the city joined the Platform of historical cities where a wider international network that provides support to Ukrainian cities.

Recommendations on preventive measures to protect the cultural heritage

The recommendations concerning the proper way of monument protection were provided by Croatian specialists. Thanks to the joint efforts of officials, volunteers, and international cultural institutions the monuments were preventively protected. The preventive action that were taken are as follows:

- The stained-glass windows of Latin Cathedral and Ioan Zolotoustyi church were covered by OSB panels and metal sheets from the outside.
- The facades of the renaissance Kampian and Boim chapel, Black stone house as well as Golgotha altar and classicism fountains on Rynok Square are hidden now under the special structure made of scaffolding and metal sheets with stiffeners.
- In order to be protected from potential fires and excessive temperatures caused by the explosion, the white stone sculptures near the Cathedral are covered with special fire-resistant fabric materials with a layer of basalt fibers. Additionally, metal mesh structures were installed to protect them from the impact of a possible blast wave and debris.
- Metal mesh structures also protect the Mickiewicz monument that is one of most valuable monuments in Lviv.
- The most valuable elements of interiors are also protected by special constructions. For example, the iconostasis of Paraskeva-Piatnytsia church is hidden now under the metal curtain in order to prevent possible fires.

[Istanbul, Turkey: Building resilience for the cultural heritage in the city in the event of an earthquake](#)

Description

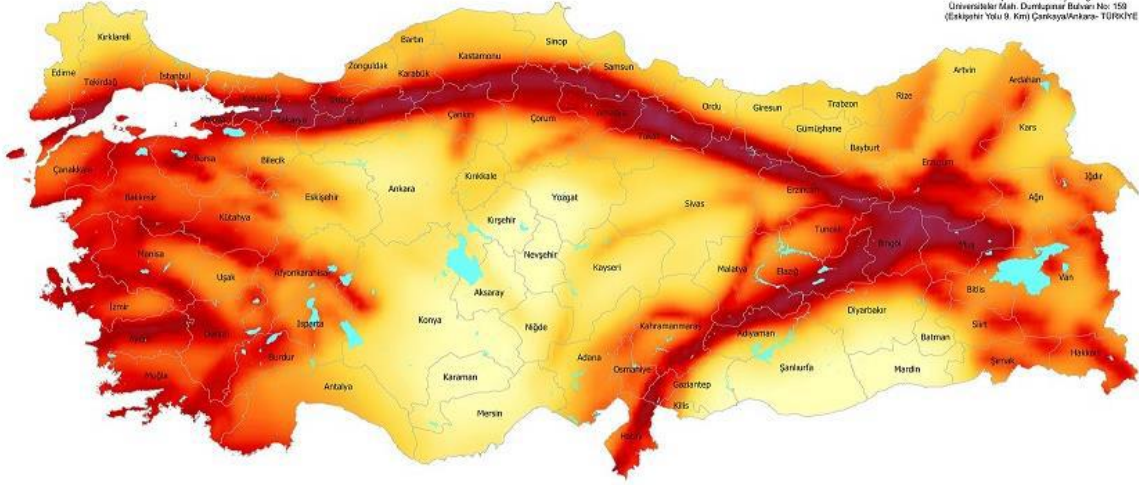
Istanbul is the most populated metropolis in Europe, home to nearly 15 million people and a quickly expanding economy. Since the middle of the 20th century, its population has increased quickly, primarily as a result of internal migration from Turkey's rural districts. Dealing with the effects of this growth and accommodating its new people while maintaining access to open space, water resources, and a high standard of living is one of the city's biggest difficulties. The city's infrastructure has undergone a number of significant additions in recent years to solve these problems. As an illustration, eleven National Gardens are currently being built to provide open space and green spaces based on aesthetic, ecological, and environmental principles.

The ancient peninsula of the city is a UNESCO World Legacy site, and Istanbul has a rich cultural heritage and several organizations, including the Ministry of Culture and Tourism, prioritise Istanbul's cultural and heritage policies to be implemented. In this regard, restoration of historical buildings and the construction of cultural hubs receive the majority of public investment.



Figure 5 and 6 Hagia Sofia & Blue Mosque, Istanbul

TÜRKİYE DEPREM TEHLİKE HARİTASI



Bu harita, Afet ve Acil Durum Yönetimi Başkanlığı (AFAD) tarafından Ulusal Deprem Araştırma Programı (UDAP) kapsamında desteklenen UDAP-C-13-06 kod no'lu "Türkiye Sismik Tehlike Haritasının Gönellenmesi" başlıklı projenin sonuçları kullanılarak hazırlanmıştır.

Bu harita, zemin koşulu (V_{20}) = 760 m/s esas alınarak hazırlanmıştır. Yerel zemin koşullarının neden olabileceği sivilaşma, büyüme, farklı oluma gibi tehlikeleri içermemektedir.

Kaynak Gösterme; Bu haritanın kullanılmasında "AFAD, 2018, Türkiye Deprem Tehlike Haritası" şeklinde kaynak belirtilmesi gerekmektedir.

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Figure 7. Türkiye Earthquake hazard map

Action Taken

In the view of managing disaster in the Metropolitan Area of Istanbul, a [Strategic Plan for Disaster Mitigation in Istanbul](#) (SPDMI) has been developed as part of urban planning studies by the Istanbul Metropolitan Municipality (IMM). One of the goals of this plan will be to improve natural and urban environmental quality, which will support the primary goal of reducing the destructive effects of a potential major earthquake. The SPDMI is prepared for this purpose in such a way that it will serve as a road map for Istanbul Metropolitan Municipality in addressing the earthquake problem.

The assessment of seismic vulnerability of Istanbul's existing building stock, the development of seismic retrofitting methods, and the determination of technical, social, administrative, legal, and financial measures are the important aspects covered by the Master Plan. The Master Plan examines the current status and potential gaps in these fields and makes recommendations for relevant measures to be taken. Finally, the Master Plan aims to plan these activities, prepare implementation programs, and identify responsibilities and responsible authorities for earthquake disaster mitigation works to be carried out in Istanbul.

The SPDMI focuses on the following points

- Conceptualization of strategic planning
- The problems and potentials of Istanbul Metropolitan Area
- A road map including strategies, planning instruments, and priorities at various levels
- Institutional and legal considerations

Another aspect is the Public Awareness programs, which are critical in introducing and raising awareness of the Istanbul Earthquake Master Plan (IEMP). These programs will also improve the level of rational acceptance and adaptation of this plan. IEMP topics range from the metropolitan level to the building level and include planning, disaster response coordination, and training programs for large population groups. Building a disaster-resilient community is a challenge due to the complexity of the problem and the difficulty in behavioural change of the citizens. Using all available mass communication methods in training will accelerate the process of preparing the community to face and overcome such disaster events.

Recommendations on preventive measures to protect the cultural heritage

The Master Plan outlines a series of steps to address the risk of an earthquake both before and after it occurs. The determination of national and international financial resources required for all pre- and post-earthquake mitigation and risk management tasks is an important aspect of the Master Plan action. In addition to identifying financial resources, the Master Plan developed a financial model for efficient resource allocation. Given the limited resources currently available for this purpose, the immediate step is to identify the hotspots and estimate the total amount for financing. The following actions have been prioritized for funding:

Pre-Earthquake:

1. Studies on earthquake vulnerability and security
2. Technical investigation and strengthening (or re-location) of public structures (hospitals, schools, key government buildings, infrastructure, bridges, dams, etc.)
3. Technical investigation and strengthening (or re-location) of private buildings (residential, commercial and industrial buildings)
4. Other related works mentioned in the Master Plan.

Post-Earthquake:

1. Provision of shelter, food, medical and social services to people
2. Technical investigation, repair and reconstruction of public and private buildings and structures.

The Risk and Disaster Management model proposed in the Master Plan takes into account not only post-earthquake response actions to mitigate the negative effects of the disaster, but also the planning phase to effectively manage the activities. The proposed model is designed to cover four disaster management stages (risk mitigation preparation and planning, response and recovery). Hence, the response emergency management model is focused on four main actions:

1. Coordination
2. Incident Command System
3. Resource Management
4. Training

Description

Hamburg is Germany's second largest city, with a population of 1.8 million people. Hamburg has a total surface area of 755.09 km². The city is constantly expanding in size. Hamburg was and continues to be a bustling commercial hub that is constantly changing. Construction of the Speicherstadt at the end of the 19th century started a change process that led to Hamburg's metamorphosis from a city with mixed residential, commercial, and industrial areas to a contemporary city with service districts. One example of how this approach was continuing at the beginning of the 20th century was the development of the Kontorhaus neighborhood. Speicherstadt and the nearby Kontorhaus area, two highly populated central city neighborhoods, are the result.

On July 5th 2015, the Speicherstadt and Kontorhaus District, including the Chilehaus, were inscribed onto the UNESCO World Heritage List. The Speicherstadt is of high international importance thanks to its architectural history. With its composition of red brick buildings in neo-Gothic architectural forms, its streets, waterways and bridges that create that unmistakable image of a "city of warehouses". Today, this area of Hamburg is a formative part of the entire cityscape.

Action Taken

The main goals of Hamburg project are to identify hazards, co-develop tools, and work within a collaborative network of cities seeking to boost the resilience of their historic areas. By joining the ARCH project the city of Hamburg aimed to integrate climate change adaptation into management of the World Heritage site Speicherstadt and Kontorhausviertel, including improved monitoring of impacts on built fabric, as well as on visitors and the local community, and increased community awareness. Hence, the city in collaboration with the scientific project partners of the ARCH project developed a local work plan. The city's local work plan is divided into four parts.

1. Part 1 outlines the current situation, summarising the content of the baseline review, introducing the historic areas in focus for ARCH, the relevant hazards expected to affect them, and the most relevant corresponding plans, strategies and actions already in existence.
2. Part 2 describes the stakeholder analysis undertaken to identify key departments, organisations and groups actively involved in managing, maintaining, using, or otherwise with an interest in the historic areas in focus, as well as identifying which of these are to be engaged as local partners.
3. Part 3 outlines the overall vision for the city's local partnership, and defines specific objectives.
4. Part 4 outlines the strategies and corresponding actions proposed to achieve these objectives, including a time plan and allocation of responsibilities



Figure 8 & 9. Cultural Buildings in the Speicherstadt neighbourhood, Hamburg

As a result of the above-mentioned Work Plan in collaboration with the local stakeholders, the city of Hamburg proposed seven strategies in order to integrate climate change adaptation into management of the World Heritage site Speicherstadt and Kontorhausvierte. The defined strategies form the local work plan are as follows:

- Strategy 1: Perform Pilot-project: BIM (Building Information Modelling, an extended and interconnected 3D model of existing (heritage) construction)
- Strategy 2: Obtain Proof of Concept on data exchange between DAFIS, LGV and BIM
- Strategy 3: Revision of the WHS Management Plan in regard to climate change impacts
- Strategy 4: Integrate Management Plan structure with UNESCO-PERIODIC REPORTING structure and relevant themes (2018-24 - Europe 22-24)
- Strategy 5: Perform risk analysis and identify resilience options
- Strategy 6: Develop dissemination tools (including strategy, exhibition concept and supporting materials)
- Strategy 7: Participation in / Organisation of Cultural activities and events (physical/virtual)

Recommendations on preventive measures to protect the cultural heritage

The city of Hamburg in order to achieve a successful implementation of the above mentioned strategies so to improve the resilience of historic areas to climate change-related and other hazards, among other actions has co-developed within the ARCH project framework, decision support tools and methods. The following are some of the main results of the ARCH project in Hamburg:

Information System

The Historic Area Information System (or HARIS) is an information system that presents data on air pollution, rainwater infiltration, or the subsidence of buildings. The Hamburg team supports the further development and helps to test the methods developed in the project under real conditions.

Mutual Learning Framework

The project work also includes a Mutual Learning Framework, which fosters exchange with cities such as Liverpool, Thessaloniki, and Regensburg, all of which face similar challenges as Hamburg.

3D Modelling

In Hamburg, the focus is also on the creation of a 3D model that incorporates information on the built environment, cultural heritage and climate data. This will test how cultural heritage can be monitored digitally and preserved for future generations.

Management Plan

Prevention and resilience play a special role in supporting the planning of measures and control mechanisms to preserve the warehouses and office buildings. For this purpose, the management plan published in 2015 will be analysed and revised in relation to the project topics. This process will be open to participation from Hamburg residents.

4. Conclusions: reflections and way forward

The six-step approach that is presented in this guidance aims to support the cultural heritage managers to coordinate action on disaster risk management with other departments of the local authorities and other relevant stakeholders. This cross departmental collaboration leads to Cultural Heritage to be one of the main pillars in disaster risk management strategies at the local and regional level. Moreover, this guidance supports the development of evidence based and solid recommendations for the disaster risk management of the cultural heritage in the cities. Building a comprehensive Disaster Risk Management Plan for the Cultural Heritage sites in the cities, following the relevant steps from the normal operating phase of the disaster management framework will equip the respective departments in the city adequately to react when a disaster occurs and manage the cultural heritage sites in the post-disaster phase. The six-steps approach was shared and discussed with cultural heritage managers from 18 different cities during the 2 days' workshop that was co-organised by OWHC & ICLEI Europe and hosted by the city of Vilnius. The main reflections from the cities on the workshop are summarised as follows:

It is important to develop a cross departmental cooperation and include the risk management of the cultural heritage sites into the risk preparedness plans, as well as to exchange, data knowledge and experience and build collaboration. This approach would allow to link perspectives and bring the stakeholders together

An established multidisciplinary working group can provide holistic policy recommendations to strengthen the resilience of the cultural heritage while building linkages with other aspects (e.g. climate change, social inclusion, etc.) that can gain political support. A road map for integrated cultural heritage risk management could guide and support the cross departmental collaboration.

It is essential to develop interlinkages of the Cultural Heritage and other sectorial plans to maximise the preservation of such sites in the city and to avoid potential conflicts among different solutions (i.e. cultural heritage and tourism)

As disaster risk management, cultural heritage and urban resilience are complex to analyse and prioritise action, it is important to make use of decision supporting systems and other tools for the development of solid disaster risk management plans.

It is important not only to make use of such tools (i.e. ARCH RAD) but also to disseminate the use of such tools to other departments and relevant stakeholders in the city in order to adopt more innovative approaches for building resilience for cultural heritage. It is critical the guidance and training on these tools to be provided in the local language in order to avoid any barriers for their adoption from the local cultural heritage managers.

Such approaches, as the proposed step-by-step guidance, can support the review of existing Disaster Risk Management Plan and guide their reviewing process.

The comparison of measures is an interesting approach as it allows you to develop a package of approaches to manage a risk and hence the flexibility to address it from different angles. In this regard, the cultural heritage and other departments can avoid a one to one process of matching one risk with one solution.

Following the two-day workshop and after receiving these guidelines, the 18 cities across Europe and North America, within the first quarter of 2023, they will reflect on these guidelines as well as whether the capacity and knowledge they built was applicable and transferable in their day to day operations as cultural heritage managers. Moreover, this guideline will be available to all the cities

members of the OWHC network to support them build resilience for their cultural heritage sites. In the long term the OWHC community of practice aims to further continue the collaboration with the member cities to develop a comprehensive roadmap for managing disasters in the cultural heritage cities that can be adopted widely and gain political support.



Figure XX. Participants at the “Heritage cities building resilience” workshop in Vilnius

5. Supporting resilience building: the international arena

This chapter explores linkages between the steps to be developed in order to mainstream disaster risk management in heritage management and existing international initiatives supporting resilience building in historic contexts.

5.1 UNDRR

The United Nations Office for Disaster Risk Reduction oversees the implementation of the [Sendai Framework for Disaster Risk Reduction](#) 2015-2030, supporting countries in its implementation, monitoring and sharing what works in reducing existing risk and preventing the creation of new risk. UNDRR does this by approaching different aspects of the disaster risk management, namely:

- [Climate action and disaster risk reduction](#)
- [Humanitarian action](#)
- [Inclusion](#)
- [Disaster risk reduction in least developed countries](#)
- [Financing prevention](#)
- [Risk governance](#)

Making Cities Resilient 2030 (MCR2030)

This is a particularly interesting initiative by UNDRR for cities, aiming to create a global partnership to strengthen local resilience. MCR2030's concrete objectives are to:

- Improve cities' understanding of risk and secure their commitment to local disaster risk reduction and resilience
- Strengthen cities' capacity to develop local strategies/plans to enhance resilience
- Support cities to implement local strategies/plans to enhance resilience

Making Cities Resilience enables opportunities for replication of best practices and peer to peer exchanges, according to specific needs and contexts.

The initiative provides not only a platform for exchange but also access to international experts and partners to collaboratively face resilience issues and vulnerabilities.

MCR2030 contributes to all steps of the above-mentioned guidance from 1 to 6.

More information is available [here](#).

5.2 Cities Race to Resilience

The Race to Resilience is a global campaign run by the COP26 Presidency and High-Level Climate Champions to rally leadership and support from cities, regions, businesses and investors to help frontline communities build resilience and adapt to the impacts of climate change. Under this campaign, the Cities Race to Resilience focuses on driving cities to join and pledge their commitment to the global fight against climate change.

The Cities Race to Resilience offers cities themselves the unique opportunity to showcase action and drive ambition, according to their own contextually relevant local landscape.

Cities Race to Resilience contributes particularly to step 1 of the guidance to include disaster risk management in heritage management, by driving political commitment towards resilience building. More information can be found [here](#).

5.3 ICCROM

The International Centre for the Study of the Preservation and Restoration of Cultural Property works mainly at the National level to preserve cultural heritage while contributing to the environmental, social and economic sustainability of communities. Aiming to promoting built heritage conservation within a sustainable development framework, ICCROM provides tools and methods to boost preventive conservation, risk management, heritage impact assessment and other relevant approaches through field projects.

Our Collection Matters

In 2020 ICCROM launched this initiative to accelerate, increase, and amplify activities that support sustainable development, through the use, development, and conservation of heritage collections. It does so by adopting a “3T” strategy: tools, training, and transformation.

This initiative can support the development of **steps from 2 to 6** of this document’s guidance by providing methods and tools to assess heritage collections vulnerabilities, identifying and selecting measures to improve their resilience and define a monitoring framework for them. More information can be found [here](#).

RE-ORG

Through the RE-ORG method, ICCROM helps museums regain control of their collections in storage by reorganizing museum storage spaces.

RE-ORG contributes to the development of measures to unlock collections potential and resilience. By doing this it contributes to **step 4** of the guidance above.

More information is available [here](#).

5.4 EURESFO

Organised by ICLEI Europe and the European Environment Agency, in collaboration with different international partners and projects each year, the European Urban Resilience Forum (EURESFO) is a unique exchange platform where city representatives and stakeholders from various local and regional institutions come together to discuss strategies and actions for adapting to climate change and building urban resilience.

Reaching its 10th edition in 2023, the forum consists of different sessions and workshops tackling the hottest topics related to urban resilience. In the last years, heritage management has been an important focus of some sessions, driving fruitful discussions and outcomes. In addition, the forum offers a marketplace to showcase the newest solutions and tools for resilience building.

In its last edition, EURESFO convened in Athens over 300 participants from more than 80 cities across Europe.

More information is available [here](#), including the easy-to-read reports from the last editions, available at the bottom of the webpage.

5.5 EU-funded projects

Other than ARCH, other two sister projects investigated similar topics related to heritage sites and resilience building.

SHELTER project

The project SHELTER, “Sustainable Historic Environments hoListic reconstruction through Technological Enhancement and community-based Resilience” is an EU-funded project, that aims at developing a data-driven and community-based resilience improvement of historic areas.

SHELTER main output and exploitable result is the **Operative Knowledge Framework**. A conservation-friendly, data-driven and community-based methodology to generate resilience and improve the reconstruction of historic areas in the face of climate change and hazard events.

A resourceful platform for local authorities, urban planners, conservation practitioners, first responders, cultural heritage owners and managers to guide the historic areas in the transformation toward more resilient, circular, smart and inclusive historic environment taking advantage of the window of opportunity that the awareness, adaptation and preparations against hazards provide.

More information is available [here](#).

HYPERION project

HYPERION aims to leverage existing tools and services (e.g., climate/extreme events models, and their impacts, decay models of building materials, Copernicus services, etc.), novel technologies (terrestrial and satellite imaging for wide-area inspection, advanced machine learning, etc.) to deliver an integrated resilience assessment platform, addressing multi-hazard risk understanding, better preparedness, faster, adapted and efficient response, and sustainable reconstruction of historic areas.

The HYPERION system ends up to an enhanced visualization tool with improved 4D capabilities (3D plus time) that can provide a simple and easy way for all relevant stakeholders to assess damage and risk. The produced vulnerability map (based on the produced climate risk regional models) is used by the local authorities to assess the threats of climate change (and other natural hazards), visualize the built heritage and cultural landscape under future climate scenarios, model the effects of different adaptation strategies, and ultimately prioritize any rehabilitation actions to best allocate funds in both pre- and post-event environments.

More information is available [here](#).

6. Further readings

Here are some important readings to investigate the intersection between disaster risk reduction, resilience and heritage management.

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