Shelter

Sustainable Historic Environments hoListic reconstruction through Technological Enhancement & community-based Resilience

D.6.1. GLOCAL user requirements

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Disclaimer:

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Glossary

Acronym	Full name
CCA	Climate Change Adaptation
CHM	Cultural Heritage Management
CH	Cultural Heritage
CSC	Case Study Coordinator
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EU	European Union
HFA	Hyogo Framework for Action
ICT	Information Communication Technology
NHM	Natural Heritage Management
OLs	Open Labs
OUV	Outstanding Universal Value
PDNA	Post-Disaster Needs Assessment
RCA	Root Causes Analysis
SFDRR	Sendai framework for disaster risk reduction
SNA	Social network analysis
ST	Sub-task
UCS	Use Case Scenario
UR	User Requirement(s)
VTC	Video Telecommunication Conference
WP	Work package
WS	Workshop

1 Executive summary

The SHELTER project takes place within the global framework of the Sendai Framework for Disaster Risk Reduction 2015-2030. Especially "the strengthening disaster risk governance to manage disaster risk" (Priority Action 2), that states "Disaster risk governance at the national, regional and global levels is of great importance for effective and efficient management of disaster risk. Clear vision, plans, competence, guidance, and coordination within and across sectors, as well as the participation of relevant stakeholders, are needed. Strengthening disaster risk governance for prevention, mitigation, preparedness, response, recovery, and rehabilitation is, therefore, necessary. It fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development".

Further, SHELTER aims to plan and adapt governance and provide cutting edge solutions to prepare sites to cope with the loss of natural and cultural heritage (CH) significance due to future climatic risks. Climate-related hazards create new challenges for conservators and heritage managers all over the world, and UNESCO sites are and will be affected in the future by the impacts of climate change. Preservation of World Heritage sites requires understanding the implications of their Outstanding Universal Value (OUV) and responding to them effectively. The cultural heritage and natural heritage are inherently linked, such as the geological and meteorological features that are as important as the social and economic situation. Heritages and their surrounding conditions affect each other, and there is no one fit for all approaches or solutions for the disaster risk management (DRM) and climate change adaption (CCA) mechanism.

The focus of the present deliverable is to identify the GLOCAL user requirements for DRM and CCA to heritage and identify the essential user requirements for the development of other aspects of the SHELTER project. This entails looking at both the bottom-up (local) and top-down (global) levels, as well as identifying key stakeholders. The research was coordinated among three partners (CRCM, UNESCO, and ULIEGE), each with a different responsibility on the broader deliverable. The deliverable is structured into three main chapters (chapter 3 to chapter 5). Finally, the results of the two approaches (top-down and bottom-up) and the analysis of key stakeholders were drawn together to provide a unified report to help guide the development of tools and solutions to be used in the Open Labs (OLs) in Work Package (WP) 7. The report separates this work into the three main chapters:

- **Chapter 3** identifies the critical user requirements of end-users by utilizing 'Use Case Scenarios' (UCS) as a method to elicit and prioritize the end-users needs within the scope of SHELTER as regards CCA, DRM, and cultural heritage management (CHM).
- **Chapter 4** utilizes an innovative form of methodology referred to as an 'ex-post analysis' based on root cause analysis (RCA) approach, which identifies the key stakeholders across different stages of DRM. As well as, explores the potential for Information Communication Technology (ICT) to facilitate and primarily to

highlight potential opportunity spaces for the user requirements to exploit and likely barriers they may face.

- **Chapter 5** identifies the main top-down user requirements of international experts collected via an international interactive workshop, which takes stock of existing frameworks dealing with multi-hazard contexts for DRM in cultural heritage.

Chapter 3 in detail

The purpose of ST6.1.2 was to identify the essential user requirements of the various experts of the five OL's responsible or confronted with DRM and CHM. A bottom-up analysis in the form of Use Case Scenarios was collaboratively developed with the end-users to identify their requirements as regards with CCA, DRM, and CHM.

Initial user requirements were identified in the proposal phase, and a text analysis of available literature cross-referenced the results. Furthermore, these results were supported by existing user requirements already visible in completed or ongoing national as well as international research projects. The initial set of user requirements developed as a result of this preliminary analysis was discussed, updated, and confirmed as a first step with the technical partners within the SHELTER consortium to establish an initial collection of user requirements going forward. In parallel, the methodology for the UCS was developed to capture the specific user requirements of the stakeholder in the SHELTER Open Labs, including a questionnaire referring to DRM, CHM, and CCA. In summary, the stakeholders in the OLs provided with an initial set of user requirements draw from the available contemporary academic literature and other projects for prioritization and discussion as well as a tailor-made questionnaire to fill out and define their specific user requirements in the context of the Open Labs cultural heritage sites.

The SHELTER Partners discussed the results from the questionnaire during a workshop held during the 2nd General Assembly meeting at Seferihisar in Turkey on the 18th December 2019. The purpose of this workshop was to discuss the results from the OL's questionnaire and UCS to establish which tools, information, and data are available within the scope of the project.

Because the five OL's are unique, facing distinctly different hazards and types of CH, the structure of the identified user requirements (general, data, models, etc.) was crucial in establishing some key 'common ground' between the different OL partners. Overall, through the combination of approaches, a total of 116 user requirements were identified. The prioritization terminology used within the questionnaire 'must-have,' 'should have,' 'nice to have,' 'not necessary' was able to refine this extensive list to the specific user requirements of the OL's. The outcome is vital for the development of WP1 as well as for technical partners in WP3 and WP5. Close cooperation with IHED in WP7 and the stakeholders in the OL's was fundamental to the successful gathering of valuable raw data and the refinement of the results into an applicable set of user requirements.

Chapter 4 in detail

The purpose of ST6.1.1 was first to identify the key stakeholders across different stages of DRM and second, to explore the potential opportunity spaces in which ICT can be used to facilitate greater stakeholder involvement and interaction. The results of this analysis are not only crucial in WP7 and the ongoing work in the OLs but when used in conjunction with the user requirements defined in chapter 3 & 5, can help to shape the outcomes of the SHELTER project and identify the critical stakeholder groups to be included or empowered.

An innovative form of 'ex-post' analysis was designed to achieve this, based on the widely adopted and embedded RCA methodological approach, which mapped out the critical events of three historic disasters (based on the available academic literature). Allowing for the identification and role of stakeholders, explicit and 'silent,' and the identification of 'causal factors' that led to or exacerbated the damage to the CH sites. The three selected case studies were as follows: November 2019 flooding in Venice, which damaged the Saint Marks Basilica, 2009 earthquake in L'Aquila city, and finally the 2006 Wildfires in Galicia, Spain. These three cases represented three different disasters at three different scales (in line with the SHELTER Framework). Nineteen critical stakeholder groups were identified through the analyses and involved within each case regardless of the scale and type of disaster. However, the level and stage of the interaction of these stakeholders varied dramatically, dependent on each case study's specific epistemological discourse, which has dramatic effects on the outcomes of each case, especially within the DRM stages of preparedness and recovery.

Furthermore, there were apparent overarching issues that were consistent across the three case studies. For example, it is clear that current scientific research and accurate data does not translate into effective practical solutions on the ground. For reasons like 'accessibility,' 'availability of resources,' and 'funding.' Furthermore, there was an apparent macroeconomic problem identified across two of the case studies, which called for the need for higher levels of transparency from stakeholders, especially at high levels and the need to make DRM and CCA as independent from bureaucracy and politics where possible. Finally, it is clear that historically ICT is not being utilized to its most significant potential, especially as a platform to engage local communities in the different stages of the DRM cycle. ICT based tools like social media provide a currently 'untapped' platform for local people to voice their opinion and develop communities. ICT offers a valuable resource for experts and practitioners alike to collect real-time data, local knowledge, and mobilize motivated community groups in large numbers. This chapter, when used in the connection of the user requirements, can help to direct the outcomes of the SHELTER Project, especially within the context of the OLs.

Chapter 5 in detail

The purpose of ST6.1.3 was to identify the main top-down user requirements, taking stock of existing frameworks dealing with multi-hazard contexts for DRM in cultural heritage. To identify the main top-down user requirements for DRM in cultural heritage, UNESCO first took stock of existing frameworks for DRM in cultural heritage dealing with multi-hazard contexts.

Following the literature review and analysis and critical stakeholders identification, UNESCO invited several international multi-stakeholders to attend an interactive workshop. The International workshop "GLOCAL," held in Venice on December 5th and 6th, discussed gaps on the impacts of climate change and in DRM on cultural and natural heritage sites, main user requirements in DRM, and put forward recommendations to bring forward in the SHELTER project.

The stakeholders identified the top-down user requirements during a 2-day systematic workshop process that involved a mix of presentations by the experts followed by plenary discussions, group work, and exercises, including the use of flip charts, mind maps, and audio recordings. Key recommendations emanating from these discussions include strengthening coordination between cultural and/or natural heritage authorities and civil protection and local government and incorporating CH into national and local regulations and plans for civil protection/emergency response, as well as better utilization of new technologies for warning systems and promoting an interdisciplinary approach for disaster management.

2 Introduction

2.1 Aims and objectives

The aim of T6.1 is to identify key stakeholders and governance principles for CHM, CCA, and DRM. A user-oriented framework will guide all SHELTER developments and will overcome potential regulatory, economic, and technical barriers in which contemporary DRM strategies aim at reducing the risk CH currently faces. The business community will be involved from the beginning to foster new investment and market opportunities. To achieve this, the task adopted an overarching GLOCAL research strategy, coordinated by CRCM. This research strategy has been separated into distinct parts. First, a bottom-up requirement analysis designed to draw out and capture the user requirements of practitioners, site managers, curators, and end-users was used. Followed by a detailed exploration of three disaster events in historic case studies that mapped out key stakeholders and their role in the DRM cycle as well as potential opportunity spaces for ICT. Finally, a top-down requirement analysis designed to draw out and capture the user requirements of international experts, academics, and policymakers.

The following core objectives guided the development of T6.1 and the GLOCAL User requirements analysis:

- *Identify* the key stakeholders and their different roles within different stages of the DRM cycle.
- *Explore* the potential of ICT within the different stages of the DRM with a focus on cultural heritage and identify potential opportunity spaces, barriers, and limitations for SHELTER.
- *Develop* a detailed list of the bottom-up user requirements of end-users, practitioners, site managers, curators, and other relevant local stakeholders.
- *Develop* a detailed list of the top-down user requirements of international experts, policymakers, and other relevant stakeholders.
- *Consolidate* the results of the different aspects of the GLOCAL strategy into a coherent set of user requirements, which can be used by the SHELTER consortium.

2.2 Relations with other activities in the project

The results of the three different ST, described in this deliverable, provide an essential baseline for the whole SHELTER project. The contributions are unpacked in greater detail and highlighted below:

- WP1: established what types of data are relevant and needed for OL's as a rough overview.
- WP2: To develop a multi-layered methodology to categorize CH assets in T2.3. and for the Agent-Based Modelling in T2.6
- WP3: For the development of technological solutions and systems.
- WP4: Development of protocols, plans and guidelines for all the DRM phases.

- WP5: Identify relevant requirements for the module as well as for the resilience dashboard and the strategic decision support system.
- WP6: For the ongoing development of the adaptive governance schemes mapping in T6.3 and for the generation of the co-production playbook and the co-creation blueprints in T6.4.
- WP7: Especially for the further work for WP7 in the following OL's workshops with the various stakeholder.

2.3 Report structure

This deliverable is structured into six chapters.

Chapter 3 - Describes the bottom-up requirement analysis, including the development of UCS and the results in close cooperation with the stakeholder of the OL's.

Chapter 4 - Identifies and maps the key stakeholders and contemporary social network services visible across recent disasters at historic sites through the use of an ex-post RCA.

Chapter 5 - Describes the top-down requirement analysis, including desktop analysis as well as the results of an international two-day workshop with several experts in DRM, CCA, and CHM.

Chapter 6 - Describes the merging of the results from the top-down and the bottom-up analysis with social network analysis (SNA).

Chapter 7 – Outlines the conclusions from the top-down, the bottom-up and the stakeholder analysis summarized.

Chapter 8 - References are listed.

Chapter 9 - Annexes are listed.

2.4 Contribution of partners

The following table details the contribution of each partner:

Partner	Contribution
CRCM	Responsible for the deliverable and ST6.1.2. Drafting of chapter 3. Development of Use Case Scenarios.
ULIEGE	Coordinator of WP6 providing the link among all activities. Responsible for ST6.1.1. Drafting of chapter 4.
UNESCO	Responsible for the coordination of the task and ST6.1.3. Drafting of chapter 5.
TEC	User requirements gathering. Support in International workshop organization and presentation. Deliverable review
UNIBO	User requirements gathering
UPV	User requirements gathering
IHED	User requirements gathering and coordination with OLs. Document review
LINKS	User requirements gathering
EKO	User requirements gathering
NBK	User requirements gathering
UMAS	Document review

Table 1: Contribution of partners

3 Bottom-up requirement analysis

3.1 Introduction and position within SHELTER

This part of the deliverable deals with the identification of the user requirements with a bottom-up approach. For that purpose, both a questionnaire to identify relevant User Requirements (UR) and a model to develop OL's specific UCS were generated. Both are described in this chapter. The two tools had the objective of identifying and documenting the knowledge and expertise of the various involved stakeholders in the five SHELTER OL's.

Both tools were distributed to the case study coordinators (CSC) within the five OL's. The distribution was timely since all five of the OL's were in the process of defining their local objectives and their core and extended stakeholder groups. Four of the OL's already had organized workshops kicking off the collaboration between their stakeholders. In those cases, the completion of the UR questionnaire and UCS model was managed by the CSC of each OL's. The CSCs bilaterally contacted the most critical stakeholders of their OL's and discussed the URs and UCS with them. Their reactions, collated per OL's, were communicated back and used for the analysis in this deliverable. In the Dordrecht OL's, the UR questionnaire and UCS model were integrated into the agenda for the first workshop with their stakeholders. In that OL's, the reactions were therefore not collected bilaterally but in a participatory way. The identified UR is a baseline for the SHELTER project, especially for the technical, more technically focused work packages, i.e., WP3 and WP5, the data related to WP1 as well as WP7 for the following OL's workshops.

3.2 Methodology – Bottom-up requirement analysis

The following methods were used during the research and are described in the following subchapters:

Questionnaire: A questionnaire provided the fundamental aspect of data gathering for the existing knowledge of stakeholders within the OL's in connection with the developed UCS. A second questionnaire was developed for validation of the identified UR by the technical partners of WP3 and WP5.

Literature review: A literature review assisted in the identification of viable international and national projects dealing with DRM, crisis management, foresight, and climate change.

Text analysis: The result of the literature review was analyzed with a text analysis tool to identify a preliminary set of UR's to guide the development of the deliverable.

Skype conferences: Several skype conferences were used to discuss, update, and explain the steps of the process across partners and the SHELTER consortium.

The process to identify the bottom-up requirements was planned following Figure 1;

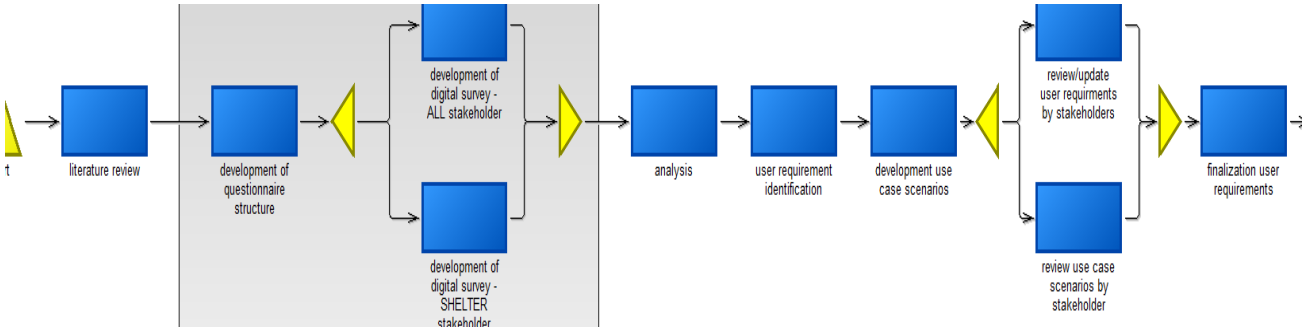


Figure 1: First process – bottom-up requirement analysis

The core of this process was the development of a digital survey for the stakeholders of the OL's as well as for other stakeholders involved in DRM to gather as much information as possible. Also, specific data related questions for WP1 were included. During the pre-test phase of the digital survey, it was decided to change the way of gathering information. The digital survey was developed as an information-gathering instrument for experts in DRM and CHM, including also relevant questions for WP1 and WP2. On the one hand, the time that the survey demands from the participants were too long, and on the other hand, it was too complicated for the first round of OL's workshops. So, a new updated process for the bottom-up requirements analysis was developed, as shown in Figure 2 below:

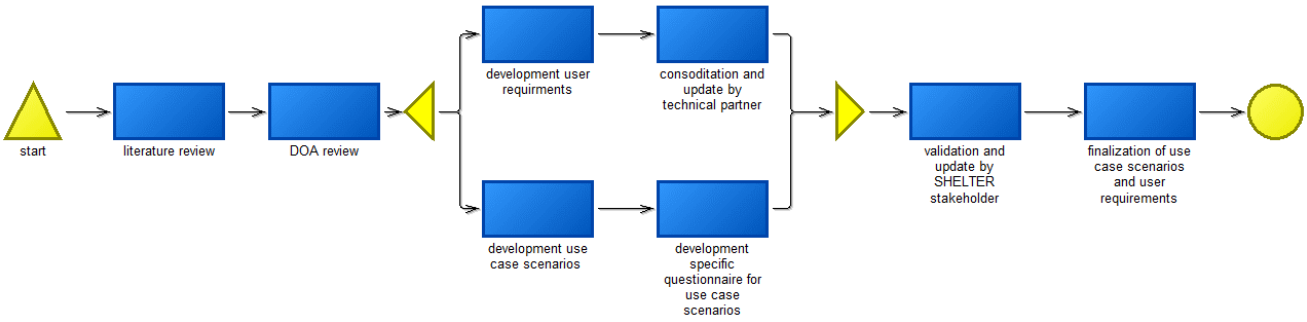


Figure 2: Updated process – bottom-up requirement analysis

Of course, the developed structure of the digital survey was helpful for this process, and some results were already used. The conceptual stage of the construction is shown in the following Figure 3.

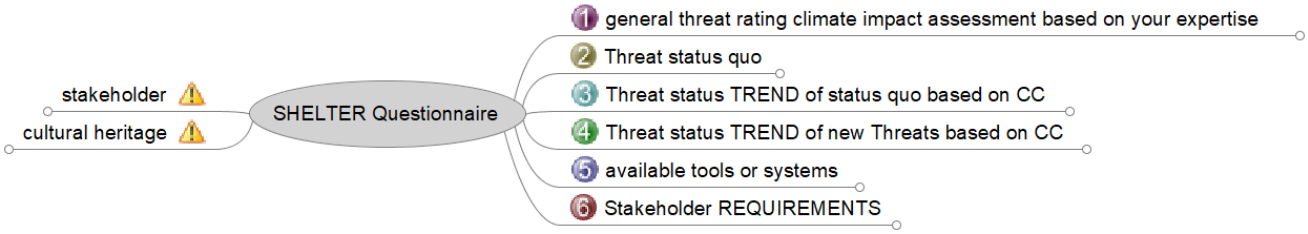


Figure 3: Concept of questionnaire structure

The complete concept for the digital survey is part of Annex I, including some additional aspects related to data for WP1. The specific elements for WP1 are marked with a cloud in the mind map. The new updated process for the bottom-up UR analysis (Figure 2) is described in the following subchapters:

3.2.1 Development of user requirements (UR)

The UR were identified during the proposal phase as well as by literature review results. Additionally, a text analysis tool called PROTERM[1] was used to analyse other relevant national as well as international projects on document level.

3.2.2 Questionnaire for User Requirements

The questionnaire for the technical partners as well as for the stakeholders follows the structure shown in the following Figure 4. All questionnaires were developed with excel.

No	Topic	Description	Task assignment	Auto or Manual	Priorities	Source(s)
UR-001	general	The SHELTER solution shall support Direct Users (see glossary) through all phases of tDRM		TBD		DoA, CRCM
UR-002	general	All direct stakeholders shall have controlled access to the SHELTER System		Automatic		DoA, CRCM
UR-003	general	All direct stakeholders shall be able to concurrently work [work at the same time]		Automatic		DoA, CRCM
UR-004	general	The SHELTER solution shall be able to support different teams working independently		Automatic		DoA, CRCM
UR-005	general	All direct stakeholders shall not modify data/information directly associated with source data/information		Automatic		DoA, CRCM

Figure 4: Excerpt of user requirements list

The technical partners have the possibility to validate the identified UR and do a general task assignment. For the assignment is a specific column available (grey marked). The update of the identified UR was done via VTC with the leader of WP5 and other technical partners.

[1] This tool is an inhouse developed terminology instrument of the MOD for amongst others cooccurrence analysis. With PROTERM the text analysis of approximately 100.000 documents can accomplished within one step.

The stakeholders were asked to do the prioritization of the identified UR due to their specific UR and/or needs (yellow marked column). The prioritization steps for the stakeholders were:

1 – MUST HAVE

2 – SHOULD HAVE

3 – NICE TO HAVE

4 – NOT NECESSARY

Technical partners, as well as OLs partners, were also asked to update the UR list and add additional ones if necessary. During this research, they proposed UR, updated, and prioritized the identified UR. For the developed process (see Figure 2), technical partners could do the update and the assignment in advance, and then stakeholders received the UR list for updates and prioritization.

3.2.3 Use Case Scenarios

Five UCS were developed. The UCS was developed on an abstract level so that every stakeholder involved was able to find itself (in their specific function) and the situation of the specific OL. For the stakeholder's workshops it was necessary to moderate the UCS and develop additional parts due to the participants experience. The UCS were forwarded to four OL responsible persons and discussed in a VTC with IHED (responsible for WP7), because the referred workshops were already finished. For one workshop the Use Case Scenarios were part of the agenda and discussed with all participants. To moderate the development process for the UCS, a joint presentation was facilitated to the moderator and a specific questionnaire to identify additional user requirements developed.

3.2.3.1 Use Case Scenario development

To organize the workshop, it was essential to consider the involvement of a mixed group of stakeholders and to address participants' open-mindness to detach them from stalled processes and procedures.

The five Open Labs, as well as the specific threats, are shown in Table 2.

Open Lab Region	Threat/Hazard
Area of Santa Croce in Ravenna (Italy)	Subsidence and flooding
Seferihisar district (Turkey)	Earthquake, heat waves and storm
Dordrecht (The Netherlands)	Flooding
Baixa Limia-Serra Do Xures Natural Park in Galicia (Spain)	Wildfire
Sava River Basin (Slovenia, Croatia, Bosnia and Herzegovina, Serbia and Montenegro)	Flooding

Table 2: Open Lab Regions and Threats

In the following Figures, the slides which are moderated during the stakeholder workshops are visualized.

First, the methodology of the Use Case Scenario is explained by the moderator (Figure 5).

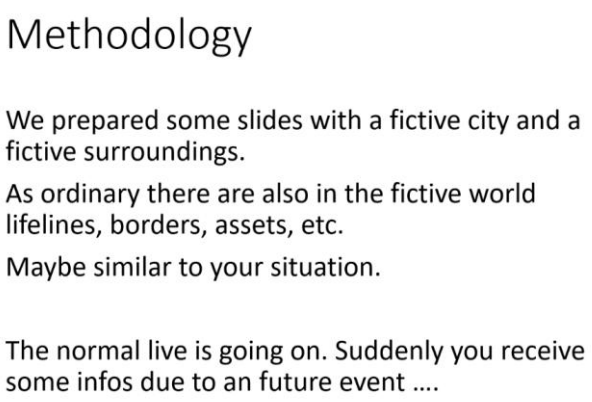


Figure 5: Methodology of the Use Case Scenario

In the next step, the workshop members created their scenario following the input of the concept of the fictive city (Figure 6). The best way to develop such a picture is on a flipchart or a whiteboard. It doesn't matter where they begin, but a bubble or circle in the sense of a system with the village or city is a good starting point. In this system, there are subsystems, and next to the system, there are other systems or metasystems.

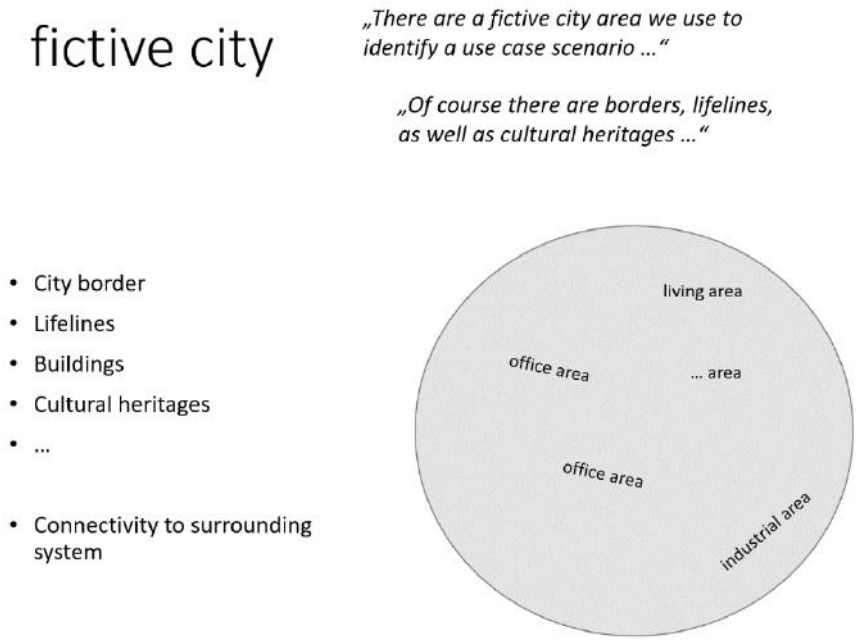


Figure 6: Building a fictive city

After some minutes, there is a picture of the fictive area developed. Figure 7 gives a short overview of how it might look like as a first draft. Different coloured lifelines, as well as borders, cultural heritage, etc. are visualized.

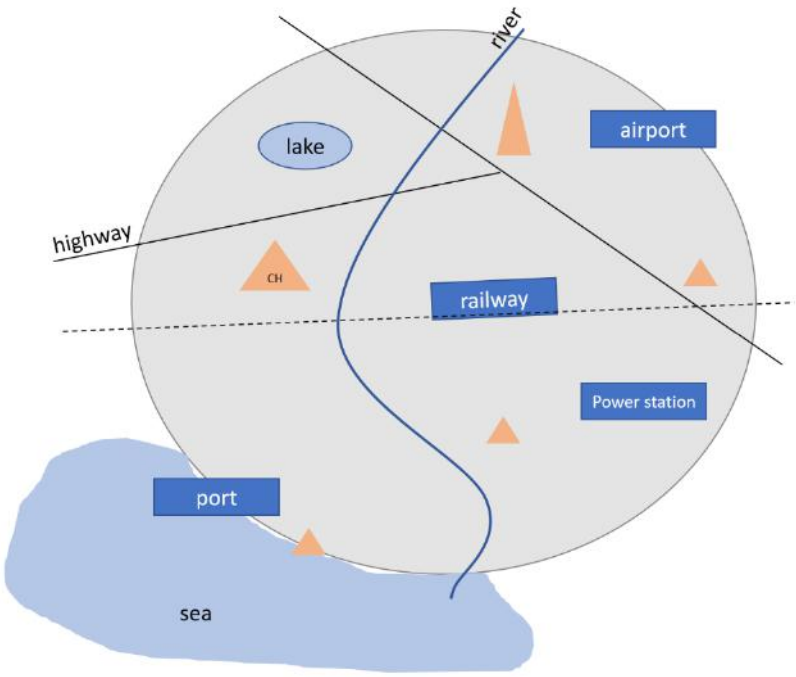


Figure 7: Picture of a fictive city

To support the stakeholders in the development process, a list of natural heritages, movable as well as immovable cultural heritage, is provided, as visualized in Figure 8. So, in an iterative step, the developed picture can easily be updated if necessary.

Figure 8: List of structured cultural heritage assets

In general, for all Use Case Scenarios but specifically for Sava River Basin and the Natural Park in Galicia, the idea of the relevance of borderlines must be taken into account.

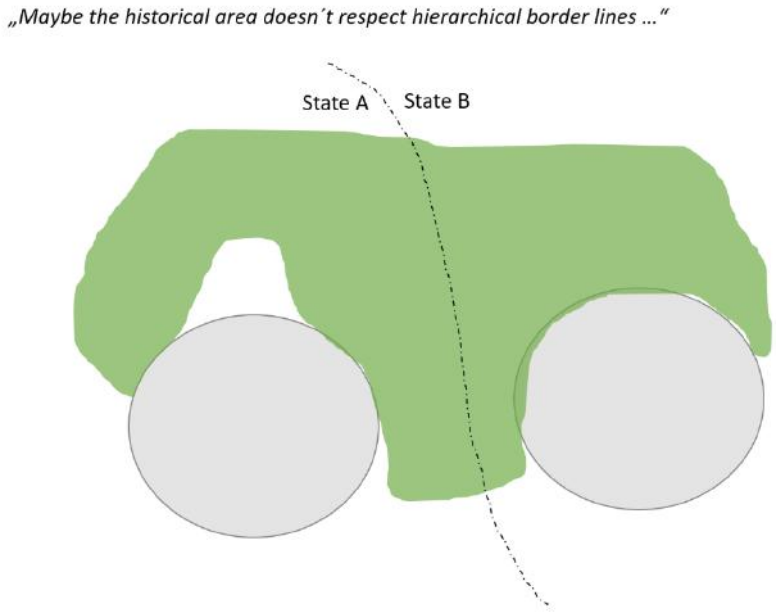


Figure 9: Prodding to borderlines

After some minutes, depending on the cooperation and the strength of the moderator, a fictive situation picture is developed based on the experience and knowledge of the stakeholders.

In the next step, the stakeholder group is confronted with the defined threat (see Table 2). The stakeholders have to discuss and document their needs and requirements following the time frame visualized in Figure 10.

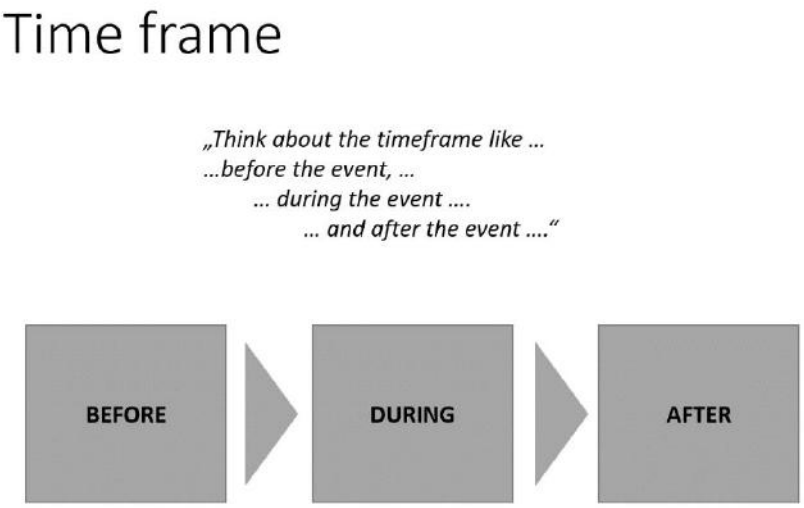
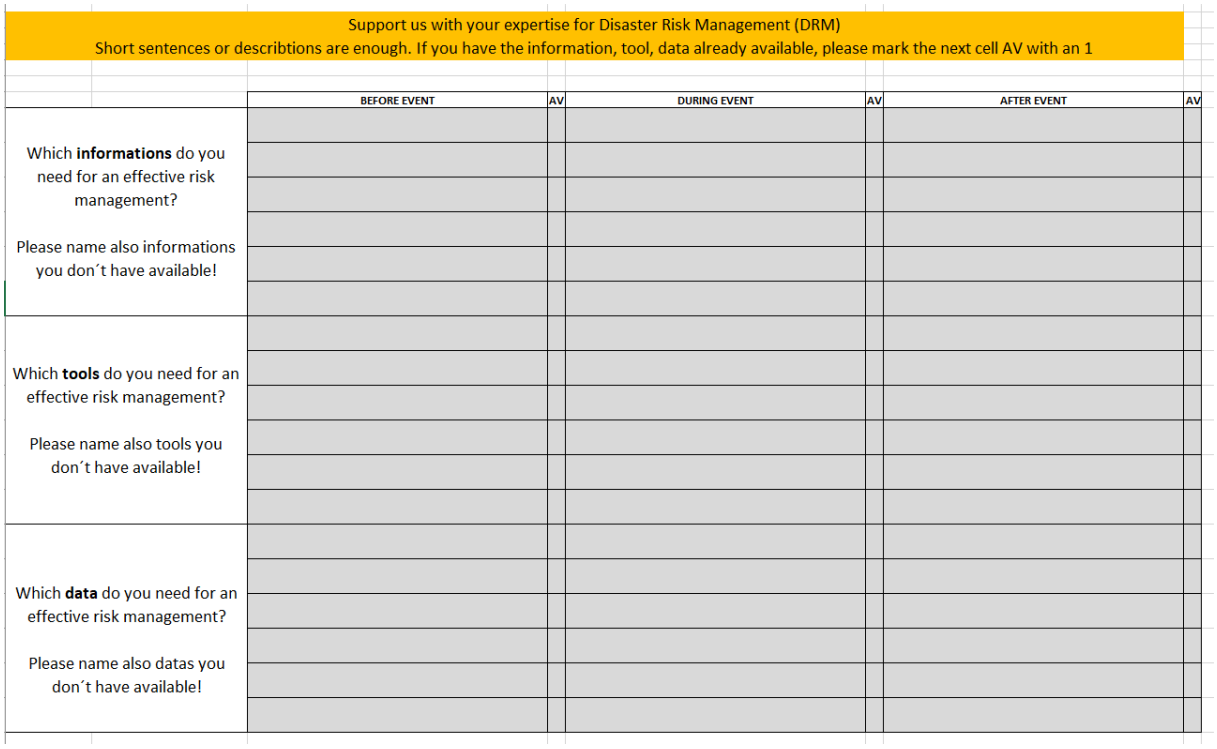


Figure 10: Time Frame for Use Case Scenario discussion

The documentation of the results of the debate depends on the available equipment and the preferred moderation type. In general, some flipcharts or posters are possible as well as blank cards or sheets of papers (e.g., each stakeholder should develop at least 3 [if possible, under the aspect of priority] requirements for each time window and topic DRM, CHM, CCA. To receive the relevant information from the stakeholders, some specific questions were developed dealing with the three identified topics. These questions are part of the following subchapter 3.2.3.2.

3.2.3.2 Use Case Scenario Questionnaire

The documentation of the discussion is necessary as a last step of the UCS development. Because four WS were done without UCS development, a specific UCS questionnaire was developed. This makes it possible that every participant can document his/her particular UR after the workshop due to the topic's DRM, CHM, and CCA. For the four OL regions which haven't developed the UCS so far, the development process (chapter 3.2.3.1), as well as the questionnaire, were forwarded to and discussed with the OL responsible persons to support the project with their expertise and impressions from the first workshops with hindsight. Figure 11 shows the questions and the structure for the DRM. So, each stakeholder can forward his/her specific expertise in the function of the daily work. In addition, there is the possibility to mark content (information, tool, data) that is already available.



Support us with your expertise for Disaster Risk Management (DRM) Short sentences or describtions are enough. If you have the information, tool, data already available, please mark the next cell AV with an 1						
	BEFORE EVENT	AV	DURING EVENT	AV	AFTER EVENT	AV
Which **informations** do you need for an effective risk management? Please name also informations you don´t have available!						
Which **tools** do you need for an effective risk management? Please name also tools you don´t have available!						
Which **data** do you need for an effective risk management? Please name also datas you don´t have available!						

Figure 11: Use Case Scenario questionnaire - DRM

The following Figure 12 shows the possibility for the stakeholders to fill in their knowledge in changes in CHM due to climate change.

Support us with your expertise for Cultural Heritage Management (CHM) Short sentences or describtions are enough.	
Do you expect any changes in CHM because of climate change for the hazard/threat and if yes which changes? If the answer is NO please write NO in the first cell.	

Figure 12: Use Case Scenario questionnaire - CHM

Especially for the OL of Baixa Limia-Serra Do Xurés Natural Park in Galicia the question was adapted to Natural Heritage Management (NHM) in the way of: "Do you expect any changes in NHM because of climate change …?".

Last but not least, Figure 13 shows the questions for CCA for each participant of the stakeholder workshop.

Support us with your expertise for Climate Change Adaption (CCA) Short sentences or describtion are enough.	
Do you think the hazard/threat will be effected by local climate change and if yes how? If the answer is NO please write NO in the first cell.	
Which are the trends in local extreme events due to the hazard/threat?	
Which impact of future local extreme events do you expect due to hazard/threat?	

Figure 13: Use Case Scenario questionnaire - CCA

3.3 Identified user requirements and user needs

The identified User Requirements are structured as follows:

- **General** – includes all UR with are basic for the SHELTER system in relation to the technical functionality as well as in relation to the identified stakeholder roles.
- **Data** – includes databases and identified important information and specific plans like evacuation plan or measurement plan.
- **Analysis** – includes amongst others UR dealing with monitoring and early warning systems.
- **Visualization** – summarizes the identified UR to visualize relevant content on digital maps including 3D as well as over time.
- **Crowd** – summarize the UR which are identified to communicate with people in both directions (e.g. warning messenger; reporting system, …).
- **Models** – includes for example foresight and state of the art models (e.g. wildfire model, meteorological model, …).

- **Equipment** – categorisation for identified equipment (just one specific UR was identified during the Use Case Scenario).
- **Report** – summarizes the UR which are specific for the reporting.

Since already in proposal phase some UR were identified, the generation of the structure concept of the UR was a logical step. Only the topic "equipment" was added after the results of the Use Case Scenarios were available. There was one UR identified (pumps are necessary in case of flooding and/or subsidence) which fits with this topic.

Additionally, some UR were identified during a WS at the 2nd General Assembly meeting in December 2019. These UR were integrated to the UR list with priority 1 (must have). This UR are also part of the whole UR list.

During the Use Case Scenario development also 23 additional UR were identified. These too were included to the UR list and marked as must have UR. In the following Figure 14 to Figure 16 the answers for the DRM questions are summarized from the returned feedbacks. A green marked cell means that the content before is already available.

QUESTIONS	OL REGION	BEFORE EVENT	AV	DURING EVENT	AV	AFTER EVENT	AV
Which **informations** do you need for an effective risk management? Please name also informations you don´t have available!	RAVENNA	monitoring system collecting all the information about the site		monitoring system collecting all the information about the site		monitoring system collecting all the information about the site	
		monitoring system collecting all the information about the risks (frequency, probability, magnitude, etc)		monitoring system collecting all the information about the risks (frequency, probability, magnitude, etc)		monitoring system collecting all the information about the risks (frequency, probability, magnitude, etc)	
		stakeholder database with the related competences		stakeholder database with the related competences		stakeholder database with the related competences	
	SAVA RiVER BASIN	Available observed and forecasted hydrological and meteorological data	1	Available observed and forecasted hydrological and meteorological data	1		
		Available data and information on CH sites and structures	1	Dissemination of warning messages describing what is happening, forecast and the expected impact, as well as advise what action should be taken or trigger a particular emergency response in the emergency plan.			
		Available warnings on vulnerable CH sites and structures					
		Available flood hazard and risk maps of vulnerable CH					
		Available flood risk management plan	1				
		Available emergency, evacuation and communications plan					
	DORDRECHT	Location of Cultural heritage objects	1	contact information of owners cultural heritage		total amounts of damages	
		Vulnerability of Cultural heritage				exact causes of damage	
		Flood data (return period, height, velocity, water quality	1	Flood data (return period, height, velocity, water quality	1	measures taken before flood event	
		contact information of owners cultural heritage				type of cultural heritage	
		long term models of flood damage	1				
		suitable adaptation measures					
	SEFEREKO	probability of risk - not available for all cases		feedback of victims to the hazard		detailed information of damage	
		action plan with spatial instructions - not available to a good quality		action plan with spatial instructions - not available to a good quality		action plan	
	GALICIA	fire prevention plan	1	Roads open for evacuation	1	landowners	
		areas of high risk	1	Roads open for emergency service	1	which species should be used to reforestation	1
		fire prevention actions	1	population living in the area affected	1	Is the reforestation working? (but we don´t have anyindicators)	1

Figure 14: Answers to DRM question about information

QUESTIONS	OL REGION	BEFORE EVENT	AV	DURING EVENT	AV	AFTER EVENT	AV
Which **tools** do you need for an effective risk management? Please name also tools you don't have available!	RAVENNA	water pumps		water pumps		monitoring system	
		multi hazard early warning system		Alert system		Alert system	
		Stabilization and consolidation techniques		Social network interaction		Social network interaction	
		citizen engagement solutions					
		platform systematizing all the information (site and risks)		platform systematizing all the information (site and risks)		platform systematizing all the information (site and risks)	
	SAVA RiVER BASIN	System for observed HM data exchange and use	1				
		System for CH data exchange and use					
		System for flood forecasting	1				
		System for flood warning					
	DORDRECHT	long term adaptation strategy		communication strategy / plan	1	communication plan	1
		Flood modelling	1	quick protection measures		updated data assessment tool	
		damage assessment / modelling					
	SEFEREKO	surveying tools - not adequate		communication tools - not effective at times of emergency		build back better materials - not always available	
		monitoring tools to determine higher risk areas and existing deformation - not available		intervention tools- available through governmental units			
		warning tools- available for storms					
	GALICIA	Queimas: to manage the fire permits of stubble-burning	1	emergency service	1	Xlumes informes: fires report that can be search by tags	1
		Convenios: to manage the agreements with local entities againts fires	1	XeoRecursos: Human and materials resources to manage fores fires	1		
				XeoCode2: GIS tool to management fires in real time (not local level, only province)	1		
				How is the fire going to spread?			

Figure 15: Answers to DRM question about tools

QUESTIONS	OL REGION	BEFORE EVENT	AV	DURING EVENT	AV	AFTER EVENT	AV
Which **data** do you need for an effective risk management? Please name also datas you don't have available!	RAVENNA	site characteristics (morphology, geology, uban functions, etc...)		site characteristics (morphology, geology, uban functions, etc...)		Report of the data registered during the event	
		DDP		DDP			
		climate data		climate data		Report of the data registered during the event	
		stakeholder database with the related competences		stakeholder database with the related competences		stakeholder database with the related competences	
		heritage charactistics (ICCD data or IBC)		heritage charactistics (ICCD data or IBC)		heritage charactistics (ICCD data or IBC)	
	SAVA RIVER BASIN	NTR		NTR		NTR	
	DORDRECHT	previous flood events data	1			actual damage data	
		value of cultural heritage (not only money)				current value of cultural heritage	
		adaptation measures average costs information					
	SEFEREKO	vulnerability maps - not available on smaller scales		communication data of vulnerable population		detailed surveys of assets - not wholly available	
		social data of vulnerable population - not available					
		monitoring data of assets as risk					
	GALICIA	Meteorological data (T, wind, humidity)	1	Meteorological data (T, wind, humidity)	1	Meteorological data (T, wind, humidity)	1
		Soil data (carbon, quality, other)		Water points	1	Soil data (carbon, quality, other)	
		Soil humidity	1	Vegetation data	1	resilience indicator or the burned area	
		Vegetation data	1	Soil data (carbon, quality, other)			
		Burnt areas	1	Soil humidity	1		
		resilience indicator?					

Figure 16: Answers to DRM question about data

In the following Figure 17 the answers for the five Open Labs dealing with climate change adaption is visualized.

QUESTION	OL REGION	ANSWER
Do you think the hazard/threat will be effected by local climate change and if yes how?	RAVENNA	Yes, the raise of rainfall will increase the risk of flooding connected with local subsidence
	SAVA RIVER BASIN	Yes, but very conditionally.
		In general all literature on floods indicates that future flood events will increase, but there has been no real quantification of this expectation.
	DORDRECHT	yes, floods and water damage will become more frequent, especially in high, unprotected areas of Dordrecht. There will be limited flooding but this still could be very damaging to the cultural heritage. Bigger storms are expected which can lead to localized flooding, extreme river discharge is still uncertain, however as there will be more extreme rainfall, peak discharges
	SEFEREKO	Yes
		The climate will affect vulnerable population through extreme weather events
	GALICIA	Yes, the dry season is becoming longer and the temperature higher which make the virulence of fires more dangerous
Which are the trends in local extreme events due to the hazard/threat?	RAVENNA	the events are getting more common and worsening
		The last August the area has been flooded with water almost over one meter high
	SAVA RIVER BASIN	Climate change will increase the peak discharges mainly in the head part of the Sava River Basin watershed.
		The maximum daily precipitation in the autumn season, which has proven to produce the largest floods, is expected to increase until the end of the 21st century.
		The hydrologic projections plainly indicate that floods will increase in the future due to climate change. The increase was shown to be greater for 100-year floods than for the 20-year events, thus suggesting an overall increase of the flood risk.
	DORDRECHT	Increasing, especially considering rainfall, draught and heat. The largest threat for Dordrecht is the sea level rise, however this will not become increase the risk for flooding in the coming decades. However if the sea level rises very quickly, by the end of this century large measures will have to be taken to ensure the safety of Dordrecht and the western part of the Netherlands.
	SEFEREKO	Extreme weather events come in two forms that affect rural livelihoods such as agricuşture and fishing, and also tourism:
		Storms affect fishing and agriculture.
		Heat waves affect the whole population.
	GALICIA	If T>30, winds > 30 km/h and humidity <-0% the risk of fire is higher. The probability of having those conditions will be higher because of the climate change and those conditions make wild fires more dangerous
Which impact of future local extreme events do you expect due to hazard/threat?	RAVENNA	The area will be partially unaccessible and closed to visitors
		the area will be abandoned
		Economic loss
		Cultural Heritage loss
	SAVA RIVER BASIN	The flood modeling results indicate that the climate-induced impact will be smaller in the downstream plains than in the upstream mountainous regions.
		The main predicted impact on future flood management is not only climate related, but associated also with future social, economic, and infrastructure development.
		Without a doubt, the impact that climate change will have on flooding in the future is significant and should not be underestimated, since the flood hazard is increasing.
	DORDRECHT	increased impact due to the higher frequency of extreme events. Damage can increase to the cultural heritage, and if the owners (often private) do not want to pay for the maintenance anymore there could be large difficulties with keeping the cultural heritage in its current state.
	SEFEREKO	One can expect deterioration of the citadel and civil architecture due to extreme weather.
		Also, tourism and such CH supporting fields of income will become less predictable.
	GALICIA	An increase in the risk of wild fires and they will be more virulence

Figure 17: Answers to CCA questions

In the Figure 18 the answers for the cultural heritage management as well as for the natural heritage management are visualized.

QUESTION	OL REGION	ANSWER
Do you expect any changes in CHM because of climate change for the hazard/threat and if yes which changes?	RAVENNA	Some parts of the area will not be accessible and partially closed to visitors
		Possible damages and permanet loss
	SAVA RIVER BASIN	If future flood events increase CHM will have to be changed and improved, especially a way how to protect the existing CH during events.
	DORDRECHT	Yes, current maintenance must change to include adaptation measures, private and public owners must be made aware and assisted to make this transition. If this can be done along the line with scheduled maintenance plans the extra costs and effort will be lower.
	SEFEREKO	Yes
		Cultural heritage will be affected by extreme weather events, which will lead to need for reinforced building materials to support restoration works.
		Sea level rises are not an immediate effect in our case study, but around the world this will lead to vacated living CH areas and subsequent detoriariation.
		Extreme temperetures in some CH areas in Turkey (but not our case study) are already threatening livelihoods and are a supporting factor to immigration.
Do you expect any changes in NHM because of climate change for the hazard/threat and if yes which changes?	GALICIA	Yes, the metereological conditions will make the NHM more vulnerable
		For example the reforestation plan wil have to be designed taking that in mind

Figure 18: Answers to CHM questions

Based on the results of the UCS some of the identified UR are still available or implemented because the stakeholder had the possibility to give their expertise not only on "missing" aspects but also in relevant and necessary existing solutions, information's, tools and data's. In the following Figure 19 these UR which are available and/or implemented in at least one OL's are visualized.

No	Topic	Description
UR-095	analysis	Platform with status quo as well as forecasted hydrological and meteorological data.
UR-096	data	Database about CH in area of interest with several information about status.
UR-099	analysis	Flood risk management plan for CH sites
UR-101	data	Location informations about CH sites. The locations may be visualized in map.
UR-107	data	Flood data (return period, height, velocity, water quality).
UR-109	analysis	Long term monitoring system of flood damage.
UR-112	models	Flood forecasting system.
UR-116	data	Database about the soil humidity

Figure 19: Identified UR available at least in one Open Lab

The combined answers for the UCS questionnaire of all OL's are part of Annex II of this deliverable. The complete list of all bottom-up analysis identified UR is part of Annex III of this deliverable.

All in all, 116 User Requirements were identified so far via the described process.

In the following Figure 20 the match of the identified UR according to the eight structured topics is visualized. Following the analysis nearly 50% of the identified UR were general ones, followed by models and analysis requirements.

	general	data	analysis	visualisation	crowd	models	equipment	report
sum	51	16	17	4	6	19	1	2
rank	1	4	3	6	5	2	8	7

Figure 20: Statistics of identified UR

Due to the prioritization done by stakeholders from all OL all identified, the result of a cross-section analysis was that nearly all UR are relevant and prioritized with "must have".

With notice of the prioritization possibilities, 12 most important UR were identified. This analysis was done by ranking the total prioritization results. These are shown in the following Figure. Due to the fact that more or less all identified UR were prioritized with "must have" for at least one Open Lab, all UR must be taken into account.

On the other hand, the focus of the SHELTER project match with this highly ranked UR. The prioritization analysis was just done with the UR (83) which were identified during proposal phase and analysis of national and international projects. The UR which were identified during GA meeting (8 UR) as well as with the Use Case Scenarios (25 UR) weren't part of this ranking, because this UR were automatically high ranked as "must have". The focus of the prioritised high ranked UR is on implementation of state-of-the-art models as well as foresight models for the hazard/threats which the Open Labs are faced. This UR are shown in the following Figure.

The UR which were identified during GA meeting and with the Use Case Scenarios are shown in Figure 22.

No	Topic	Description	SEFEREKO	DORDRECHT	ISRBC	UNIBO	Galicia	highest score	sum	rank
			Priorities	Priorities	Priorities	Priorities	Priorities			
UR-005	general	All direct stakeholders shall not modify data/information directly associated with source data/information	2	1	1	2	1	1	7	7
UR-007	general	The analyst shall be able to rely on the information stored on the SHELTER system	1	1	2	1	1	1	6	3
UR-009	general	The System Administrator shall be able to assure the team manager that the information processed by SHELTER is secure.	1	1	1	1	1	1	5	1
UR-020	general	The SHELTER solution shall support the collection of data from a range of present information sources and the possibility of adding other information sources in the future.	2	2	1	1	1	1	7	7
UR-039	general	The systems administrator shall be able to identify the issue(s) with faulty collection events	2	2	1	1	1	1	7	7
UR-040	general	The SHELTER system shall be able to support multiple arguments [search using multiple filters/keywords etc.]	1	1	1	2	1	1	6	3
UR-045	general	The Analyst shall be able to export the data from the SHELTER tools.	1	1	1	2	1	1	6	3
UR-060	models	Implement state of the art models for climate change	1	1	1	1	1	1	5	1
UR-061	models	Implement forecast models for climate change	2	1	1	1	1	1	6	3
UR-067	analysis	Implement algorithms for risk analysis	1	2	1	1	2	1	7	7
UR-075	visualisation	Automatically visualisation of relevant content on digital mapping tool	2	2	1	1	1	1	7	7
UR-083	visualisation	Geographic vizualisation of risk and resiliance measures over time	1	2	1	1	2	1	7	7

Figure 21: High ranked "most important" UR based on prioritization by stakeholder

In general high ranked are the 33 UR which were identified during the GA meeting and the Use Case Scenarios. This UR are visualized in the following Figure.

No	Topic	Description
UR-084	analysis	Decision making tool for the existing as well as new identified and collected data to support decision makers more efficient.
UR-085	analysis	Resilience indicator assessment to map CH correctly due to vulnerability and resilience.
UR-086	crowd	Platform for private sector to engage. Possibility to share ideas and views to the topic.
UR-087	general	Integration of still existing tools into the SHELTER platform.
UR-088	crowd	Kind of informations platform for adaptation measures for citizens in advance or during event.
UR-089	analysis	Financial calculation tool about losses. Need to identify financial solutions to protect Cultural/Natural Heritages.
UR-090	general	Communication plan or strategy for stimualtion adaptive maintenance of CH.
UR-091	general	Implement a territory custody for private sector contracts.
UR-092	analysis	Real time monitoring system for situation on site including determination of existing deformations.
UR-093	analysis	Risk monitoring system (including frequency, magnitude, propability, etc.).
UR-094	data	Stakeholder database with real time status informations (ready for use, in mission, location, etc.).
UR-095	analysis	Platform with status quo as well as forecasted hydrological and meteorological data.
UR-096	data	Database about CH in area of interest with several information about status.
UR-097	crowd	Warning messenger including possibility of integration of forecast informations, expected impact informations, etc.
UR-098	models	Multi hazard early warning system specific for several CH sites.
UR-099	analysis	Flood risk management plan for CH sites.
UR-100	data	Emergency, evacuation and communication plans available. The plans must be updated continuously so therefore a database with reminder would be good.
UR-101	data	Location informations about CH sites. The locations may be visualized in map.
UR-102	analysis	Instrument to receive total amount of damage after event.
UR-103	data	Database for stakeholder to support about amount of damage after event.
UR-104	data	Database of owner informations of CH sites.
UR-105	analysis	Vulnerability assessment or analysis of CH in advance.
UR-106	general	Post information about the exact causes for damage during event.
UR-107	data	Flood data (return period, height, velocity, water quality).
UR-108	analysis	Information about status of measures taken before event starts available after event.
UR-109	analysis	Long term monitoring system of flood damage.
UR-110	data	Suitable prepareness measurement plan.
UR-111	equipment	Water pumps (specific for RAVENNA).
UR-112	models	Flood forecasting system.
UR-113	data	Database with value of CH not only money based. Value parameters to be defined.
UR-114	analysis	Preview about average costs of adaptation measures.
UR-115	data	Database about the soil conditions (carbon, quality).
UR-116	data	Database about the soil humidity

Figure 22: High ranked UR based on GA meeting and Use Case Scenarios

During the literature review also different stakeholder roles were identified. The description and structure are part of the following Table 3. Due to the fact that the five Open Labs covers the range of local to international perspective by reference to different hazards/threats this identified stakeholder roles are the common denominator. Of course, there are also other roles available, but these seems to be the most important roles for the SHELTER project.

However, it should be noted that probably the role Analyst and Collector can be merged in some cases.

Role	Description
Team leader	**This is a management centred role.** This is usually a middle management figure, whose role it is to manage the operational efficiency and efficacy of investigative team.

Analyst	**This is an information centred role.** This role would normally be performed by a specialist who is concerned with the interpretation of content
System administrator	**This is a technology centred role.** This role would be performed by someone who is concerned with ensuring SHELTER is available to use and will be called upon to reconfigure the system to accommodate new technological capabilities.
Collector	**This is a data centred role.** This role is concerned with capturing relevant data. They would then input this data system and may specialise in certain collection means in order to ensure and maintain proficiency in those collection techniques.

Table 3: Stakeholder Roles

An extensive description of the potential roles that stakeholders played in each root cause analysis (RCA) and the potential opportunities in which SHELTER could explore is provided in chapter **¡Error! No se encuentra el origen de la referencia.** in **¡Error! No se encuentra el origen de la referencia.**.

3.4 Conclusions and outlook

In this chapter the process for the bottom-up UR identification as well as the UCS are described. So, via literature review in combination with text analysis as well as direct contact with technical partners as well as stakeholders from the Open Labs via the team of WP7, a complete setting of UR were identified. The process describes the identification as well as modification and update of the user requirements within several steps. This identified UR are for the complete SHELTER project especially for the technical work packages WP3, WP4 and WP5, for WP1 dealing with data as well as for WP7 for the following OL workshops.

With the described steps using templates of prepared questionnaires and UCS as well as several workshops, 116 specific user requirements were identified and prioritized by the stakeholders. Following the analysis nearly 50% of the identified UR were general ones, followed by models and analysis requirements. More or less all identified UR are prioritized as "must have" for at least one OL. So, ranking of the UR was done with the total of the prioritization results. Implementation of state-of-the-art models as well as foresight models for the hazards the Open Labs are faced was identified as potential with this analysis. In addition, also the UR which were identified during GA meeting as well as UCS were ranked as "must have".

Nevertheless, for the further research all of the UR must be taken into account. Another result was that most of the identified UR were general one followed by models, visualization and analysis-based UR´s.

The feedback from the stakeholder for the questions for CCA and CHM are common that the damages due to hazards increase. Trends of local extreme events increase too. Consequences for the cultural sites are not available so far but predicted by the experts.

It depends on location but the prediction ranges from damage of object will increase to final destruction and permanent loss of sites. Analysis and measures are necessary according the fact that hazards increase. Another result of this research was to identify some stakeholder roles which are necessary to be implemented according to use a potential SHELTER system. The complete list of all bottom-up analysis identified UR is part of Annex III of this deliverable.

4 Identification of key stakeholders & application of ICT based on past events

4.1 Introduction & position of T6.1.1 within the SHELTER Project

The following section of the deliverable outline's the purpose of T6.1.1 within the context of the entire T6.1, as well as its broader role in the SHELTER Project. ULIEGE was responsible for the delivery of this task and proposed the use of an adapted form of root cause analysis (RCA) methodology referred to as an 'ex-post analysis.' RCA is a well-established, and embedded qualitative research tool (Miller, 1992) used across a variety of different disciplines and research applications. The methodology will explore three contemporary case studies of disasters which have affected cultural heritage. These three case studies represented three distinct spatial scales (following the scales defined with the SHELTER Project) and three different hazards.

The methodology was designed to give the most breadth and depth of detail within the timeline of the project. The case studies are outlined in section 4.3. The available contemporary literature on each case study developed specific causal factors charts identifying the causal factors particular to each event. Furthermore, the key stakeholders will be identified and associated with the context of CCA and DRM. This will allow for the development of a mapping of key stakeholders based on their perceived power and influence within each case. Additionally, the existing barriers and opportunities in which ICT could provide potential solutions in each case have been used to broaden the scope of the data-driven platform and help to shape the outcome of T6.3 (adaptive governance mapping schemes). This task will deliver a series of actors and rules to be considered in the ABM (T2.6) and guide adaptive social capacity assessment as inputs for WP2.

4.2 Methodology: ex-post analysis of recent disasters (root cause analysis)

The RCA is an extremely well-cited and well-embedded methodological approach across academia (Rooney *et al*., 2004). RCA has a clear and well-defined purpose as a 'reactive' methodological approach used to identify the multiple causes of a problem after the event. The methodology was defined concisely by Rooney *et al*., (2004) and can be categorized as;

> '*A tool designed to help identify not only what and how an event occurred, but also why it happened*.'

Initially, RCA was designed to assess the causes and risks associated with industrial accidents. But due to its adaptability, the methodology has been used in a wide array of iterations across many disciplinary lenses to suit different projects including but not limited to; health care (JCR, 2015; Charles *et al*., 2016), quality assurance, service improvements (Dorsch, 1997; Dalgobind & Anjani, 2008), and even to explore issues during military exercises (Miller, 1990). RCA has been used in response to the call for science to support policy by facilitating the development of more holistic solutions to

disaster risk within the Sendai framework (see UNDRR, 2015). Contemporary research has identified the value of RCA within the context of DRM and the identification of risk. One such example is in the preparation made to mitigate against extreme and rare events in coastal regions framework, known as the (PEARL) framework (Fraser *et al*., 2016) (see. http://www.pearl-fp7.eu/about-pearl/ for more detail). However, despite a comprehensive array of applications, there are limited examples where the methodology has been used to unpack distinct events that occurred within a disaster explicitly. As a result, there are very few examples to draw from and inform the design and development of a robust RCA that can be used to address the research question.

However, because of the clearly defined conceptual boundaries, a large array of pre-existing research work can be used to design a suitable methodological approach. Rooney *et al*. (2004) provides a handy summary of the RCA approach and states that four major steps are consistent across the diverse applications which develop a correct and robust approach. These are outlined as follows; 1) Data Collection & Consolidation; 2) Causal Factor Charting; 3) Root Cause Identification; 4) Recommendation Generation & Implementation. These steps were the basis for the development of an ex-post analysis of the three case studies within this report. This methodological approach has been outlined below.

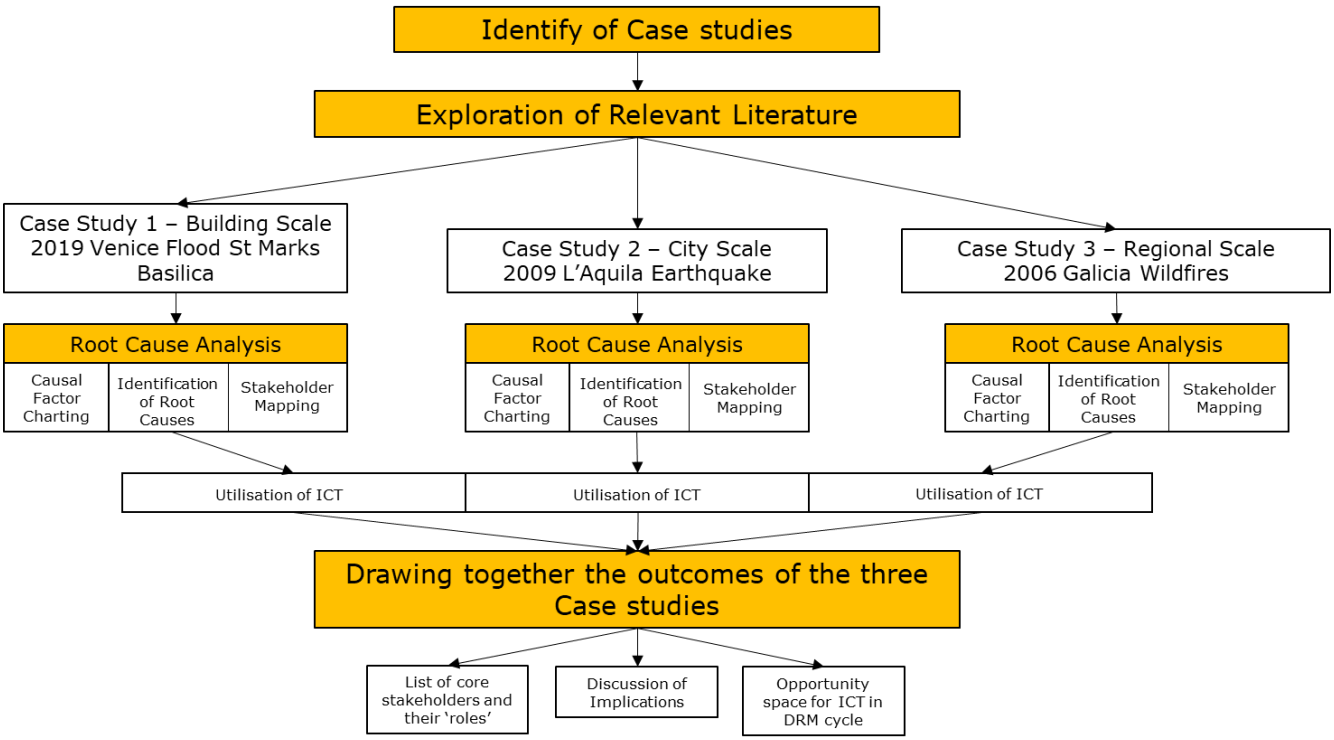


Figure 23: An adapted form of ex-post analysis methodological approach based on the root cause analysis used to highlight the root causes of three natural disasters, map stakeholders, and explore the usage of ICT.

The methodological approach outlined above is an adapted form of ex-post analysis based on an RCA. The initial step in the methodology requires the identification of three case studies and then independent literature reviews consolidating and organizing the events that occurred during those case studies.

Secondly, a causal factor chart developed on each of the case studies, which highlights the different events that occurred throughout the disaster and the perceived causal factors which contributed or exacerbated the issues within each case study. Furthermore, a map of the key stakeholders is elicited from the literature review based upon their 'power' and 'interest' in that event. The identified causal factors are then used to establish the specific root causes. Finally, based on the exploration of literature, a review of the utilization of ICT will be conducted for each event.

Approaching the development of stakeholder mapping in this way allows for the consideration of the interacting nature of different elements that occurred during the event. Furthermore, it provides a mechanism for revealing potentially 'silent' stakeholders that are not always considered in the various stages of the DRM cycle. Finally, this section of the report also provides a valuable example of how RCA can be used retrospectively on a disaster. The following section of the report is the first step in the methodological approach and identifies the criteria for selecting case studies based on the requirements of the research.

4.3 Identification of three case studies

Not only have the frequency and magnitude of disasters increased within the last few decades (Lionel & Jackson, 2016). But ICT has provided an improved ability to record and analyze the different aspects of disasters accurately. To ensure useable results for SHELTER and to help inform T6.1, case studies chosen so that they share many characteristics with the SHELTER OL's. There were several specific requirements which the case studies had to fulfil to be suitable for the research and the wider SHELTER project which helped to identify the following three case studies;

1) 2019 flooding in Venice with a focus on the 'St Marks Basilica.'

2) 2009 City of L'Aquila earthquake in the Abruzzo region in Italy.

3) 2006 autonomous community Galicia wildfires in Spain.

Case Study	Scale	Date	Type of Disaster	Heritage Value
1. Saint Marks Basilica, Venice.	Building	November 2019	Wide-scale flooding as a result of the seasonal rise in sea levels.	Built between AD829- 832; Unique Architecture; Houses the body of St Mark.
2. City of L'Aquila' Italy.	City/Urban	April 2009	6.3M_w earthquake with an epicentre 2km away from the city centre.	Iconic baroque and renaissance architecture; Romanesque churches
3. Autonomous Community of Galicia, Spain	Regional	August 2006	Regional Wildfires as a result of increased drying of vegetation and potential arson.	Natural, cultural heritage; watermills, granaries, and stone laundry basins and oral traditions

Table 4: Summary of the three case studies selected for the RCA.

4.4 Case Study 1 ('Building Scale') – 2019 Flooding in Venice, St Marks Basilica

4.4.1 Background & context

Figure 24: Location of St Marks Basilica in Venice [Image adapted from Google Earth].

Venice was founded in the 5th Century AD, and the existing settlement spread over 118 small islands. The city has one of the highest concentrations of important historic architecture in the world (UNESCO, 2019). The Lagoon section of the city is considered an architectural masterpiece and an internationally recognized cultural heritage site because of its integrity, authenticity, and management (UNESCO, 2019). However, due to the city's orientation and location, it is under continuous threat from flooding, which is being exacerbated by climate change. The city has a history of flooding and the most recent of which took place in November 2019, in which high tides caused a rise in the water levels by 1.87m. The rise in sea levels caused wide-scale flooding and millions of euros worth of damage to the array of important heritage sites across Venice.

Saint Marks Basilica is cited as the oldest building in Venice built between AD829- 832 to house the body of St Mark (Fletcher & Spencer, 2005). Because of its history, it is an important cultural heritage site and one of the few examples in the world in which eastern and western cultures are experienced together in architecture. However, the site has a well-documented history of flooding dating back to the Roman times (Fletcher & Spencer, 2005), and it bears the marks of centuries of damage, most recently the 2019 November floods, which resulted in millions of Euros of damage to the historic buildings architecture. The purpose of the case study is to explore the events of 2019 to understand the root causes of the damage resulting from the November 2019 Flooding that affected St Marks Basilica. The following section attempts to map out those key events and identify the root cause, core stakeholders, and the application of ICT throughout the case study.

4.4.2 Causal factor charting

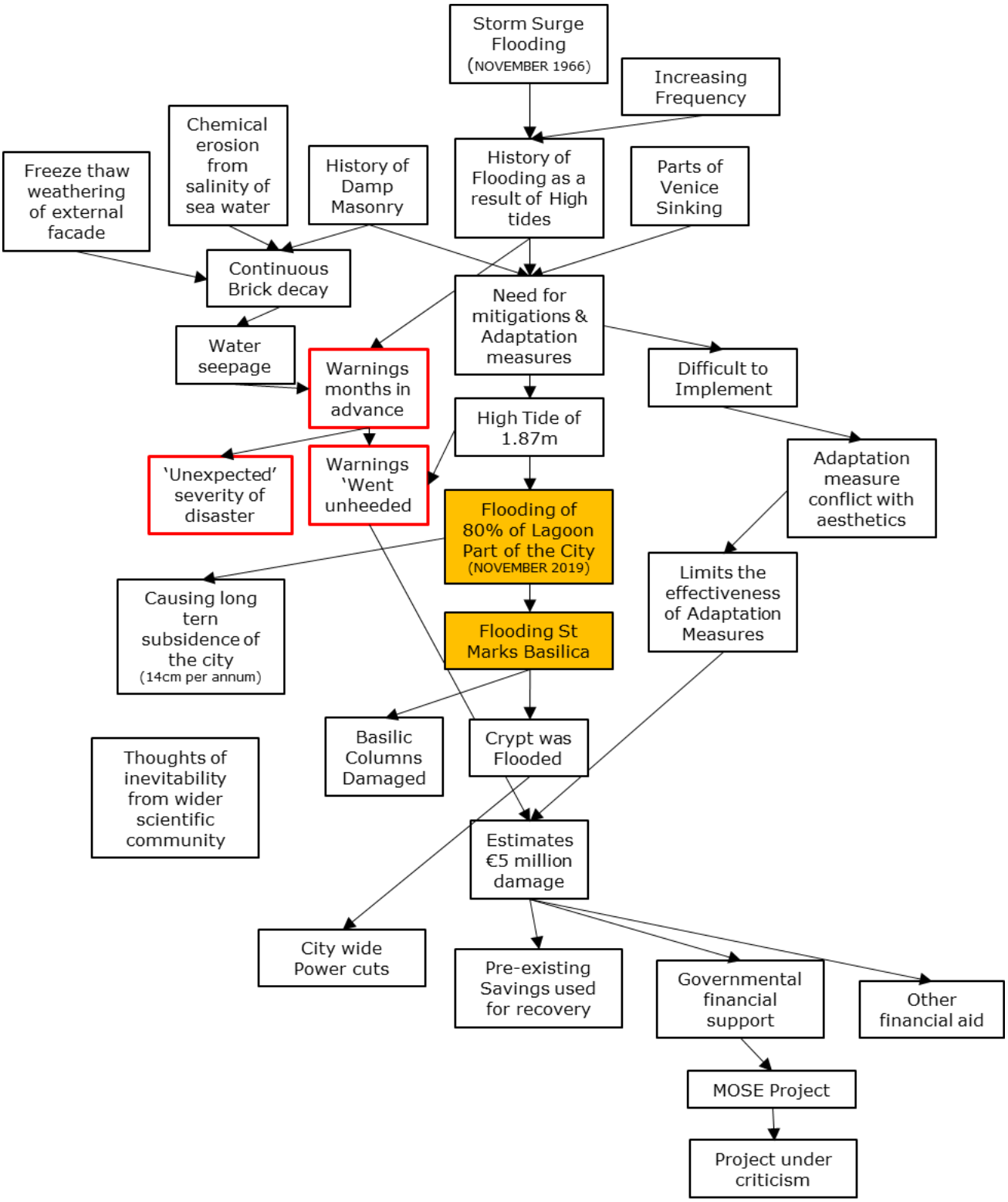


Figure 25: Causal Factor Chart unpacking the events that affected St Marks Basilica that took place during the 2019 Venice Floods in Italy.

4.4.3 Identification of root causes

Root Cause 1: Insufficient mitigation measures and 'unexpected' severity nature of the disaster - First of all, there is a well-cited and recorded history of flooding across Venice as a result of the seasonal high tide event known as the '*Acqua Alta*' (Trincardi *et al*., 2016). There have been mitigation measures put in place to prevent damage to the vast array of important heritage sites resulting from rising sea levels. However, despite this commonly occurring and somewhat predictable nature of the phenomenon, Venice continues to flood at an increased rate of severity and frequency (Pirazzoli, 1983). Indicating that mitigation measures that are currently in place are failing to account for the increasingly severe floods and acceleration of flooding due to climate change.

Root Cause 2: Science not necessarily making the effective transition in policy and practice - Within the case study, it became apparent that there is a conflict of interest between protecting the building from the ongoing water damage and altering the aesthetics. For example, according to work conducted by (Sandrolini *et al*., 2005) proposed innovative engineering mechanisms to protect the crypt could not be used because they hindered the ascetics of the building and would disrupt the pre-existing old architecture. Furthermore, despite the vast array of modeling and prediction data being made available to predict rising sea levels, the mitigation measures implemented in Venice failed to prevent the damage.

4.4.4 Stakeholder mapping

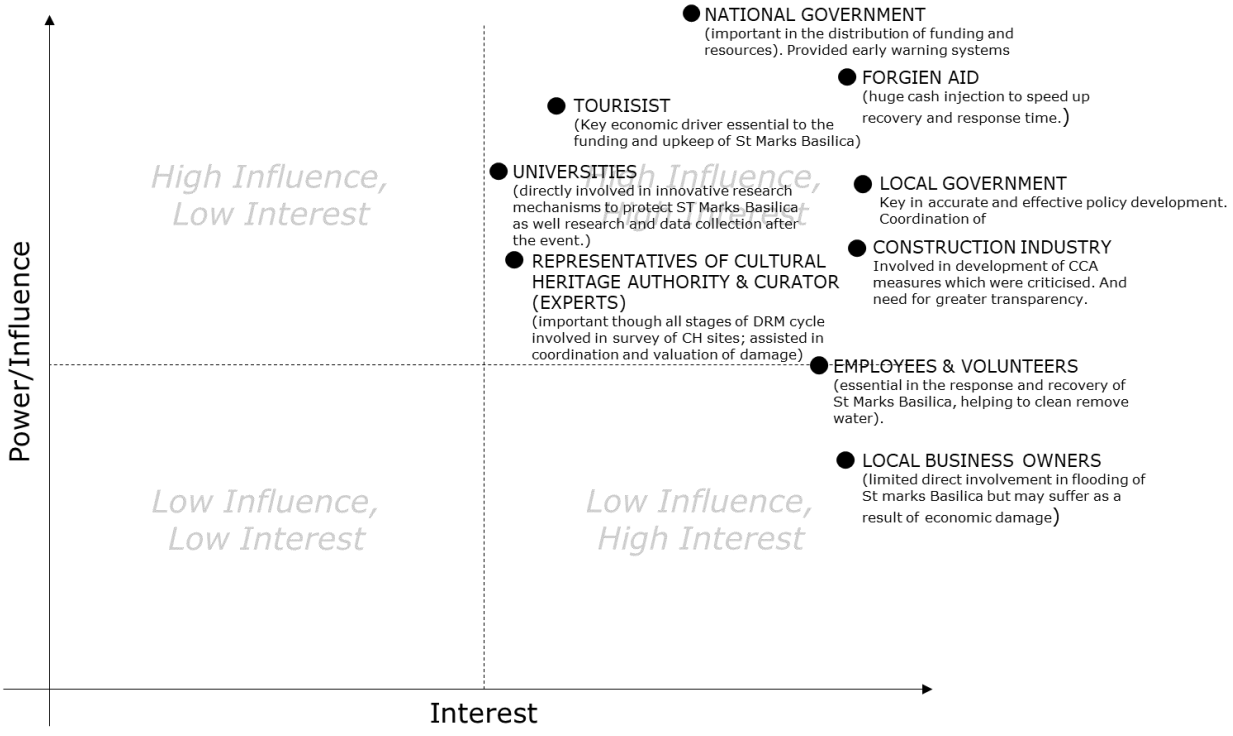


Figure 26: Map of stakeholders referred to within available academic literature and external sources of information 2019 Flooding in Venice. Map by the power/influence and interest immediately after the event.

4.4.5 Application of ICT

First of all, because of the failures of the current mitigation measures such as the MOSES project, it appears modeling and prediction mechanisms are insufficient at keeping up with the impacts of climate change and the increase in sea level. This indicates that the current ICT modeling systems used may be inaccurate.

4.4.6 Summary of case study & implications

- Measures to mitigate the dramatic situation in recent years that are being developed may not follow the trend/steps with rapidly increasing climate change and will not protect vulnerable sites.
- There may be a conflict of interest between the public, technology, culture, and heritage authorities between measures/integration of mitigation measures and influencing the aesthetics and history of the building.
- Tourism, despite being a huge economic driver in many cases of CH sites there have minimal impact or input in the CCA & DRM strategies.

4.5 Case Study 2 'City Scale' - 2009 L'Aquila Earthquake in the Abruzzo Region Italy

4.5.1 Background & context

L'Aquila is a city in the Abruzzo region in central Italy (Chiarabba *et al*., 2009). The city has approximately 70'000 inhabitants with a long and rich history because of its strategic importance as the region's capital (Binda *et al*., 2011). The entire Abruzzo region is famous for its cultural heritage, including its iconic baroque and renaissance architecture. Most notably are the 1000 Romanesque churches, twelve situated in the city of L'Aquila, which shape the city's urban planning. These churches have significant value for World Heritage (Gattulli et al., 2013), in particular, the Basilica of Collemaggio (Gattulli et al., 2013) and the Basilica of San Bernardino. Furthermore, the region has over 700 palaces (Binda *et al*., 2011) and a renaissance era Spanish fortress, all of which contribute to the region's unique cultural heritage.

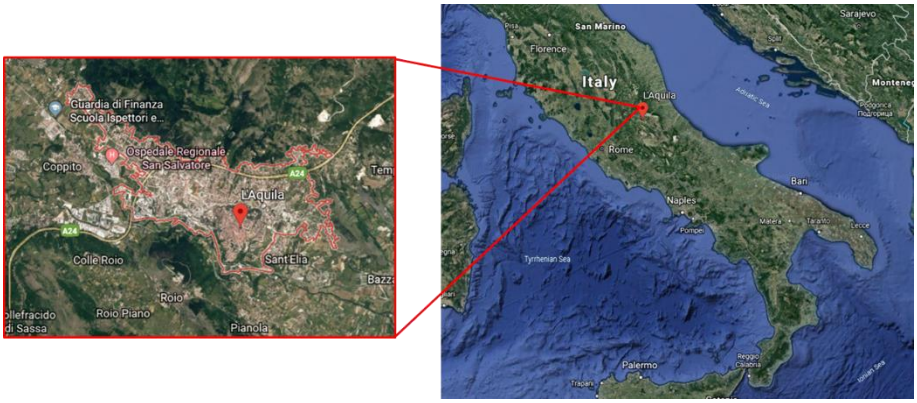


Figure 27: Location of L'Aquila [Image adapted from Google Earth].

However, the Abruzzo region has a history as one of the most active seismic areas in the Mediterranean (Gruppo di Lavoro CPTI, 2004; Modena *et al*., 2010) and Italy (Akinci *et al*., 2009) with a history of earthquakes dating back to the Roman Empire. This seismic activity is a result of a combination of factors, first of which is the fact that L'Aquila is situated on the convergence of the African and Eurasian tectonic plates (Parisi & Augenti, 2013) in which several faults occur (see. Chiarabba, *et al*., 2009). Furthermore, the distinct geology of the Abruzzo region further exacerbates the effects of the seismic shocks (Modena *et al*., 2010). On the 6th April 2009, following several months of foreshocks (Chiarabba *et al*., 2009), the region experienced a moderately sized earthquake.

The earthquake hit at 1:32 UTC, and 3:32 am local time occurring on the SW dipping Paganica fault (Walters *et al*., 2009). The epicenter was at Poggio del Roio 3km south from the L'Aquila town center measuring an Mw6.3 magnitude (Chiarabba *et al*., 2009). The earthquake was felt across the surrounding 81 municipalities, including L'Aquila, Avezzano, Sulmona, and Teramo (Modena *et al*., 2010). Concerning L'Aquila, the earthquake resulted in between 308-321 fatalities (ERRI, 2009), injuring 1'500 and left more than 60'000 people homeless (ERRI. 2009). Furthermore, much of the city´s foremost cultural heritage sites were severely damaged, as well as one wing of the University dormitory (Lagomarisano, 2012) totaling an economic loss estimated at more

€25 million (Formisano *et al*., 2010). The earthquake highlighted the vulnerability of L'Aquila city to a moderate seismic event, and large amounts of academic research explored the lessons to be learned from the disaster. Much of the following research focused around the causes of building collapse (Binda *et al*., 2010; Modena *et al*., 2010) and the marginalization/victimization of the local communities after the event (see. Alexander, 2010; Alexander & Magni, 2013; Alexander, 2018). The purpose of this RCA is to revisit the L'Aquila literature and outline the events that occurred throughout the earthquake. To highlight the causal factors, identify core stakeholders and analyze the utilization of ICT within the event to provide a map of the key stakeholders, highlighting the main causal factors and how ICT may, or could have been used to minimize the vulnerability of the cities buildings to earthquakes.

4.5.2 Casual factor charting

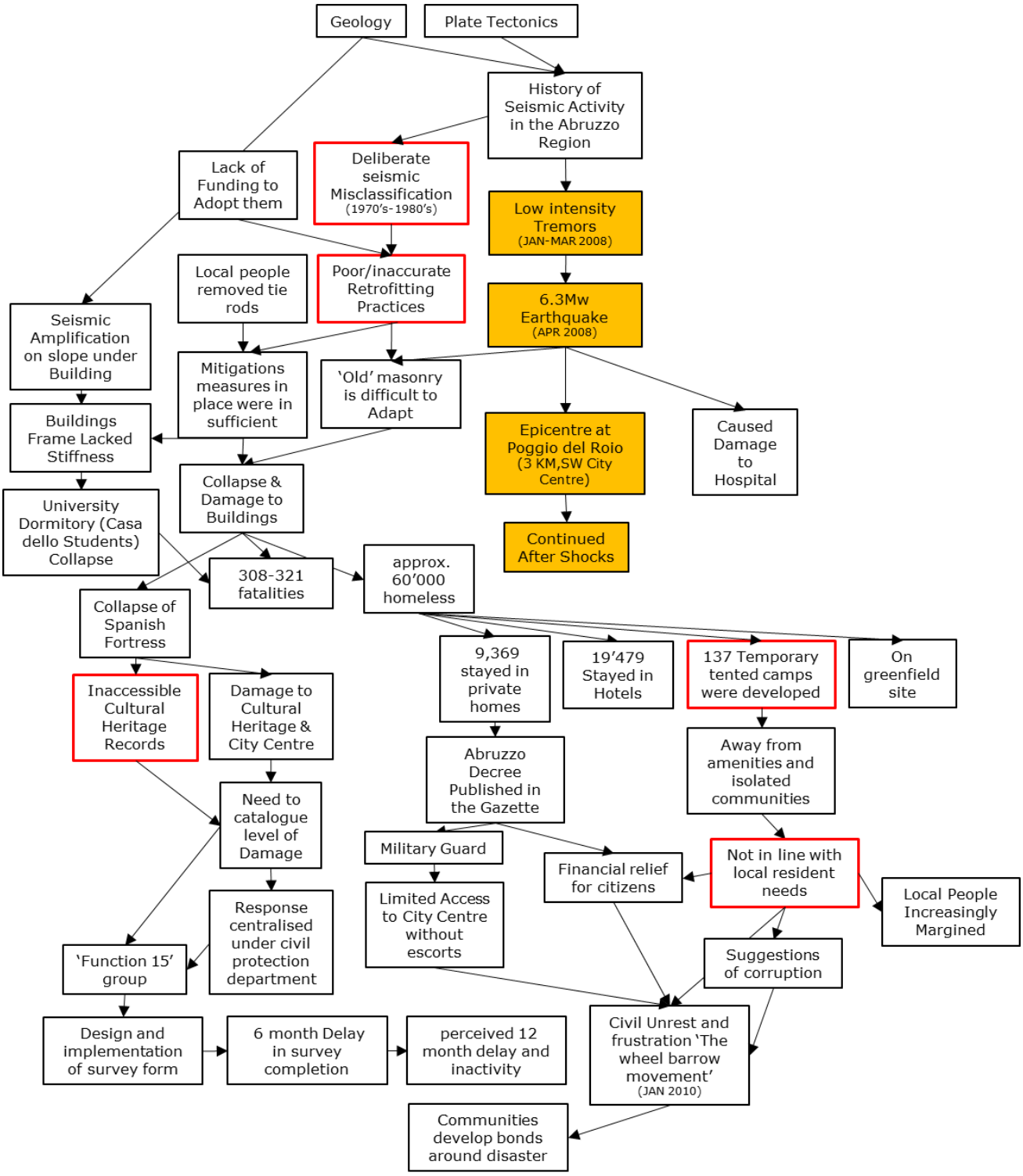


Figure 28: Causal Factor Chart unpacking the events that took place during the 2009 L'Aquila earthquake in the Abruzzo region, Italy.

4.5.3 Identification of root causes

The causal factors outlined in section 4.4.2 highlight the significant causal factors which resulted in the unprecedented damage and slow recovery of the cultural heritage in the L'Aquila region. The causal factors have been used to identify four perceived root causes; which has been unpacked in detail in the following section.

Root Cause 1: A lack of local participation & engagement at all stages of the disaster risk management cycle – First of all, the exploration of literature and causal factor mapping identified some significant issues with the level of stakeholder engagement both before and after the earthquake, notably, between the governing bodies and the local communities. Many of the buildings that collapsed during the earthquake, including the churches and the Spanish fortress, were not adequately reinforced, and those that were, had the CCA measures removed (Binda *et al*., 2010). Initially, this could be a result of a lack of ineffective education as the people may not have been aware of the critical purpose that the structural supports provided. However, it could also raise an essential conflict of interest between installing mitigation measures and the aesthetics that make these sites culturally significant.

Secondly, the mitigation measures developed to provide support and financial breaks for the local people seemed to be both inadequate and inconsistent with their needs. For example, the 'Abruzzo decree' was a government decree established in the aftermath of the earthquake, which outlined many relief measures for the local people. However, many areas of the city were still inaccessible for up to one year after the initial earthquake (Di Gregorino, 2017), including homes, businesses, and some cultural heritage sites. Initially, after the evacuation, 171 tented camps were set up in surrounding municipalities to provide short term housing (Alexander, 2012), which is typical for post-disaster recovery (see. Alexander, 2012; Lizarralde *et al.*, 2010). These developments, referred to as the C.A.S.E complexes, were considered to be an experiment and not built to an adequate standard to house people in the long term. The cost phases were €1.6 billion for subsidizing permanent 5736 apartments in 19 complexes' (Alexander, 2012). The construction of these resulted in the local people spending several months in 'short term' tented camps and then being placed in permanent apartment blocks. These apartment blocks failed to meet their basic needs as they were developed in a place that was not appropriate to the function of the local urban system (Alexander, 2012).

Finally, the failures of the local government, delays, and perceived inactivity of the recovery of the city center resulted in social unrest and uncertainty (Bock, 2016). This culminated in a social movement referred to in the literature as the 'Wheelbarrow people' or 'protesta delle carriole' (Treré, 2010; Bock, 2016) intended to induce the government to act. According to Bock (2016), the residents became so angry that they overcame the military guard and began to clear the city street of rubble with wheelbarrows. All of these different elements indicate a failure in active stakeholder engagement, both pre and post-disaster. The case study of L'Aquila highlights how vital local participation is in the disaster recovery process and how mitigation measures developed without active

engagement are likely to fail. Finally, it provides evidence of how quickly a disaster can snowball into distrust and social unrest if local people were not mobilized.

Root Cause 2: Policy not effectively translated into practical outcomes – Secondly, it appears as though the policy in place regarding DRM and CCA had failed. For example, many of the buildings were unable to meet current building regulations, and construction regulations have been cited as 'lax.' This is despite the precise policy and building regulations at a strategic level (ERRI, 2009). The reasons for this are somewhat challenging to distill from the available academic literature. Many sources attribute the degree of damage to the 'old' or 'poor' masonry of the buildings and structural support mechanisms (EERI, 2009; Binda *et al*., 2010; Modena *et al*., 2010). This is visible in many of the buildings that collapse during the earthquake, including the 'incorrect use of reinforcing concrete' clearly visible in the ruins of San Marco' church and the Beata Antonia's Church (Modena et al., 2010). It appears as though the root cause of the high level of the collapse of the buildings is a result of the policy not translating into effective practice.

Root Cause 3: Limited and lack of utilization of ICT – Another outcome of RCA was the apparent failure to use ICT mechanisms to store the CH records remotely and electronically (Binda *et al*., 2010). According to Binda *et al*. (2011), after the earthquake, the damage was caused to the Spanish fortress, which had been repurposed into a museum and town hall. The only copy of the CH records for the city which cataloged the valuable cultural heritage sites was stored in this building. As a result of the earthquake, they became inaccessible (Binda et al., 2011) and cataloging and recording of the valued sites and their damage had to be conducted from nothing, delaying the response and recovery.

The failure to transition this documentation into an electronic format that could be accessed, amended, and updated by different stakeholders was a significant root cause of the prolonged and delayed effects of the L'Aquila earthquake. Ultimately, highlighting the importance of CH data to be electronically stored and made rapidly available. Secondly, despite the Abruzzo region´s history of earthquakes, there were no data collection methods in place before the disaster, and survey mechanisms to catalog and evaluate the damage were retroactively developed after the initial disaster. The failure to have these mechanisms in place before the disaster was a root cause of the damage. Finally, academic literature widely cites the value of ICT, social media as a mechanism for mobilization and as a platform for local communities to contribute to decision making (Ginzarly *et al*., 2019). However, it appears as though this mechanism for participation was absent during the L'Aquila. Social media groups were developed following the event due to frustration, distrust, and anger (Farinosi & Treré, 2010). These groups developed in response to the marginalization of local people and the lack of a platform to express their voices. In this way, social media provided the population with a mechanism to quickly organize and voice their concerns.

Root Cause 4: Overarching governance shortfalls – The analysis of available literature of the 2009 L'Aquila earthquake indicates a distinct failure of the current

governance mechanism in place to address disaster risk and recovery within L'Aquila. The findings of the causal factor chart agree with the results of Alexander (2019), which states that even 'moderate' seismic events that occur in an area can have a prolonged recovery process if it is highly vulnerable to the disaster and had not been addressed by Italian policy. Secondly, that poor local participation, limited preparedness, and mismanagement of the recovery process can create as much of a damaging effect on the local people as the initial event itself. As a result, over and above the other four root causes unpacked above is the failure of governance mechanism to adequately prepare and mobilize local people in the event of a disaster. Furthermore, according to Alexander, (2010) the construction of the 19 apartment complexes which did not follow the typical disaster recovery processes led to long-term issues and the continued marginalization of the local communities (Carnelli & Forino, 2017). Finally, it is essential to mention the aspects of corruption and individuals attempting to profit from the recovery of disaster (Farinosi & Treré, 2010). Few academic and non-academic sources highlight the issues surrounding corruption in the recovery and reconstruction phase of the disaster in the years after the event, but despite this, it may have played an essential role in the different stages of DRM.

4.5.4 Stakeholder mapping

The following Figure maps the stakeholders referred to within the academic literature immediately after the disaster. The different stakeholders are mapped depending on the two axes. The X-axis indicates the stakeholders' level of interest in the event, and the Y-axis refers to the amount of power or influence that the stakeholder has immediately after the event.

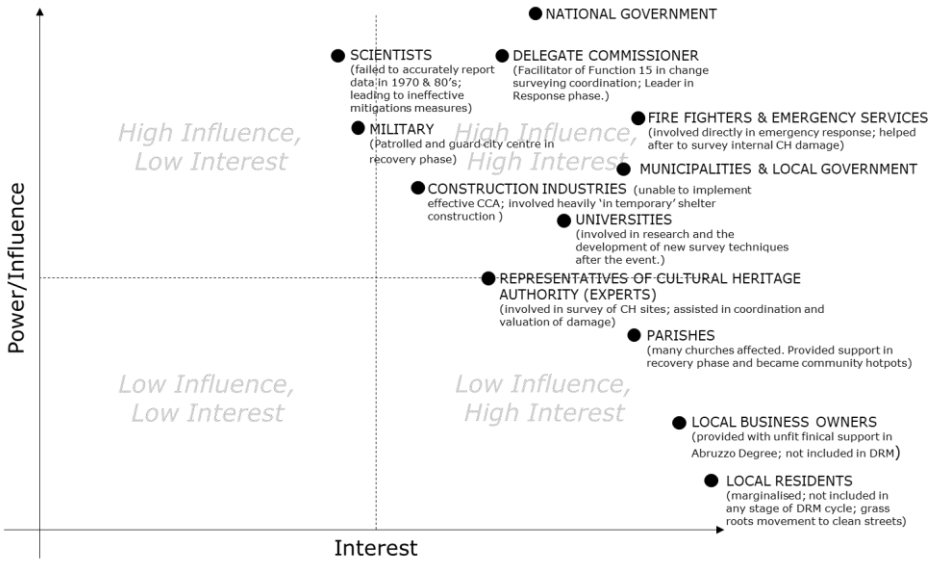


Figure 29: Map of stakeholders referred to within the academic literature immediately after the 2009 L'Aquila Natural disaster. Map by the power/influence and interest shortly after the event.

An analysis of the stakeholders involved in the L'Aquila earthquake indicates how marginalized the local communities become. The approach to DRM focused on a top-

down approach facilitated by the delegate commissioner in the 'Function 15' recovery group.

4.5.5 Application of ICT

First of all, it is clear from the causal factor chart that the failure to turn the CH records into an electronic format was a distinct root cause of the delayed response and recovery within the city of L'Aquila. This alone could have increased the delay in response times and potentially mitigated some of the effects after the initial disaster. Secondly, the level of public participation throughout the disaster was minimal, and the local communities became marginalized (Carnelli & Forino, 2017). These communities mobilized themselves motivated by impatience and distrust to address the problems in movements like the 'Wheelbarrow movement.' However, the local communities began to identify with one another as a result of the shared experiences of suffering by producing physical spaces of exchange and sympathetic understanding (Bock, 2015)

It is in these physical spaces in which social media can provide an invaluable platform to collect, communicate, and positively mobilize these communities. However, in the case of L'Aquila rather than be a mechanism for coordinated mobilization facilitated by the strategic policy. Local communities used a variety of social media platforms, blogs and online journals as a mechanism to coordinate protests and also as a means to communicate opinions which can gather momentum very quickly (Farinosi & Treré, 2010).

Overall, the utilization of formal and organized ICT was very low. There was a failure to back up records, and local populations did not participate in disaster preparedness and recovery. This case study provides a valuable example of the benefits ICT can ensure DRM and reduce the vulnerability of important cultural heritage sites. Early adoption and incorporation of ICT into the DRM strategies and the use of ICT, such as social media, could have the potential to alleviate some of the issues. However, in this case, matters appeared to stem from a much more significant macroeconomic problem, associated with the inadequate allocation of money and resources as a result of misclassification of previous disasters.

4.5.6 Summary of case study & implications

- The emergency services play a vital role throughout the entire DRM cycle. First, they provide crucial lifesaving support to the affected people. But they can provide a mechanism for education and awareness pre-disaster. As well as a powerful tool for raw data collection and consolidation with specialist training and access. Which ultimately speeds up the recovery process.
- A failure to facilitate local participation at all stages of the DRM cycle (especially in the preparation phase) can have devastating long-term effects, but this can stem from a complex political landscape.

- The inability and unwillingness of local authorities to address the participation of heritage experts in all phases of the DRM cycle (especially in the preparation phase) can have devastating long-term effects (an important reason may be the country's complex political situation.
- Local news, municipality, are not responding to problems from a much broader macroeconomic perspective. They underestimate the reality of climate change. Inappropriately allocate public money and resources due to misclassification. Where there is an error, it is necessary to define the wrong processes clearly.
- There was a failure to learn lessons and a reluctance to prepare actively and follow well-established recovery procedures.
- Finally, this case study provides a valuable example of how the effects on society and economy can be damaged even decades after an event due to inadequate public participation and policy and governance shortfalls. As well as an example of how ICT can help to mitigate and overcome some of those issues (as long as the measures are in place before a disaster)
- An underlying macro-economic problem can severely limit the implementation and effectiveness of disaster risk management strategies in the long-term.

4.6 Case Study 3 'Regional Scale' – 2006 Wildfires in Galicia Spain

4.6.1 Background & context

Galicia is an autonomous community that encompasses the north-western provinces of Lugo, A Coruña, Pontevedra, and Ourense in Spain. It covers an area of approximately 29'000km and a population of approximately 2.7 million people (Balsa-Barreriro & Hermosilla, 2013). The region is greatly valued for its cultural heritage with the capital Santiago de Compostela, which is designated a UNESCO World Heritage site in 1985 (see. http://whc.unesco.org/en/list/). As well as the Roman wall of Lugo is an important aspect of the region's cultural significance.

Figure 30: Location of Galicia [Image adapted from Google Earth].

Furthermore, the history of agriculture in the region provides a rich agrarian landscape that reflects the long-term history between society and the environment (Antrop, 2005). This is reflected in the traditional land management techniques and the associated buildings and structures such as watermills, granaries, and stone laundry basins, and oral traditions (Kizos and Koulouri, 2006; Moreira et al., 2006.). These aspects are widely valued by local agricultural communities (Calvo-Iglesias et al., 2006).

Unfortunately, there has been an increasing trend of wildfires recorded internationally, including in Europe (European Commission, 2001), especially as a result of human behaviors such as arson (Chuvieco *et al*., 2010; González-Olabarria *et al*., 2011; Juan *et al*., 2012). Galicia is an area prone to particularly persistent wildfires, which have become increasingly exacerbated by the effects of climate change (JRC, 2006) and land-use change (Modugno *et al*., 2016), which put this essential natural cultural heritage at risk. On the 4th August 2006, the was a combination of factors in which the local experts referred to as the 'law of 30'; temperature higher than 30°C, a wind greater than 30km per hour and humidity of less than 30%. These climatic conditions on the lead up to the 2006 wildfires meeting these criteria with strong northwestern winds, low humidity and intense heat causing the drying of vegetation. This dried vegetation was then ignited by for a multitude of reasons (Chas-Amil *et al*., 2010). Because of the abundance of the fires, the pre-existing DRM was insufficient at dealing with the spread of the fires. The wildfires burned until the 11th of August when rainfall from the Atlantic Ocean helped to bring the blaze under control. Furthermore, according to (JRC, 2006) fighting the fires required the coordination of seven fire brigades using a volume higher than 24 million liters of water until the wildfires were finally doused on the 15th August.

4.6.2 Causal factor charting

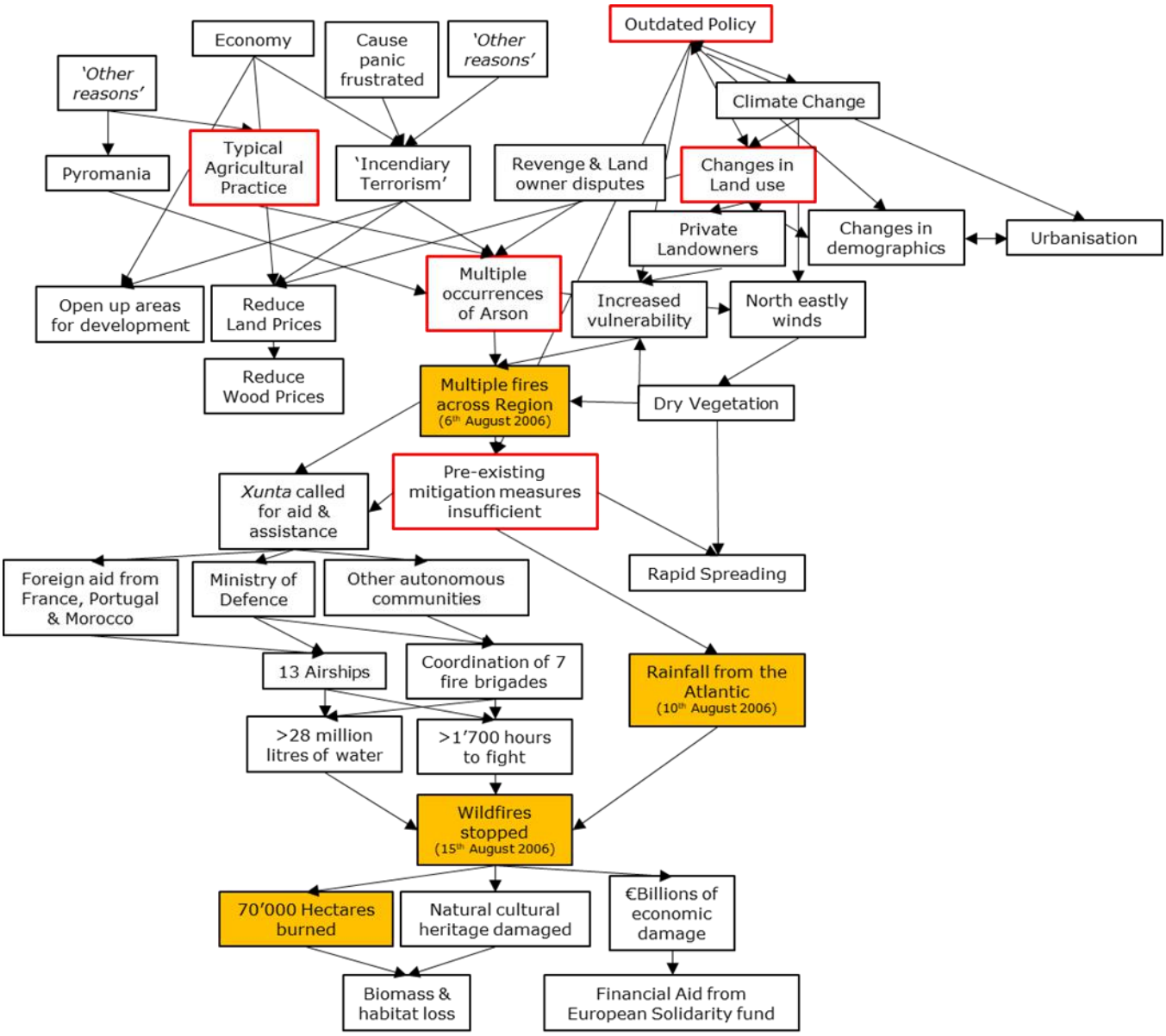


Figure 31: Causal Factor Chart unpacking the events that took place during the 2006 Wildfires that affected the autonomous community of Galicia, North-western Spain.

4.6.3 Identification of root causes

The six causal factors outlined in section 4.6.2 highlight the significant causal factors which resulted in the extensive damage of the natural, cultural heritage in the Galicia region. The causal factors have been used to identify three perceived root causes, see which have been unpacked in detail in the following section.

Root Cause 1: Pre-existing societal norms & ingrained behaviors - Unlike for the other cases presented in the report, the most significant cause of wildfires in Europe is deliberate fire setting and, as a result, is considered to be a 'human-mediated event' (Chas-Amil *et al*., 2010). This is particularly prevalent in Spain, in which 42% of fires are caused by humans (Chas-Amil *et al*., 2010). The reasons for the human fire setting can

be for a variety of reasons, including; pyromania, incendiary terrorism, land disputes, revenge, negligence and even to cover up another crime (Chas-Amil *et al*., 2010).

This multifaceted nature, isolated locations, and complex mix of stakeholders in which the fires are started making it difficult for policymakers to tackle. The 2006 wildfire was particularly devastating because of the spatial distribution across the whole southern western and western region of Galicia (see Figure 5 in Balsa-Barreriro & Hermosilla, 2013, source: Conselleria de Medio Rural, 2007) and the vast quantity of fires started in a short period (Balsa-Barreriro & Hermosilla, 2013). As a result, the process of fire starting is an epistemologically embedded behavior within the society, the effect of which is becoming exacerbated by the increasing global temperatures and drying winds resulting from climate change. This makes these societal norms and standard agricultural behaviors a significant root cause of the risk to the natural cultural heritage in Galicia.

Root Cause 2: Rapid economic & societal changes with insufficient policies - According to the research conducted by Balsa-Barreiro & Hermosilla (2013), Galicia has gone through dramatic economic and social changes since the turn of the 20th century. First, is the transition of the local economy from small scale agriculture to forestry and logging production (Lage, 2003). According to Balsa-Barreiro & Hermosilla (2013), 2,000,000 hectares of Galicia are now designated to hardwood forests, which represents a total of 68.9% of Galician land cover. Importantly, 97.2% of which is privately owned and managed. Furthermore, according to Balsa-Barreiro & Hermosilla (2013), to add another layer of complexity, this private land ownership is separated into either individuals or communities, and these can be further subdivided into even smaller plots of less than 0.5 hectares. Creating an extremely challenging mosaic of private landowners and convoluted boundaries of ownership, which research has shown to be extremely difficult to manage at the regional level.

The complex mosaic of land ownership links directly to Fernandes *et al*., (2011) who discusses the concept of the 'Fire Paradox' in which fire management strategies focus on suppression and assign a minor role to fuel management. Driven by the changing economy, much of the ecosystems in Galicia are covered with woodland. As a result, the policy that facilitated fuel management strategies rather than focused on the suppression of fires may have limited the spread and mitigated the damage to the ecosystem. Furthermore, other research such as (Barrel Pernas, 2015) has highlighted that at the time of 2006, despite insurance being a valuable tool in forest restoration in Spain it was rarely used by local people. This is because insurance companies do not provide cover for private landowners. Given that 97.2% of the woodland in Galicia is privately owned, it implies that the public policy does not reflect the needs of the landowners in Galicia (Barrel Pernas, 2015). As a result, one of the significant root causes of the Galicia wildfire was that the public policies in place to mitigate, restore habitat, and reduce the risk of fires were insufficient.

Root Cause 3: Need for education & awareness across landowners - Finally, according to the available literature and the conclusion of the RCA, wildfires are very much a social issue, which is being exacerbated by climate change. The complex mosaic

of private landowners and the incidents of deliberate arson may require co-ordinated education and awareness.

4.6.4 Stakeholder mapping

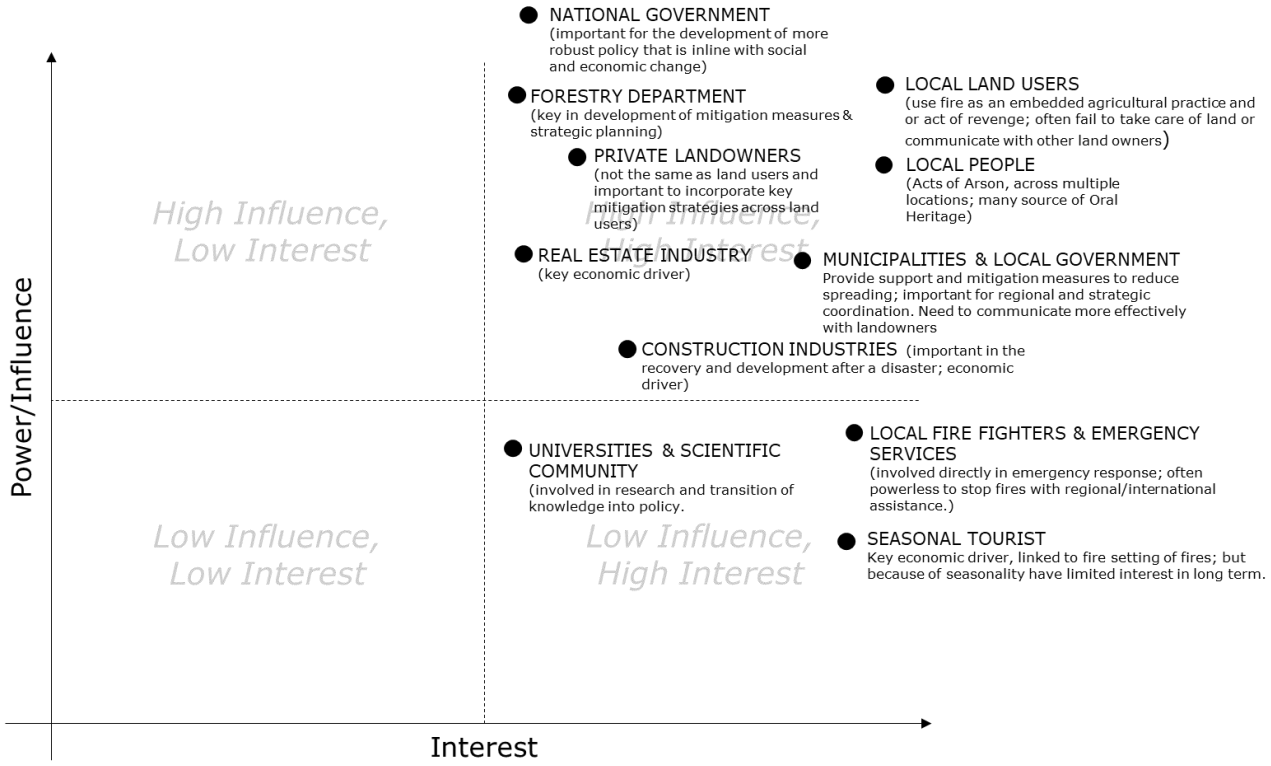


Figure 32: Map of stakeholders referred to within the academic literature during the 2006 Wildfires in Galicia. Mapped by the power/influence and interest.

4.6.5 Application of ICT

Fundamentally, the wildfires that occur in Galicia are a social issue that is exacerbated by climate change. As a result, the use of ICT needs to address the issue on a societal dimension. According to Rego *et al*. (2018), education and raising awareness is one of the most significant mitigation measures to tackle these kinds of problems. As a result, what may be required is a platform for education to raise awareness of the causes of wildfires. It is in this space in which social media may provide a valuable mechanism. Currently, because of the history of wildfires, the wildfire risk mapping software is very sophisticated in Galicia, and there is a considerable amount of data available, helping to map and record wildfire risks. This provides a valuable resource for experts to develop well-informed adaptation strategies. However, based on the outcomes of the RCA and the available academic literature, the mitigation and adaptation measures in place were vulnerable to multiple fires started across the region simultaneously. Furthermore, the complex and convoluted mosaic of private landowners creates an environment where it may be challenging to implement wide-scale CCA measures. It is in this space in which ICT could be used to coordinate and mobilize local people.

4.6.6 Summary of case study & implications

- Again, the case studies emphasize the importance of local people as actors within the DRM cycle. However, in this case, they are driving the intensity of the natural disaster rather than being marginalized. Showing a distinctly different balance of power.
- Greater work needs to be done in understanding the distinct drivers in which ICT and social media could provide a platform for understanding these perceptions.
- Policy, regulation, and financial incentives need to keep up with the rapidly shifting societal changes in order CCA measures and DRM strategies to be effective.
- Coordination across neighboring municipalities was a crucial driver in controlling the wildfires at the regional level.

4.6.7 Discussion, outcomes & proposed actors & rules to be considered in the agent-based management (T2.6)

Based on the RCA conducted on the case studies, a list of core stakeholders has complied within the table below. As well as, drawing together the elements from the bottom-up and top-down user requirement analysis. This is accompanied by a description of the potential roles stakeholders played in each RCA and the potential opportunities in which SHELTER could explore.

Core Stakeholders identified from the case studies	Potential Opportunity Space for SHELTER
Residents & Property Owners	Local participation is critical in producing effective preparation strategies, but there needs to be a way to capture local perceptions of cultural heritage, their valuation, and, eventually, its use in decision making. They can also provide a key **collector role** after the initial disaster. Furthermore, residents can also be mobilized in the recovery phase but require an effective platform of communication.
Local Business Owners, SME's & large businesses.	Local business owners rely on rapid recovery and response to continue to live. There are also fundamental to the local economy and often the social fabric of the people. Very often, they provide an essential role in the recovery and response phases of the DRM cycle and serve as prominent '**Collector**' and '**Team leader roles**.' Providing the community with vital resources and support.
Local Land Users	Local land users can often differ from landowners, creating a complex mosaic of different stakeholders. They are critical in the preparedness stage of the DRM cycle. Involvement in preparedness is essential for effective policy implementation and in the understanding of how it can be effectively translated into mitigation and response strategies.

Private Landowners	Important to engage with for strategic purposes and policy development, providing vital support in both the preparedness and recovery after a disaster. They serve as an important mechanism of communication to local landowners providing valuable data **collection roles.**
Emergency Services & Emergency Responders	First of all, they are critical stakeholders in both the response and recovery phase of the DRM cycle. Furthermore, they provide a valuable resource to be involved in data collection and mitigation, providing a valuable **Collector role.** However, they need to have simple and practical tools to collect that data.
Surrounding Municipalities	Directly involved in the strategic mitigation at larger scales providing crucial support at the regional level, making them fundamental in the response, recovery, and prevention stages of the DRM cycle. Furthermore, through ICT, they can provide essential **team leaders** and **system administration roles**.
Construction & Real estate Industry	Are fundamental in the prevention, preparedness, and recovery phases of the DRM cycle.
Universities, Scholars and Research Groups	Are typically involved in the response and prevention phases of the DRM cycle, after an event providing a critical **collector and analyst role**. Providing advice and technical support in implementing disaster risk management procedures for cultural heritage. In the long term, they are essential in developing research and tools to aid in the recovery and to inform. Furthermore, they provide valuable insights into data collection.
Parishes	Often important cultural heritage sites and cornerstones of local communities places for people to collect after a disaster. because they are often essential pillars of society, they provide key areas for support and communication in an indirect **Leader Role.**
Local Government	Are political decision-makers and administrative bodies provide an important **system administration role** which is essential and provide data to driving policy at the local level. The RCA highlighted the need for a greater need for transparency and accountability. As well as the need to aid in helping science translate into practical solutions.
Regional Government	The regional government is a critical stakeholder in developing strategic mitigation and response tools and a key system **administration role** providing wide-scale local data. However, the root cause analysis highlighted the need for a greater need for transparency.
'Technical Experts'	There was often reference to the role of experts in the response and recovery of the DRM cycle, and they provide a key **Team Leader** and **Collector role**. Being able to delegate responsibilities and be able to help prioritize sites after disasters to help catalog damages. These vary from artistic, heritage, etc.

Military	The military is often used as an important resource of emergency response in the initial phases of a disaster. They also provide a means for control and protection after the first event during the response and recovery phase. However, they are seen as intimidating and untrustworthy in some cases and therefore have the potential to exacerbated issues in the long term.
Tourists	Tourists are seasonal but have an influence on the long-term economy of an area. They serve a very minor role in the DRM cycle but play a key driver in funding and valuation of some sites.
Foreign aid	Foreign aid is typically called upon the response and recovery phase to help co-ordinate relief efforts and provide support.
Non - departmental government bodies & National authorities	Within the RCA these stakeholders were heavily involved in the response phase and helped with wide-scale coordination of relief efforts. They serve an important **system administration role** and also can provide support in the **analyst role**.
Practitioners	Key at implementing CCA and DRM strategies as well as translating policy into practical delivery.
Civil protection authorities, emergency managers	Important during the preparedness and response phases of the DRM cycle. Provide **system administration role** by sharing information on their existing national strategies, guidelines, legislation, and plans related to disaster risk reduction, emergency preparedness and response, and post-disaster reconstruction on heritage.
Site managers	Provide insights at the local level and provide important **Leadership roles** as well as **collector roles** after a disaster because of their experience and expertise.

Table 5: Identification of key stakeholders identified from the consolidation of the results from the RCA, the 'Stakeholder Roles' defined in Table 3 and the key stakeholder analysis conducted as part of the top-down user requirement(see chapter 5.4).

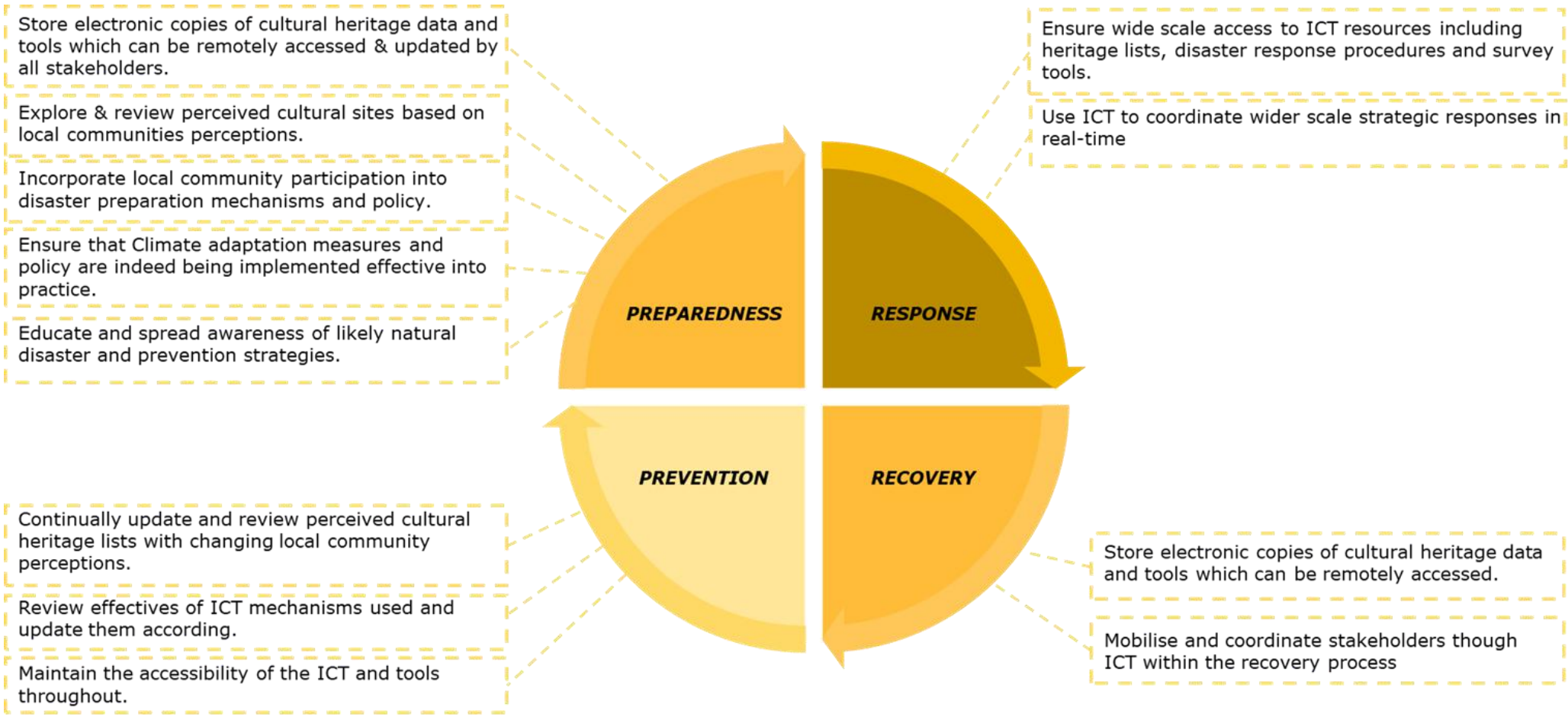


Figure 33: Potential opportunities for Applying ICT in the stages of the disaster risk management cycle to help inform outcomes for the SHELTER Project, especially with regards to the OPENLAB in WP7

Importantly, it seems as though there are several opportunities for the SHELTER Project to increase the role of these stakeholders with disaster risk management and climate change adaptation. For example, Emergency services play a vital role in post-disaster to mitigate potential damage. However, based on the outcomes of the RCA, it appears as though there is an opportunity to utilize the emergency services such as the fire brigade at all stages of the disaster risk management cycle. They provide an essential source of raw data collection immediately after the disaster. However, their expertise and training make them equipped to collect invaluable raw field data helping to understand the level of extent of damage, prioritize recovery and speed up the recovery process.

Secondly, the root cause analysis emphasized the importance of local people as a stakeholder. Poor participation, bad engagement can lead to profound and damage social unrest much later after the initial event. Develop an accessible, interactive and reliable platform for CH mapping how can we tap into local knowledge ICT can provide a widely underutilized platform to gather this information and

Finally, all of the RCA identified a profound issue with how science relates to public policy and how this translates into effect practical solutions on the ground. This conclusion is not a new finding and is prevent within academic literature. However, what is does highlight is the fact that despite the increasing amounts of technology and data informing response and relief efforts

Furthermore, it was evident that contemporary governance and bureaucracy can 'slow down' the development of mitigation measures and invoke issues such as corruption. Therefore, it may be important to explore potential solutions to protect climate change adaptation measures, which are separate bureaucracy or, at the very least, promote a greater degree of transparency between stakeholders.

4.6.8 Implication's, guidance & rules to inform ABM

- Local people are essential at all stages of the disaster risk management cycle; if they are not incorporated or involved in the proposed recovery strategy, then it leads to significant issues.
- Local people can be a powerful mechanism in the recovery and response after an event if their needs are clearly understood. Social media has proven to be a platform in which people use to voice their concerns and develop communities.
- Emergency services can be a crucial stakeholder in the recovery process, helping to develop more detailed raw data because of their access and specific training.
- Science does not always make an effective transition into policy and practice regardless of the level of detail and quality of the work.
- ICT can provide a platform for strategic coordination and recovery after the disaster, which is widely available and remotely accessed.

- There is a need for greater transparency across all stakeholders as there appears to be a reference to corruption, victimization and profiteering in some of the case studies explored above.
- There may be a need to create CCA measures that are free from bureaucracy as it slows down their implementation and limits their effectiveness.
- There is a core list of stakeholders in which the SHELTER Project should attempt to reach. However, the input into the disaster risk management cycle should be explored as there is clearly an opportunity space in which we could take advantage of.

5 Top-down requirement analysis

5.1 Introduction and position within SHELTER

As noted in the executive summary at the beginning of the deliverable, cultural heritage and natural heritage are affected by both local and global conditions. To ensure a comprehensive 'GLOCAL' approach to the subject, following a review of bottom –up local conditions, this part of the deliverable focuses on top-down requirements for DRM and cultural and natural heritage. Therefore, in parallel of chapter 3 "Bottom-up approach", which is a community based approach, we utilized an top-down approach to identify the user requirements at global and national levels by looking at regulatory framework. The general objective of the top-down analysis is to identify the global/regional/national part of the GLOCAL approach and prioritize user requirements in DRM. To ensure that these top-down user requirements are understood and see whether they are being used, UNESCO organized, on December 2019, an International workshop with key international, national and local stakeholders. The methodology is explained below. The community, as primary actor, helped to provide with recent knowledge for better prioritization of the top-down requirements.

5.2 Methodology – Top-down requirement analysis

A "top-down" approach looks at the big picture by first focusing on global processes, stocks, macro indicators, end-users' requirements and desired results. Finally, the data required to support end-users applications is determined and sourced trickling down from the above.

In order to identify the main top-down user requirements for DRM in cultural heritage, UNESCO took stock of existing frameworks dealing with multi-hazard contexts. In the framework of SHELTER project, a dedicated deliverable (D1.2- Building of best/next practices observatory) will present this review of knowledge more in detail while next paragraph will present a summary of the material that was introduced and discussed further with international CH experts in DRM.

Once the literature had been reviewed (see §5.3) and the key stakeholders identified (see § 5.4) UNESCO invited a number of international multi-stakeholders (see Annex VII -List of participants) to attend an interactive exercise. The focus group during the International workshop "GLOCAL" discussed during different sessions:

- Gaps on the impacts of Climate Change and in DRM on cultural and natural heritage sites
- Main user requirements in DRM
- Recommendations to bring forward in SHELTER project.

The stakeholders have identified the top-down user requirements during a 2-day systematic workshop process that involved a mix of presentations by the experts followed by plenary discussions and afterwards group work and exercises in a world café style. At the beginning of each group work participants could propose their own requirements based on their expertise and faced hazard, afterwards the groups have been requested to come up with an agreed set of requirements that has been further discussed and narrowed during the plenary to ensure a shared prioritization of the user requirements.

5.3 Review of scientific literature

5.3.1 Desktop analysis

In order to identify the main top-down user requirements, UNESCO performed an initial desktop analysis of the more important policy documents and guidelines (for details see D1.2) addressing disaster risk reduction (DRR), disaster risk management (DRM), emergency preparedness and response, and post-disaster reconstruction for immovable (built) cultural heritage from International organizations (ICOMOS, ICCROM, UNESCO, UNDRR, ICBS), processes (PDNA), and from regional organizations (European Union directive, European Commission and Council of Europe), as well as best practices in European countries.

5.3.1.1 International

The desktop analysis, based on more than 130 references (for details see D1.2) highlighted that at International level several frameworks address the different topics and it is internationally recognised:

- The importance of **implementing adequate DRR/DRM procedures for cultural heritage;**
- The need to integrate these procedures into general **DRR/DRM programmes and policies at the national and regional levels**;

But methodological approaches, **practical or detailed guidance** to implement DRM for cultural heritage is only addressed by a **few documents**:

- Resource manual Managing Disaster Risks for World Heritage (Jigyasu, 2010)
- ABC Method – A risk management approach to the preservation of cultural heritage (Michalski *et al.*, 2016)
- Guidance on Post Trauma Recovery and Reconstruction for World Heritage Cultural Properties (ICOMOS, 2017)
- Handbook and Toolkit First Aid to Cultural Heritage in Times of Crisis (ICCROM, 2018)

- Climate Vulnerability Index (2019)

Some practical guidelines and manuals have been produced, but their applicability should be analysed on a case by case basis.

5.3.1.2 European

European level documents (for details see D1.2) are more focussed on "recommending" and highlighting:

- The importance given to cultural heritage by high-level European Union (EU) institutions
- The need to implement adequate DRR/DRM procedures for the cultural heritage sector
- What needs to be implemented to achieve robust practices towards reducing disaster risks in cultural heritage in Europe

But:

- The **practical consequences** of those documents have been **minor** (mostly in the form of recommendations for Member States)
- **Very little** has been developed targeting **emergency actions** and **post-disaster reconstruction** for cultural heritage

Regarding processes there are almost no guidelines but Post-Disaster Needs Assessment (PDNA) is the exception.

5.3.1.3 National

At national level different countries have different levels of development on the various topics, and usually development has occurred, in many cases, due to recent events. The documents (for details see D1.2) highlight:

- The **different levels of development** of different countries on the various topics (and this development has occurred, in many cases, due to **recent disasters)**
- There is a general **lack of adequate risk assessment** procedures
- Emergency units with adequate knowledge to deal with cultural heritage in emergency scenarios are **slowly developing**
- **It is not clear if knowledge** on the different topics **is shared** among countries.

5.3.2 Questionnaire on the existing policies and guidelines DRM, DRR, CH

A "*Questionnaire to identify gaps and needs in Disaster Risk Reduction for Cultural and Natural Heritage*" was conducted on the existing policy and guidelines related to disaster risk reduction, emergency preparedness and response, and post disaster reconstruction

on cultural heritage (Annex VI). This included an analysis of best practices from multiple national countries participating at the GLOCAL workshop (see chapter 5.4) and other SHELTER related countries such as Italy and Spain looking in particular at geographical scope, responsible entity(ies), objective, year, mandatory/voluntary, implementing body (municipality etc.). The questionnaire was developed based on the four priorities of the Sendai Framework and identified the following gaps and needs in Disaster Risk Reduction for Cultural and Natural Heritage:

- Risk awareness,
- Heritage risk assessment,
- Legislations and institutions for DRR in Heritage,
- Guidelines/mechanisms/strategies for emergency response and post-disaster actions,
- Heritage data collection and digitalization (Georeferenced inventories of heritage),
- Post-disaster needs assessments,
- Training (civil protection authorities).

5.4 Identification of key Stakeholders

UNESCO identified the main top-down user requirements, through the interactive involvement of the following key stakeholders:

a) World heritage sites managers;

b) Civil protection authorities and emergency managers and national authorities;

c) Practitioners, scholars, technical experts of DRM in CH.

In addition, international organizations on cultural heritage disaster and risk management -ICOMOS, ICCROM, and International Sava River Basin Commission, International scientific community, advisors and technical experts (such as engineers)- were also identified as key stakeholders in the SHELTER project. Furthermore, a fundamental contribution on the analysis is given by national authorities on CH that faced in the recent time extreme events due to climate change.

The **sites managers** from UNESCO World cultural and natural Heritage sites and other UNESCO sites are expected to provide some insights at the local level into how the sites, notably the 5 Open Labs where the project development will be validated, are confronting hazards such as floods, earthquake, fire as well as the adverse impacts of climate change. These 5 Open Labs, representative of main climatic and environmental challenges in Europe and different heritage's typologies, are situated in the World Heritage site of: the Area of Santa Croce in Ravenna (Italy); the coastal district of Seferihisar (Turkey), the old town of Dordrecht and its island (Netherlands), the Baixa

Limia-Serra do Xurés Natural Park in Galicia (Spain) and the transboundary Sava River Basin. Therefore, UNESCO mapped the key stakeholders belonging to the countries where 5 Open Labs are located or other related countries (e.g. transboundary areas in the case of Sava River Basin), but also looked at the main climatic and environmental challenges of the 5 open-lab areas.

The **civil protection authorities, emergency managers and national authorities** in culture and natural heritage would share information on their existing national strategies, guidelines, legislations and plans related to disaster risk reduction, emergency preparedness and response, and post disaster reconstruction on heritage. These stakeholders could also reflect the challenges and good practices on the regulation and its implementation, which would feed into the overall project. In identifying the key stakeholders of this category, the participating countries (and other related countries) of the SHELTER project were particularly prioritized, looking in particular at its management geographical scope, responsible entity(ies), implementing body (municipality etc.).

The **practitioners, scholars, technical experts** of DRM in cultural and natural heritage were identified to provide advice and/or technical support in implementing disaster risk management procedures for cultural heritage, notably the experts whose research and/or project experience are related to Open Labs or relevant sites within the participating countries (and other related countries) of the SHELTER project.

The stakeholders that participated in the workshop on GLOCAL user requirements for Disaster Risk Reduction and Cultural and Natural Heritage included *inter alia*: 1) Cinque Terre National Park, Italy (World Heritage sites managers); 2) Venice and its lagoon World Heritage site, Italy (World Heritage sites managers); 3) Cultural Heritage Risk and Emergency Management Unit for Castilla and León, Spain (authorities in culture and natural heritage); 4) Conservation Departments and Inspection Sector, Ministry of Culture of the Republic of Croatia (authorities in culture and natural heritage); 5) Regional Emergency unit for Cultural Heritage, General Directorate for Cultural Heritage of the Murcia region, Spain (authorities in culture and natural heritage); 6) CORILA, Italy (experts); 7) University of Porto, Portugal (experts); 8) International Sava River Basin Commission (international organizations).

The workshop was structured around an interactive framework in which 20 selected participants from 8 European countries (Albania, Bosnia and Herzegovina, Croatia, Netherlands, North Macedonia, Portugal, Spain, Italy), interplayed with 9 SHELTER Partners + sister EU projects ARCH and HYPERION, 7 members of UNESCO (both from the regional Bureau in Venice and HQ in Paris) to provide substantial feedback on the top-down user requirements.

All levels were covered among the participants:

- **2 International level**: UNESCO and International Sava River Basin Commission;
- **8 National level**: national authorities in culture and heritage;
- **8 Local level**: local authorities/institutes+ World Heritage sites managers;

- **3 Practitioners/scholars** of DRM in heritage.

5.5 Good practices at different scales

Through the desktop analysis and the International workshop discussion the following two cases came up as good practices in terms of DRM in CH.

5.5.1 Case study 1 – International - UNESCO

UNESCO has published numerous Conventions, Declarations, Recommendations and Resolutions addressing cultural heritage protection, which have been split into two categories below:

- Disaster risk management and disaster risk reduction on one hand and
- Policies and guidelines addressing post-disaster reconstruction

5.5.1.1 Disaster Risk Management and Disaster Risk Reduction

With respect to specific issues related to DRR for cultural heritage, reference is made to the 2007 *Strategy for Risk Reduction at World Heritage Properties* (UNESCO, 2007) that was developed to mirror and adapt the guiding principles of the Hyogo Framework for Action 2005-2015 (HFA) (UNISDR, 2005) in the context of the preservation of World Heritage sites. The purpose of this *Strategy* was mostly twofold:

- To strengthen the protection of World Heritage and contribute to sustainable development by assisting Member States in integrating cultural heritage concerns into national disaster reduction policies and in incorporating concerns for disaster reduction within World Heritage management plans.
- To provide guidance to State Parties, the World Heritage Committee, the World Heritage Centre and the Advisory Bodies to integrate DRR into World Heritage strategic planning and management, including the allocation and use of Emergency Assistance under the World Heritage Fund.

The *Strategy* was structured to reflect and mimic the five "Priorities of Action" and the corresponding "Key Activities" of the HFA. As such, the *Strategy* also presented five "Objectives" and each of them was complemented by two "Priority Actions", thus replicating the model provided by the HFA and including adaptations to reflect specific concerns of World Heritage sites. As an example, reference is made to HFA's Priority for Action Nº 2 whose aim was to "identify, assess and monitor disaster risks and enhance early warning" and was replicated in Objective Nº 3 of the UNESCO *Strategy* whose aim was to "identify, assess and monitor disaster risks at World Heritage properties". One of the "Key Activities" of the HFA for this Priority for Action was to "develop, update periodically and widely disseminate risk maps and related information to decision-makers, the general public and communities at risk in an appropriate format". Similarly, for Objective Nº 3, the UNESCO *Strategy* established a Priority Action whose objective

was to "develop a World Heritage Risk Map at the global level or at regional levels to assist State Parties and the Committee to develop better responses".

In 2015, UNESCO adopted a Resolution (UNESCO, 2015) proposing a *Strategy* to strengthen its action for the protection of culture and the promotion of cultural pluralism in the event of armed conflict. Two years later, UNESCO adopted an addendum to this *Strategy* that expands it by defining a strategic framework to deal with emergencies associated with disasters caused by natural and human-induced hazards (UNESCO, 2017). The overall goal of the revised *Strategy* is to enhance the capacity of State Parties in successfully implementing the culture and heritage-related provisions of the Sendai framework for disaster risk reduction (SFDRR) (UNISDR, 2015). As such, it proposes two overall objectives:

- Strengthen the ability of State Parties to prevent, mitigate and recover the loss of cultural heritage and diversity as a result of disasters caused by natural and human-induced hazards.
- Incorporate consideration for culture into the DRR sector and humanitarian action related to disasters by engaging with the relevant stakeholders outside the cultural domain.

To achieve these objectives, the *Strategy* is also structured according to the Four Priorities of the SFDRR and, for each priority, it establishes a series of actions. The following list highlights some of the actions found to be more relevant for the context discussed herein:

- **Priority 1 - Understanding disaster risk to culture**: the *Strategy* highlights the importance of having baseline information about cultural heritage assets to enable the implementation of disaster risk management in this sector. In this context, it refers the need to strengthen, centralize and share baseline information across relevant authorities and agencies, including up-to-date inventories and multi-hazard maps to establish the main features of the pre-disaster conditions of cultural heritage, and to assess the extent and the impacts in post-disaster scenarios. Furthermore, the *Strategy* also highlights the need to build the capacity of national authorities and relevant stakeholders for performing multi-hazard risk assessments for cultural heritage in order to effectively prioritize risks and inform emergency preparedness.
- **Priority 2 - Strengthening disaster risk governance of the culture sector to manage disaster risk**: the *Strategy* refers the need to strengthen the integration of the culture and DRR sectors at all levels, in order to promote information and data sharing, develop culture-sensitive policies, and enhance coordination mechanisms among relevant institutions and actors in the implementation of DRR strategies and plans. Furthermore, the *Strategy* also refers the need to engage in capacity-building assessment processes at the national level for DRR and emergency preparedness and response, to identify the specific needs

of the culture sector and develop tailored capacity-building materials and tools, namely for national authorities, institutions as well as communities.

- **Priority 3 - Investing in DRR of culture for resilience**: the *Strategy* emphasizes the need to promote the broader inclusion of DRM as an integral component of cultural heritage site management plans, in particular when considering the low number of World Heritage properties that developed policies, plans and processes to manage potential disaster risks.

- **Priority 4 - Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction of culture**: the *Strategy* reiterates the role of UNESCO in supporting and building the capacity of countries to plan and coordinate Post Disaster Needs Assessments for the culture sector, in particular by developing training materials developed based on the experience gathered so far.

Among other policy documents published by UNESCO regarding cultural heritage protection, a brief reference is also made to the 2015 *Recommendation concerning the protection and promotion of museums and collections, their diversity and their role in society* (UNESCO, ndr) This *Recommendation* is one of the more recent documents that, within the scope of DRR and museum activities, refers that such activities should include the development of risk analyses for their collections, as well as emergency and preparedness plans.

On the specific issue of climate change impacts to cultural heritage, reference is made to the 2017 revision of UNESCO's 2008 Strategy for Action on Climate Change (UNESCO, 2007). This new *Strategy for Action on Climate Change (2018-2021)* (UNESCO, 2017) is expected to support State Parties in taking urgent action to address climate change and its impacts through education, sciences, culture, information and communication, in line with their respective National Determined Contributions under the Paris Agreement adopted by the United Nations Framework Convention on Climate Change (UNFCCC, 2015), and in the overall context of the 2030 Agenda for Sustainable Development (UN, 2015). Among the thematic actions that are proposed by the *Strategy*, an explicit recommendation is made regarding the importance of promoting cultural diversity and cultural heritage safeguarding for climate change mitigation and adaptation. Furthermore, the *Strategy* recognizes the links between climate change and DRR and the need to increase the resilience of communities to climate change and extreme weather phenomena through systematic planning and capacity development

With respect to guidelines, reference is made to the 2010 resource manual *Managing Disaster Risks for World Heritage* (Jigyasu, 2010) which is one of the publications of a series developed by a joint undertaking involving the three advisory bodies of the World Heritage Convention (ICCROM, ICOMOS and the International Union for Conservation of Nature) and the UNESCO World Heritage Centre. This manual provides the necessary methodological framework to identify, assess, and mitigate disaster risks in cultural heritage properties, to prepare and respond to emergency situations in cultural heritage properties, and to recover and rehabilitate cultural heritage properties after a disaster.

Globally, these topics are discussed within the overall objective of developing an adequate DRM plan for cultural heritage properties. Nevertheless, for the specific aspects related to risk assessment and management, aside from the methodological guidance, this manual provides little practical tools for the implementation of risk assessments. In particular, it only briefly refers the ABC risk assessment method originally developed for museum collections (Michalski, 2007). From a methodological point of view, this manual also complements the 1998 publication *Risk Preparedness: A Management Manual for World Cultural Heritage* (Stovel, 1998) by ICCROM, ICOMOS and the World Heritage Centre, and further emphasizes the increasing importance of these topics.

5.5.1.2 Policies and guidelines addressing post-disaster reconstruction

Even though the debate on cultural heritage reconstruction has been ongoing for several decades, the shortcomings of cultural heritage policies in providing guidance for a practical and inclusive reconstruction process in a post-disaster scenario was only clearly established in Decision 40 COM 7.12 of the World Heritage Committee in 2016 (UNESCO, 2016). Aside from other documents that were produced (see next Section), the 2018 *Warsaw Recommendation on Recovery and Reconstruction of Cultural Heritage* (UNESCO, 2018) was developed as a response to such shortcomings and reflects several antecedent documents, namely the 1994 *Nara Document on Authenticity* (ICOMOS, 2004). The *Warsaw Recommendation* reaffirms the connection between reconstruction and authenticity as discussed in paragraphs 79 to 86 of the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO, 2019). In particular, paragraph 86 states that reconstruction of archaeological remains or historic buildings or districts is justifiable only in exceptional circumstances, and that reconstruction is acceptable only on the basis of complete and detailed documentation and to no extent on conjecture. Still, the *Warsaw Recommendation* also recognizes the legitimate aspiration of concerned communities to overcome the trauma of disasters by reconstructing, as soon as possible, their cities and villages, and particularly their affected cultural heritage, as a means to reaffirm their identity, restore their dignity and lay the conditions for a sustainable social and economic recovery. In practice, the *Warsaw Recommendation* establishes a set of non-exhaustive principles and specific recommendations in order for the World Heritage Committee to continue the reflection on the complex multidisciplinary process that is reconstruction within World Heritage properties. Moreover, this further reflection is then expected to evolve towards developing new guidance that is able to reflect the multi-faceted challenges that cultural heritage reconstruction involves. In particular, the *Warsaw Recommendation* highlights:

- The importance of understanding the values of a heritage site and the attributes that carry these values prior to taking any decision on a proposal for reconstruction and recovery. Simultaneously, values identified by local communities and new values resulting from the traumatic events associated with the destruction should also be integrated in this process.
- The need to follow people-centred approaches and fully engage communities and relevant stakeholders in reconstruction and recovery processes.

- The importance of proper documentation and inventories.
- The need for establishing a strong governance based on a fully participatory process that includes mechanisms that coordinate national and international actors.
- The adoption of the historic urban landscape approach (UNESCO, 2011), to set out a holistic planning strategy for reconstruction and recovery that integrates cultural heritage within the larger framework of urban development.
- The role of education and awareness-raising to promote the knowledge, appreciation and respect for the diversity of cultures.

Alongside these principles, it establishes that, in post-disaster situations, the overall goal is the recovery of the society. Among other aspects, this involves restoring or improving the economic, physical, social, cultural and environmental assets, systems and activities of an affected community or society, aligning with the principles of sustainable development and "build back better". An essential part of this process is the recovery of cultural heritage, which may include reconstruction. According to the *Warsaw Recommendation*, in the World Heritage context, the term "reconstruction" is understood as a technical process for the restitution of destroyed or severely damaged physical assets and infrastructures following a disaster. Furthermore, it emphasizes that, in this context, the reconstruction of physical assets must give due consideration to their associated intangible practices, beliefs and traditional knowledge which are essential for sustaining cultural values among local communities.

5.5.2 Case study 2 – National - ITALY

5.5.2.1 Policies and guidelines addressing Disaster Risk Management and Disaster Risk Reduction

For the case of earthquake risk in cultural heritage and historic constructions, Italy has been developing a series of legal guidelines and standards whose latest version is the 2011 *Guidelines for the assessment and mitigation of seismic risk in cultural heritage (DPCM, 2011)*. The purpose of these *Guidelines* is to provide a framework for performing structural analysis, assessment and retrofitting tailored to the specific features and needs of heritage structures. The *Guidelines* offer three possible levels of analysis for assessing the seismic performance of a given construction, namely LV1, LV2, and LV3. Each level increases the complexity of the analysis and, simultaneously, requires an increasing amount of information regarding structural details and materials properties. The LV1 assessment method is useful for evaluations at a territorial scale and is able to provide an estimate of the ground acceleration related to the collapse. This level only requires a visual inspection and a qualitative judgment of some structural details of the construction. The LV2 assessment method involves a simplified construction-level analysis that, nevertheless, is able to account for the potential interaction among the structural parts of the construction and that is able to provide insights for designing local retrofitting. The LV3 assessment method involves a detailed construction-level analysis

that requires the modelling of the nonlinear mechanical behavior of the components of the construction. This assessment level requires a large amount of data and may be extremely time consuming from a computational point of view. For any level, the seismic performance assessment should be carried out by a structural engineer with adequate knowledge about heritage and historic constructions. As an additional comment, it should be noted that the *Guidelines* refer that, for cultural heritage buildings, it is often preferable to accept a higher seismic risk, when compared to that of ordinary buildings, rather than to implement interventions in disagreement with authenticity and/or conservation principles. Still, accepting this means accepting the burden of responsibility in case an earthquake causes heavy damage or collapse of the cultural heritage asset, which may then lead to injuries or deaths. Furthermore, it also means that everyone involved should be aware of this risk and accept it.

For the case of fire risk, Italy is currently in the process of developing a standard addressing fire risk assessment for cultural heritage constructions accounting for their specificities. In the meantime, a guideline has been published by the Italian fire brigade (VVF, 2016) to address fire safety issues in cultural heritage buildings. Given the characteristics of cultural heritage buildings, it is often difficult to implement fire safety measures commonly found in regular buildings. In particular, those measures are, in some cases, only applicable through invasive interventions that are incompatible with the preservation of heritage values. For such cases, the existing fire safety standard (DPDR, 2011) establishes exceptions that allow designers to define alternative fire safety measures. In light of this, Italian fire brigade issued a guideline to assist designers in defining adequate fire safety measures for these situations. From a methodological point of view, the guideline provides help for performing a preliminary fire risk assessment (for occupants and for valuable contents) whose outcome is then used to determine the strategy and the technical solutions that will ensure a fire safety level equivalent to that of regular buildings that follows the existing standard (DPDR, 2011). Since the guideline is based on the most frequent situations of exception, it reminds that the proposed technical solutions are not exhaustive and might only be useful to address the more general issues related to the fire safety of cultural heritage buildings.

For the case of flood risk, following the operational implementation of the EU Flood Directive in Italy (MATTM, 2013), the Italian Institute for Environmental Protection and Research (ISPRA) ("Istituto Superiore per la Protezione e la Ricerca Ambientale") has published a risk map of cultural heritage assets exposed to flood risk and landslide risk (ISPRA, 2018). The risk maps combine the flood and landslide hazard maps developed by ISPRA for the Italian territory for different hazard levels with georeferenced data about the cultural heritage assets, obtained from the Vincoli In Rete database of the Higher Institute for Conservation and Restoration ("Istituto Superiore per la Conservazione ed il Restauro") (VIR, 2019), and assign a certain vulnerability level to each asset. This vulnerability level represents the expected level of damage of a given asset exposed to an event and, according to (ISPRA, 2018), was conservatively set to 1 for all assets, on a scale defined between 0 (no damage) and 1 (total loss), due to a lack of data about the individual cultural heritage assets.

Finally, reference is made to the *Italian risk map* project ("Carta del Rischio") of the Ministry of Cultural Heritage and Activities and Tourism (MiBACT) ("Ministero per i Beni e le Attività Culturali e per il Turismo") (MiBACT, 2019). The *Italian risk map* is a georeferenced tool that was developed to identify actions that need to be implemented to protect cultural heritage assets across the country. This tool does not provide guidance on the type of structural interventions that should be implemented but ranks the assets according to their priority. The mapping strategy considers a multi hazard approach and the physical vulnerability of each asset by estimating its potential damage. For each asset, risk is defined by a combination of hazard and vulnerability. The **hazard component** describes the level of threat (independent from the presence of the built environment) and is divided into three components:

- **Environmental** - accounts for weather, microclimate and pollutants in the air, and is described by variables that can be connected to the physical degradation of the surface of the materials of the assets (namely leading to erosion, blackening, or physical stress).
- **Structural** - accounts for natural phenomena that can affect the stability of a building (e.g. earthquakes, landslides, flooding, coastal dynamics, avalanches, volcanic activity), and is related to the degradation of the mechanical properties of the structure of the asset.
- **Anthropic** - accounts for socio-demographic dynamics and is related to the potential degradation of the asset due to dynamics connected to human activities either directly (e.g. theft, vandalism,) or indirectly (e.g. population density, tourist flow patterns).

The **vulnerability component** describes the level of exposure of a given asset to external threats and is also divided into three components:

- **V1** - which reflects aspects connected to the surface of the materials of the asset and is defined by variables that are related to the state of conservation of the surface, based on the urgency, severity and extent of the potential damage.
- **V2** - which reflects aspects connected to structural components and is defined by variables that are related to the state of conservation of the structure, based on the urgency, severity and extent of the potential damage to each structural component.
- **V3** - which reflects aspects connected to the maintenance and safety of assets and is defined by variables that are related to the use and the safety of the asset.

Although the concept appears to be interesting and wide-ranging, the publicly available information about the details of the risk quantification process is scarce and, from what was able to be determined, it is not clear if the vulnerability component of the assets is not estimated in an overly simplistic way for some of the hazards that are considered.

5.5.2.2 Policies and guidelines addressing disaster preparedness and response

As a result of the cooperation between the civil protection and multiple Italian institutions, several post-disaster damage survey forms were specifically developed for immovable and movable cultural heritage (MiBACT, 2015). Some of the better-known forms are those developed for post-earthquake damage survey of churches and palaces, which also have different versions depending on the level of details that is required for the damage survey. Aside from these, forms were also developed for ground settlements and extreme weather events. For some of these forms, detailed manuals were also developed to help filling the requested data, e.g. see (DPC, 2013). For the case of damaged immovable heritage assets, these forms normally collect general information about the asset (location, owner, contacts, typology, dimensions, construction materials, etc.), about its damage and estimated vulnerability, and the use and access restrictions that need to be enforced (safe, unsafe, partially safe where safe and unsafe zones are identified within the asset). This data is normally collected by experienced professionals from different fields (structural engineering, architecture, history, conservation, civil protection, etc.) and is then used to develop the necessary measures for immediate and temporary stabilization of the damaged cultural heritage asset, as well for the development of more definite repair/recovery solutions.

On the topic of temporary stabilization, reference is made to the field manual "Schede Tecniche di Opere Provvisionali" (STP, 2011) developed by the fire brigade division of the Italian Civil Protection and that contains a set of information sheets for emergency shoring operations, illustrating the most common design solutions to secure damaged buildings, as well as the necessary construction details. The purpose of this manual is to make the definition of on-site emergency shoring works implemented by fire brigades easy and practical, starting from the earliest stages of the emergency. In the case of cultural heritage assets, similar stabilization solutions can also be implemented, but normally under the guidance of professionals with experience in cultural heritage. The stabilization solutions that are included in the manual were identified by taking into account the means and the techniques used by the Italian fire brigades, the type of materials that are usually available and issues related to building operations, e.g. safety of workers, simplicity and speed of implementation, etc.

With respect to disaster response procedures related to cultural heritage, two additional aspects are further highlighted, which are relevant in case of earthquakes. The first point is related to the Italian Decree-Law 189/2016 Art. 28 (GI, 2017) that establishes provisions for the treatment and transport of materials deriving from the collapse of buildings due to earthquakes. For the particular case of cultural heritage, this law is complemented by Annex 1 of the Circolare 53 2017 (MiBACT, 2017) that provides procedures for the removal and recovery of rubble of protected properties and historic buildings. This rubble is classified into three types: A – of listed heritage assets, B – of historic assets, C – of assets of no cultural significance. Type A rubble should be preserved in-situ as much as possible, while types B and C must be transferred to temporary deposit sites for a more detailed identification and selection of relevant

cultural or architectural elements. The general objective of this process is to recover cultural or architectural remains that might be reused in the future restoration of heritage assets and historically relevant constructions. This reuse of materials and elements is then expected to help places affected by earthquakes in regaining their sociocultural identity. In theory, the process of identifying and selecting this rubble is expected to be fast. In practice, however, this process is complex and involves significant amounts of rubble to go through. Certain researchers who analysed this issue mention that faster procedures were put in place after the October 30 2016 earthquake (Dolce *et al.* 2018), while others (Carbonara, 2018) refer that, in some locations, damaged historic centres were cleaned and razed without any consideration for these historic remains. It is clear that rushing the collection of these remains can contribute to the loss of identity, values and collective memory. However, time is a critical factor in post-earthquake recovery scenarios due to multiple socioeconomic factors, as well as other external factors (e.g. weather conditions). The right balance is, as in most cases, difficult to achieve.

The second point is related to the safe housing of rescued movable cultural heritage assets from damaged or collapsed constructions, as well as of the previously referred recovered heritage remains. These rescued movable cultural heritage assets and heritage remains require adequate facilities for safe temporary housing and restoration. Available information from the emergency actions carried out after the 2016 earthquake series (OS, 2018) highlights that such facilities were not available throughout the affected regions, thus delaying the recovery operations, and that not all of the available facilities had suitable characteristics to safely store these items. For example, following the 1997 earthquake, Umbria constructed a 5000m2 earthquake-safe storage facility equipped for conservation and restoration of different types of artworks, archives and books. Following the 2016 earthquake series, it was able to house close to 7000 movable assets, as well as rubble remains recovered from damaged heritage assets in the region. On the contrary, movable assets recovered in the Marche region were stored across multiple facilities where some do not possess adequate storage, preservation and safety conditions.

5.5.2.3 Policies and guidelines addressing post-disaster reconstruction

After the 2016 earthquake series, specific legislation was published addressing recovery and reconstruction issues related to the historic settlements that were heavily damaged. Simultaneously, MiBACT established a working group to define specific approaches for the reconstruction of historic centres damaged by the earthquakes. Within the context of the Circolare 53 2017 (MiBACT, 2017a), guidelines for post-earthquake reconstruction defined by the referred working group were also published (MiBACT, 2017b) to establish the admissible contexts for the reconstruction of damaged buildings in historic centres. One of the main points highlighted by the guidelines is that these historic centres are an essential component of Italian cultural and landscape heritage and of the identity of the affected locations. Therefore, the guidelines encourage the reconstruction of the damaged areas in their original location (instead of creating new settlements as was done in some situations after the 2009 L'Aquila earthquake), following approaches that

are based on the needs of the affected communities. The type of recovery interventions proposed by the guidelines involve:

- Repair and recovery of historic and monumental buildings.
- Partial reconstruction of buildings with cultural elements or architectural remains that were salvaged by the process referred in Section 4.2.4.
- Complete reconstruction in compliance with the values and the characteristics of the original building (volume, spatial arrangement, morphology, material, structure, etc.), either as close as possible to the original building, or involving a reinterpretation of the original building.

Furthermore, the guidelines also highlight that reconstruction should consider measures to increase the safety of the building in order to prevent similar damage situations in future earthquakes, as well as measures to ensure their energy efficiency and thermal comfort. According to the contents of these guidelines, it should be noted that the reconstruction of monuments in historic centres is not addressed.

5.6 Top-down analysis of user gaps, challenges and requirements

The analysis is based on a first set of requirements encompassing the entire DRM cycle from early warning to post-disaster scenario, by using a full set of internationally recognized resources and tools.

The initial user discussions highlighted the following as the broad topics to focus on DRM:

- Historic risk event and collective disaster memory
- Public and governmental awareness raising
- Local and traditional knowledge
- Risk assessment
- Information and data.

5.6.1 Gaps and challenges in DRM

In order to capture the gaps and challenges from the participants from different stakeholders, three different sessions were organized to look at different angles of the current practice: 1) through the layer of the institution (international, national and local level), 2) through the different hazards (earthquake, flood and fire), and 3) through the different phase (pre and post disaster). At each session, the gaps and challenges are summarized.

5.6.1.1 International and national

Planning	Policy	Data	Resources
Coordination between CH and Civil emergency	National Plans for Civil protection should include CH	Georeferenced Inventories: CH/ collections archives	Dedicated financial budget for emergency
CH sector should approach Civil protection	Feasibility of Management Plans& Laws /Regulations	Availability of databases & georeferenced data	Preparation of list of endangered monuments may help in prioritizing
More Joint activities & Open Labs needed	Political factors & conflicts affecting CH	Collecting & managing data	Lack of resources
Feasibility analysis (short-medium-long term)	Negotiation-solving conflicts between different groups	Data reliability	
Action Plan with cost estimation	Awareness raising for decision-makers on consequences of DR	Usage of web/phone applications/new tech (AI, Social media, mobile)	
Identifying value of CH (e.g. OUV)			

Table 6: Summary of the discussion on gaps and challenges on international and national level of the institution

5.6.1.2 Local level

Preparedness		Emergency		Reconstruction	
Weakness	**Strengths**	**Weakness**	**Strengths**	**Weakness**	**Strengths**
Microparcelization of properties	Awareness of population	Difficulty to have multidisciplinary teams to manage the disaster	Good capabilities and competence of the civil protection authorities	Lack of manpower (Non-specialized)	Disaster can be an opportunity for change: long term perspective
Difficulty to have governmental support	Implement DRR more easily	Involvement of site managers in the crisis unit at regional level	Multidisciplinarity is well acknowledged among stakeholders	Lack of Plan and communication for ground management and tourist education	traditional construction technique

Lack of communication	Possibility to invest money in DRR	Limited time for Decision making	DRM Approach to be more incorporated into the practice	Bureaucracy
Lack of budget	Local knowledge and skills in heritage protection	Increasing of frequency of intense rainfalls	Applicable solutions	Lack of exemplary model projects
Lack of inventories and data	Good engagement of local communities in the heritage sites	Most part of densely populated areas are flooded areas	Collecting data of disasters	
Lack of Specific CH laws/Guidelines	Good coordination between Ministry of culture and civil protection	Lack of integration of RM into urban planning tools		

Table 7: Summary of the discussion on gaps and challenges on local level of the institution

5.6.2 DM multi-hazards requirements

The next paragraph visualizes through mind maps [®coggle] the requirements identified by the stakeholders divided by topic discussion groups on Flood, Earthquake and Wildfire hazards. The requirements are structured in four groups: 1) Data and Knowledge; 2) Tools and Solutions; 3) Assessment and Monitoring systems; 4) Plan and Regulation aspects.

5.6.2.1 Flood Risk Management requirements for CH

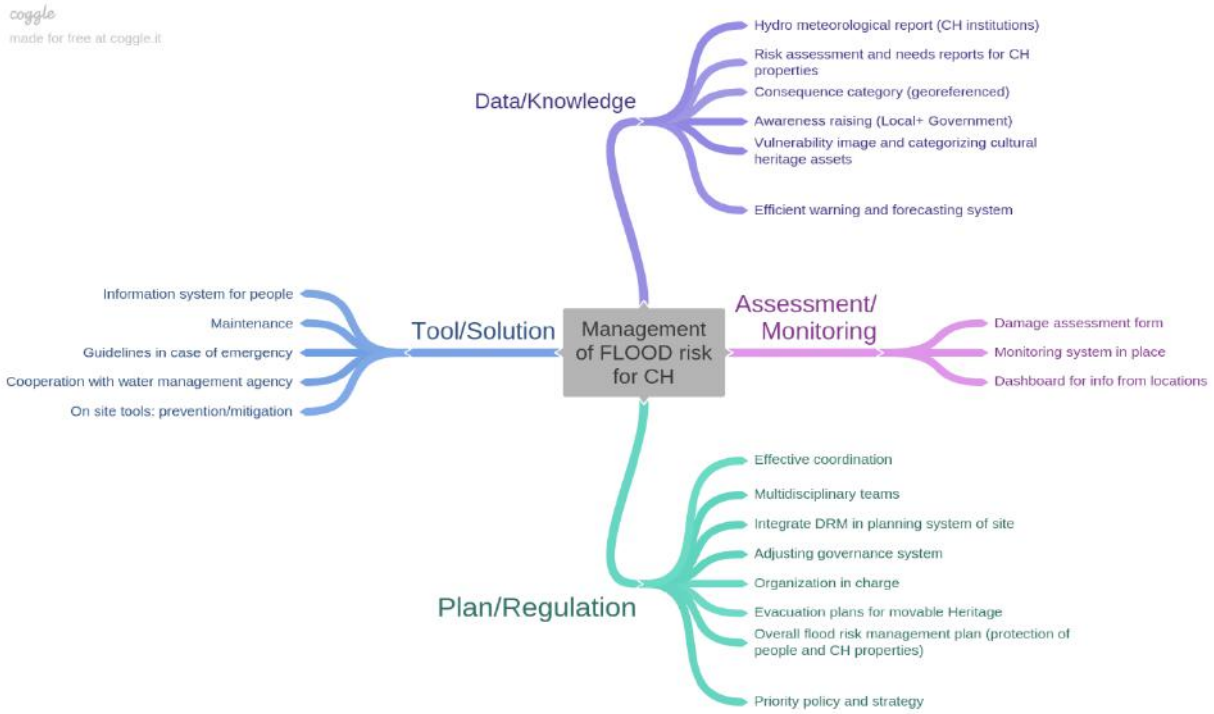


Figure 34: Flood Risk Management requirements for CH mind map [®Coggle]

5.6.2.2 Earthquake Risk Management requirements for CH

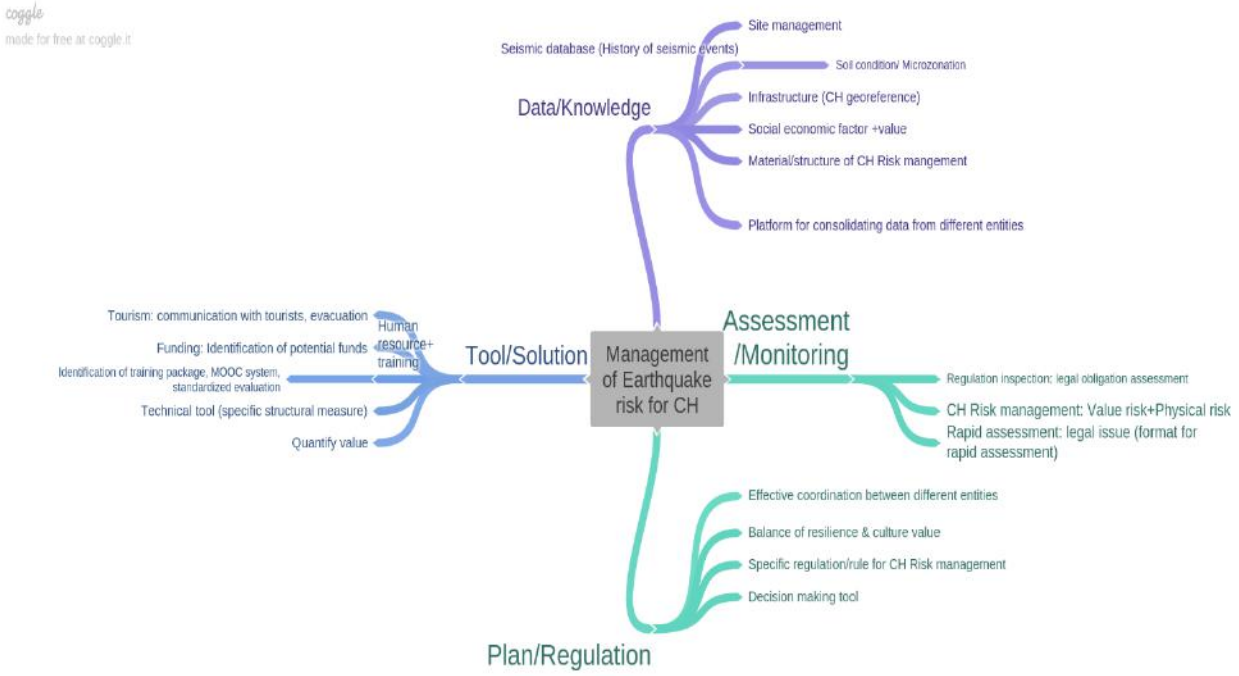


Figure 35: Earthquake Risk Management requirements for CH mind map [®Coggle]

5.6.2.3 Wildfire Risk Management requirements in CH

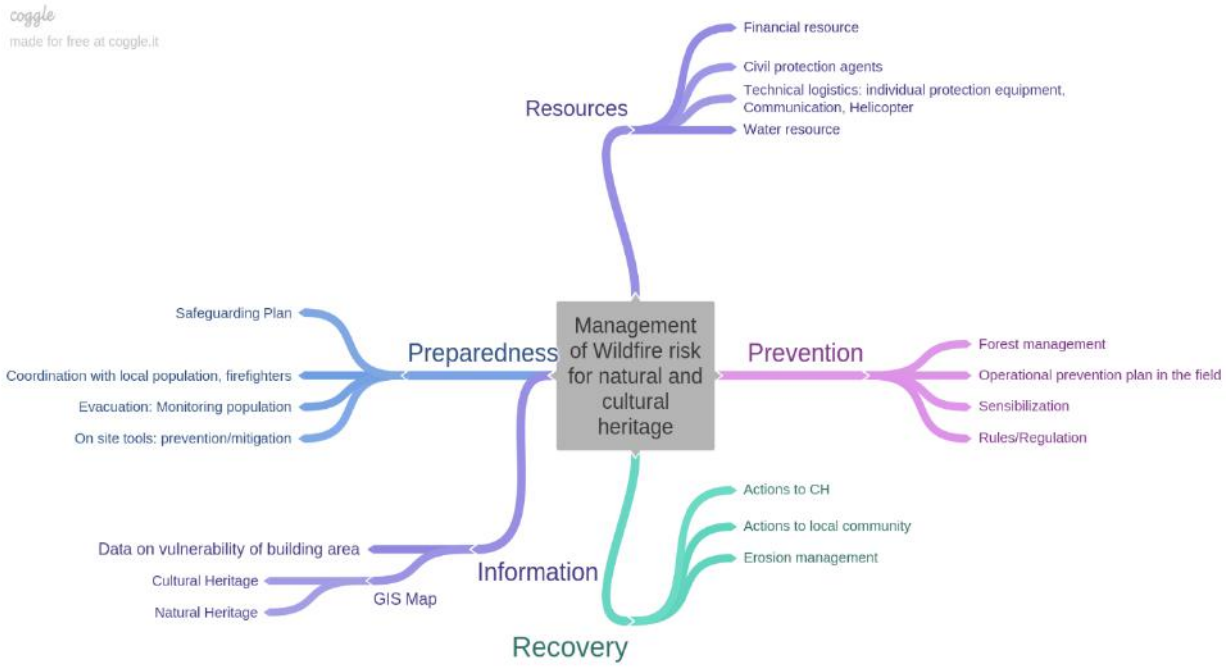


Figure 36: Wildfire Risk Management requirements for CH mind map [®Coggle]

5.6.3 Top-down user requirements for DRM

In order to come up with a list of top-down requirements for DRM in CH we asked the stakeholders to merge and prioritize the previous multi-hazard analysis. This is possible only taking into account the DRM cycle and dividing the requirements in pre and post disaster phase.

5.6.3.1 Pre-Disaster

Data/Knowledge	Georeferenced data Baseline data (including history of previous hazards) Risk mapping (hazard, vulnerability)
Tool/Solution	Improving protocols and tools) Training for civil protection agents, heritage management agents, public prevention and risk awareness Warning system Communication system Damage assessment protocols (for prevention and mitigation) Physical protection tools
Assessment/Monitoring	Monitor cycle: evaluation improving Monitor people on site: for evacuation
Plan/Regulation	Coordinating structure Communication plan for agents and mass media Emergency plan Evacuation plan for movable heritage

Table 8: Top-down user requirements for pre disaster risk management

5.6.3.2 Post-Disaster

Data/Knowledge	Platform of data consolidation (e.g. GIS) Damage data standard (e.g. SAVA) Acquire data from other ministry (satellite image)
Tool/Solution	Prioritization tool (Science, culture value) Communication tool (tourism) Effective tool in training (MOOC) Funds / equipment/materials (assessment + reconstruction) Expert (contact info, training)
Assessment/Monitoring	Format of rapid assessment of damage Update damage information (survey & monitor) Acquire data
Plan/Regulation	Management Plan/ Action plan/implementation Protocol for culture agency (1 hr, 12 hr, 1day, 1week) Ameliorate governance system Coordination (Civil protection & culture agency/ local government) just after incident (when, who, responsibility) Tools to be used in facilitation Specific rules/regulations in reconstruction

Table 9: Top-down user requirements for post-disaster risk management

5.6.4 Conclusions

The level of development of different countries regarding the **implementation of regulations, frameworks or activities** addressing the various topics is very different. Countries with a higher level of development appear to have reached such level as a response to recent disasters. Still, the risk governance approach of such countries is considerably more focused on issues related to disaster preparedness and response, and is marginally starting to address issues related to risk assessment (and mitigation). Regarding countries with a lower level of development, most exhibit a lack of risk governance structure and a lack of political will to enforce measures to address disaster risk management for the cultural heritage sector. This is partially due to a low level of awareness regarding the likely impacts of disasters in a society due to impacts in the cultural heritage sector.

According to the countries analysed most of them **do not have risk assessment procedures** for cultural heritage. Despite the availability of several (international) documents addressing this topic, there is an insufficient number of practical hazard-specific guidelines and manuals that could be applied at the site level, or at the country level to rank risk mitigation priorities of different sites. Furthermore, the soundness of available procedures is, sometimes, doubtful. Scientific research in this topic is rather scarce, despite what many people think. At the practical level, the hazard-specific and asset-specific risk assessment methods, guidelines and manuals are needed to help stakeholders in doing their own assessment. These methods cannot be overly complex but must provide results/outputs that are robust and meaningful. Further research is needed on these issues. Adequate training of stakeholders in implementing those methods is also required.

The participants highlighted the fact that there is no overarching framework that allows countries to **share and disseminate the experience and good practices on disaster preparedness and prevention** with other countries that want to do the same, even though disaster preparedness and prevention measures are being developed in certain countries (e.g. emergency units with adequate knowledge to deal with cultural heritage in emergency scenarios). The language barrier adds difficulties in sharing this experience/knowledge since English proficiency is often not as common as one would expect. This was identified as a key gap that could be addressed by the project.

In addition, the stakeholders at the International workshop were very much aware of the Sendai Framework but, other than the group of experts and those working in UNESCO sites, were not very familiar with either UNESCO-related policies and guidance documents concerning climate change risk analyses methodologies, mitigation strategies and risk management, or any EU related document on the topic, or event best practices at the national level. This again was identified as a gap that can be addressed through the project.

Local and traditional knowledge about the experience (good or bad) gathered from recent disasters in certain countries is scarce. The traditional knowledge is necessary to understand and rehabilitate the landscape and immovable heritage. The collective memory/experience notably for historic event/disaster should draw attention of the policymakers and practitioners and be integrated into local practices. In addition, local knowledge could change with time and vary from regions. It therefore needs to be developed and improved so that it could be applicable and sustainable, e.g. traditional techniques. Furthermore, it is crucial to digitalize the information and make it available for the public.

Technical equipment and new technologies (mobile application, AI, social media) applied in warning system, data collection and individual protection is needed in risk management in the cultural and natural heritage.

Post-disaster reconstruction is the topic on which countries exhibit the lowest level of development and for which they exhibit the least amount of awareness. Despite the numerous documents discussing and conceptualizing how to deal with the issue, there is probably no single right answer. As such, decisions are likely to be made case-by-case (i.e. disaster-by-disaster), depending on the national/international significance of the cultural heritage that is involved. Nevertheless, it is clear that pre-disaster awareness and discussion is needed among the (risk) governance structures that might be involved in these decisions, particularly in order to become familiar with the more recent trends that conceptualize adequate frameworks and steps to be taken to address the multiple dimensions of cultural heritage recovery.

According to the countries analysed most of them do not have adequate **national data platforms** with the necessary information to start addressing DRM in the cultural heritage sector. Some countries still do not have an easily accessible digital (GIS-based) inventory of cultural heritage. The fact that, in some countries, the GIS-based inventory of cultural heritage is private does not facilitate the development of research on these

issues also. At the country level, there is a generalized need for data and knowledge platforms dedicated to cultural heritage where all the data (hazard, exposure, vulnerability) relevant to DRM/DRR could be organized, shared (and exploited at the local, regional, national levels. Such platforms are the fundamental to for developing adequate risk assessment procedures and provide data-driven DRM/DRR decisions.

A large portion of the stakeholders involved in the workshop have a certain **lack of awareness** about the amount of technical documents that have been produced over the years on the different topics (i.e. disaster risk management, disaster risk reduction, disaster preparedness and response, and post-disaster reconstruction). The fact that all these documents cannot be accessed through a "central" repository adds to this lack of awareness since many people do not what to look for and where to look for it. The fact that many of these documents are not available in the native language of a country is also a barrier to the spread of information contained in these documents. Besides, lack of awareness, notably for politicians, regarding the importance of DRR in CH is a problem. Sites managers need to communicate to the Government and decision makers the key messages on the consequences of the damage of CH, as it is hard to quantify the consequences of the damages and the loss of value of CH. Including civil society could be an effective way to raise public awareness. Another perception from the workshop is that a significant number of stakeholders also have some misconceptions related to risk-related terminology. This is a very common issue (not just in the cultural heritage sector). Stakeholders lack awareness of the complexity of the decisions and implications of the multiple options that may be followed in post-disaster recovery of cultural heritage.

Many workshop participants recognize the need to **enhance cooperation with (local/regional/national) civil protection institutions and CH technical experts and authorities** in order to integrate disaster preparedness measures and emergency procedures in the DRM procedures of those institutions. However, in most cases, stakeholders have not taken the first step of establishing contact with civil protection institutions to try to push this issue forward.

There is a need to develop adequate **capacity building programmes** to train and prepare cultural heritage staff for emergency situations and to make them aware of the procedures that will be followed by the civil protection agents that will be on the field.

Finally, reference is made to the fact that there is also a **lack of adequate tools for collecting post-disaster data on damage and loss of value(s)** that will provide part of the fundamental information needed to develop a post-disaster recovery strategy. The use of remote sensing tools is also not fully explored so far by the cultural heritage sector for this purpose (with some exceptions in cases of and armed conflicts situations). The other part of the information that is needed for developing post-disaster recovery strategies is the baseline pre-disaster data that should reflect the value(s) of cultural heritage and its importance for society.

The majority of the international-level and European-level documents only refer the importance of **adopting adequate risk management practices** for cultural heritage

protection, highlighting also stakeholders that should be involved. Few documents address practical frameworks, methodological approaches or more detailed guidance for implementing risk management for cultural heritage. Some of the countries that were analysed have developed guidelines and legislation that can be applied to support the implementation of DRR practices for certain hazards. Still, in the overall, there is a need for better risk assessment and risk mapping procedures for cultural heritage addressing different hazard types.

Several DRM initiatives addressing **emergency preparedness and response** for (or that can be applied to) the cultural heritage sector were identified at the international-, European- and national-levels. In some cases, the development of these procedures at the country-level was driven by recent disasters and the experience and knowledge drawn from these events (both in terms of cultural heritage losses, as well as in terms of preparedness/response procedures) should be shared across countries or among interested stakeholders. Aside from the need to develop specific procedures defining emergency actions for cultural heritage, it should be highlighted that establishing adequate partnerships between cultural heritage institutions and the civil protection sector is fundamental to ensure an adequate cooperation and coordination in emergencies.

In terms of **post-disaster recovery/reconstruction** of cultural heritage, most of the relevant documents covering this issue were produced at the international level. Still, it is believed that these documents provide a sound basis for discussing the issue after a disaster that severely affects or destroys cultural heritage. Furthermore, it is also believed that decisions on this topic are likely to be made case-by-case and depending on the national/international significance of the cultural heritage assets that are affected. Nevertheless, pre-disaster awareness and discussion is found to be needed among those that might be involved in these decisions.

5.6.5 Way forward to DRM

In conclusions, the top-Down analysis identifies the following way forward to DRM:

a) Effective **coordination** between cultural and/or natural heritage authorities and civil protection and local government.

b) Incorporating CH into national and local **regulations** and **plans** for civil protection/emergency response.

c) Identifying/quantifying **value of CH** (e.g. OUV) and balancing resilience improvement and culture value preservation.

d) Filling the data gap and increasing the **data** reliability relating to DRR for cultural/natural heritage: georeferenced inventories, risk mapping, vulnerability image and categorizing heritage assets, GIS.

e) Technical equipment and new **technologies** (mobile application, AI, social media) applied in warning system, data collection and individual protection.

f) **Assessment/Monitoring**: risk assessment for cultural/natural heritage, damage assessment (prevention/mitigation), monitoring population on site for evacuation.

g) **Training** for civil protection and heritage authorities (e.g. MOOC system) and enhancing public prevention/risk awareness.

h) **Multidisciplinary** teams and **Interdisciplinary** and **inter sectoral** approach for disaster management are needed.

i) **Local and informal knowledge**, which are necessary to understand and rehabilitate the landscape and immovable heritage.

j) **Modern knowledge and methodology** for prevention and rehabilitation of the CLT heritage.

k) Dedicated financial **budget** for emergency preparedness/response for cultural/natural heritage.

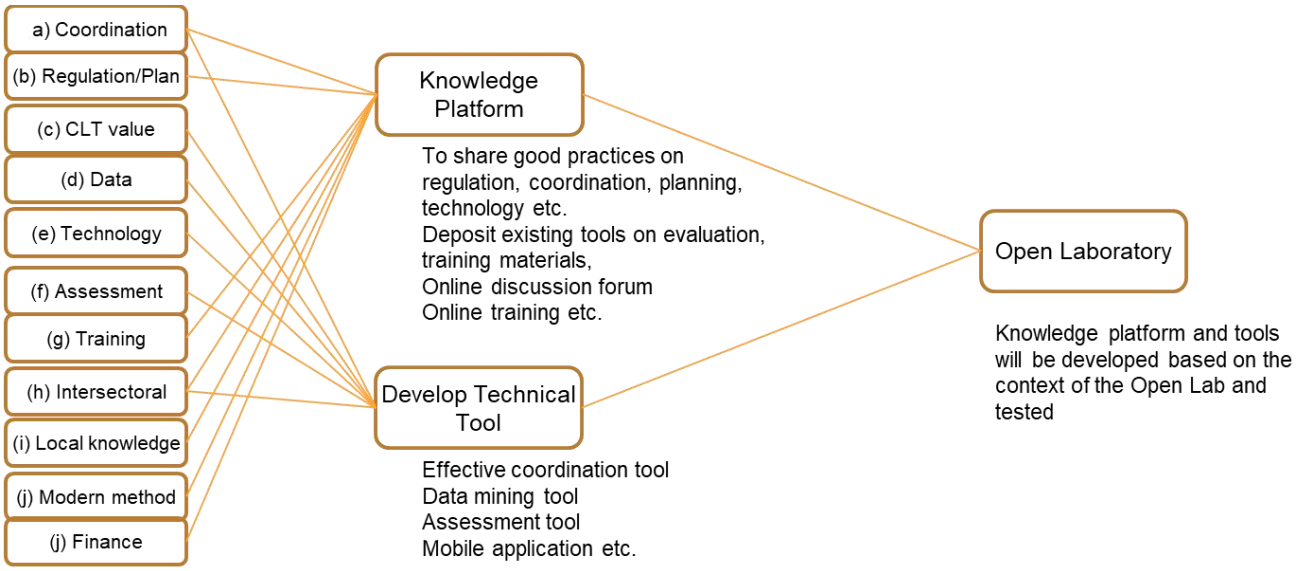


Figure 37: Way forward to DRM of multi-hazards

6 GLOCAL User Requirement Analysis

This chapter deals with the results from the top-down as well bottom-up approaches to identify the GLOCAL UR.

In the following Figure the structure of the combination of both approaches is shown. There are several topics identified which refers to the top-down as well as to the bottom-up approach. The topic "tool/solution" was identified during the top-down approach. Within both analyses the topics "general", "analysis", "crowd" and "data" were identified. "Visualisation", "report", "models" and "equipment" were identified during bottom-up analysis.

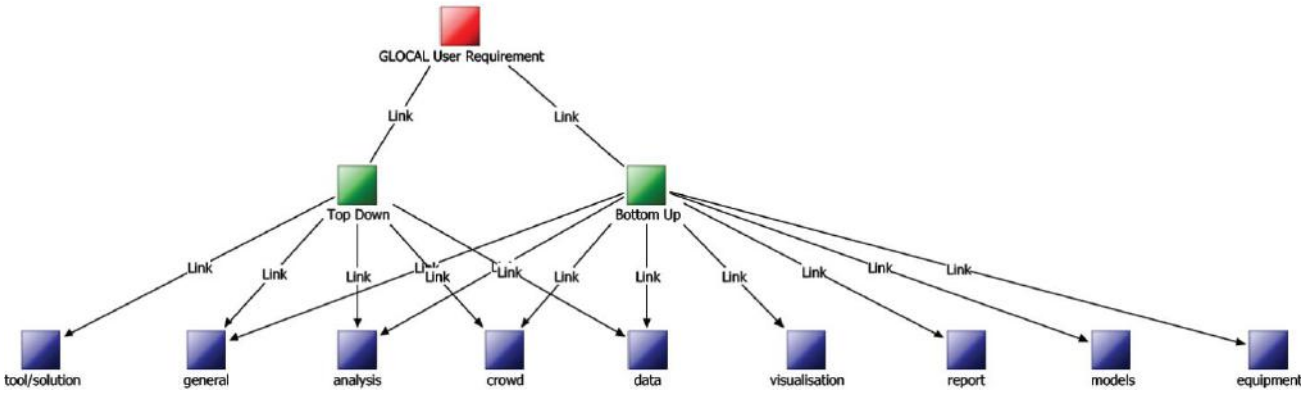


Figure 38: Top-down and bottom-up UR and topics

Not all identified UR are necessary or relevant for all phases of disaster management. Especially during the top-down workshop there were just UR identified for the pre-disaster phase and the post-disaster phase. Therefore, for the disaster phase just the identified UR of the bottom-up approach are available. Especially for the disaster phase the knowledge of the relevant stakeholder of the Open Labs are relevant which were gathered with the bottom-up analysis.

The topics "tools/solution" (from top-down approach) don't match with disaster phase. In addition, the topic "equipment" (for a specific UR due to Use Case Scenarios) just match with the pre-disaster phase. The network of this is shown in the following Figure.

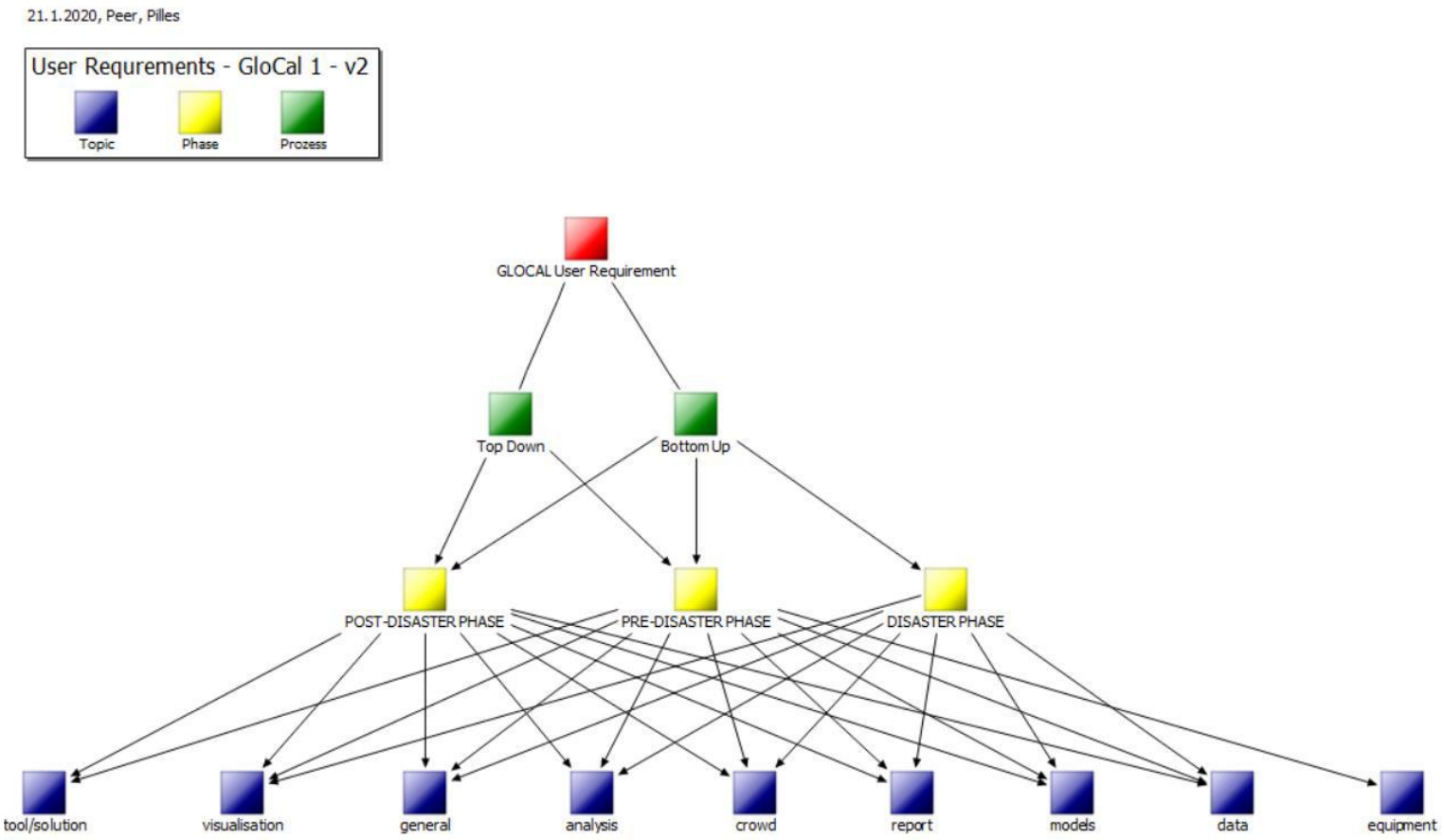


Figure 39: Structure of combination of approaches

In the following Figure the top-down UR network is visualized. The network is structured following Figure 39. During the top-down analysis, as mentioned before, no user requirement was identified for the disaster phase. All in all, nine user requirements were identified referring to topic "general" followed by eight UR for the topic "analysis". The edges as well as the nodes of the network of the top-down analysis are labelled with 1. This is relevant for the combined network of both analyses.

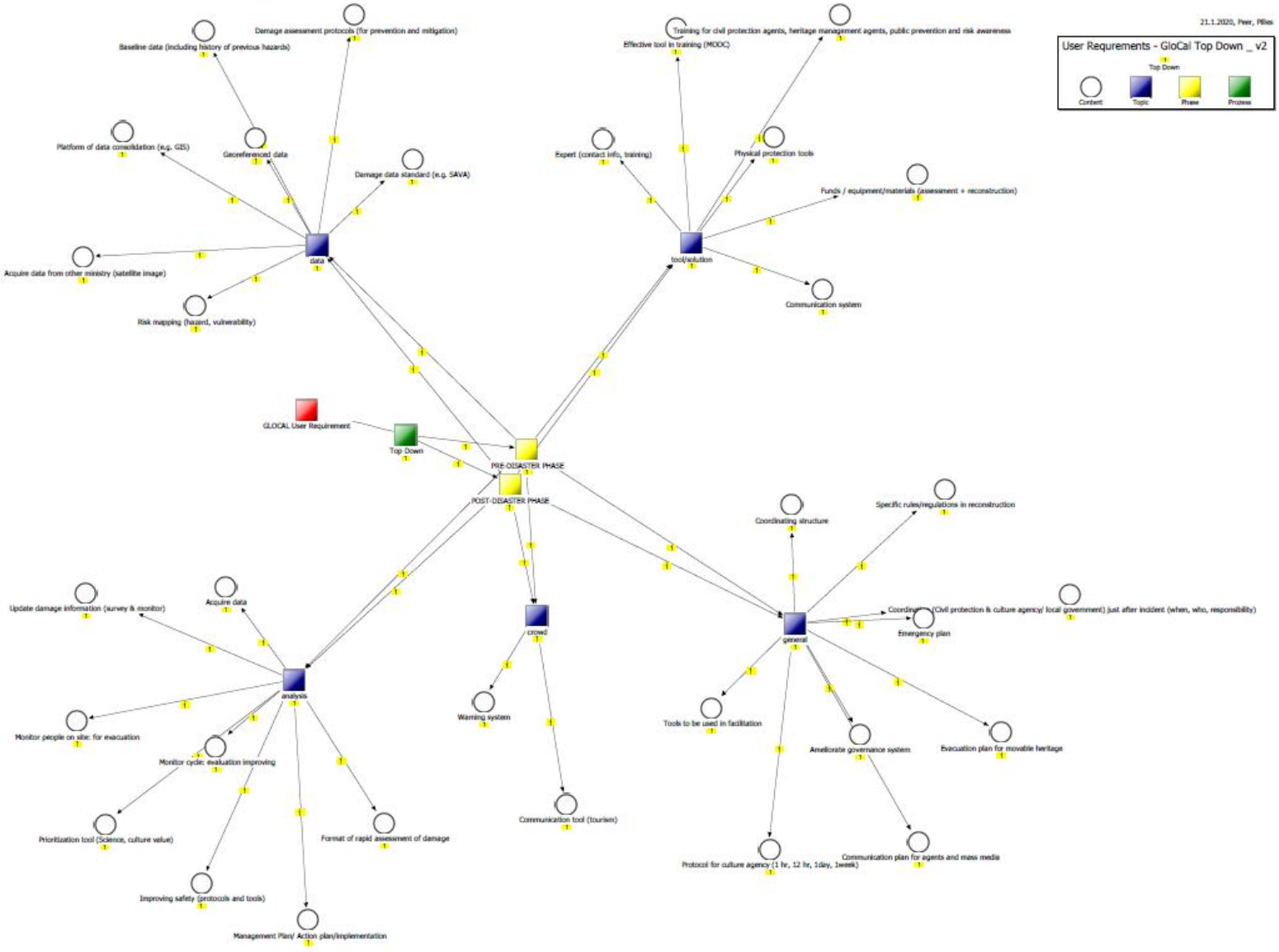


Figure 40: Top-down UR network

The network for the bottom-up approach as well as the combined network of the two approaches is visualized in Annex IX and Annex X of this deliverable

The edges as well as the nodes of the bottom-up approach are labelled with 2. This is relevant for the combined network to identify which UR was identified with which approach.

Dependency of the two approaches with the three phases and the identified topics as well as consensus can be seen especially in the Annex X.

Some results are:

- The four "strong" topics "general", "model", "data" and "analysis" can easily be identified.
- UR were identified for both approaches within the topics "general", "analysis", "crowd" and "data".
- Topic "solution/tools" only match with top-down approach.
- Topic "models", "visualisation", "report" and "equipment" only match with bottom-up approach.
- UR from top-down approach were identified for pre – disaster as well as post – disaster phase.
- There was only one UR identified by local stakeholder for topic "equipment".
- For the topic "report" only two UR were identified.

The combination of the results of the two approaches are visualised on the following Table.

Approach	Topic	Pre-disaster phase	Disaster-phase	Post-disaster phase
Top-down	Data	Georeferenced data		Platform of data consolidation (e.g. GIS)
Top-down	Data	Baseline data (including history of previous hazards)		Damage data standard (e.g. SAVA)
Top-down	Data	Risk mapping (hazard, vulnerability)		Acquire data from other ministry (satellite image)
Top-down	Analysis	Improving safety (protocols and tools)		Prioritization tool (Science, culture value)
Top-down	Tool/solution	Training for civil protection agents, heritage management agents, public prevention and risk awareness		
Top-down	Crowd	Warning system		Communication tool (tourism)
Top-down	Tool/solution			Effective tool in training (MOOC)
Top-down	Tool/solution	Communication system		Funds / equipment/materials (assessment + reconstruction)
Top-down	Data	Damage assessment protocols (for prevention and mitigation)		
Top-down	Tool/solution			Expert (contact info, training)
Top-down	Tool/solution	Physical protection tools		
Top-down	Analysis	Monitor cycle: evaluation improving		Format of rapid assessment of damage
Top-down	Analysis	Monitor people on site: for evacuation		Update damage information (survey & monitor)
Top-down	Analysis			Acquire data
Top-down	Analysis			Management Plan/ Action plan/implementation
Top-down	General	Coordinating structure		Protocol for culture agency (1 hr, 12 hr, 1day, 1week)
Top-down	General	Communication plan for agents and mass media		
Top-down	General	Emergency plan		Ameliorate governance system
Top-down	General	Evacuation plan for movable heritage		Coordination (Civil protection & culture agency/ local government) just after incident (when, who, responsibility)

Top-down	General			Tools to be used in facilitation
Top-down	General			Specific rules/regulations in reconstruction
Bottom-up	General	The SHELTER solution shall support Direct Users (see glossary) through all phases of DRM.	The SHELTER solution shall support Direct Users (see glossary) through all phases of DRM.	The SHELTER solution shall support Direct Users (see glossary) through all phases of DRM.
Bottom-up	General	All direct stakeholders shall have controlled access to the SHELTER System.	All direct stakeholders shall have controlled access to the SHELTER System.	All direct stakeholders shall have controlled access to the SHELTER System.
Bottom-up	General	All direct stakeholders shall be able to concurrently work [work at the same time]	All direct stakeholders shall be able to concurrently work [work at the same time]	All direct stakeholders shall be able to concurrently work [work at the same time]
Bottom-up	General	The SHELTER solution shall be able to support different teams working independently	The SHELTER solution shall be able to support different teams working independently	The SHELTER solution shall be able to support different teams working independently
Bottom-up	General	All direct stakeholders shall not modify data/information directly associated with source data/information	All direct stakeholders shall not modify data/information directly associated with source data/information	All direct stakeholders shall not modify data/information directly associated with source data/information
Bottom-up	General	All direct stakeholder's actions, processing and decisions shall be recorded (Who, What, Where, When - and in some cases Why) This can be seen in an audit log file	All direct stakeholder's actions, processing and decisions shall be recorded (Who, What, Where, When - and in some cases Why) This can be seen in an audit log file	All direct stakeholder's actions, processing and decisions shall be recorded (Who, What, Where, When - and in some cases Why) This can be seen in an audit log file
Bottom-up	General	The analyst shall be able to rely on the information stored on the SHELTER system	The analyst shall be able to rely on the information stored on the SHELTER system	The analyst shall be able to rely on the information stored on the SHELTER system
Bottom-up	General	The SHELTER solution interface(s) shall support the default languages	The SHELTER solution interface(s) shall support the default languages	The SHELTER solution interface(s) shall support the default languages
Bottom-up	General	The System Administrator shall be able to assure the team manager that the information	The System Administrator shall be able to assure the team manager that the	The System Administrator shall be able to assure the team manager that the information processed by SHELTER is secure.

		processed by SHELTER is secure.	information processed by SHELTER is secure.	
Bottom-up	General	The SHELTER solution will not be a permanent store of information [each stakeholder must have their own master system external to SHELTER]	The SHELTER solution will not be a permanent store of information [each stakeholder must have their own master system external to SHELTER]	The SHELTER solution will not be a permanent store of information [each stakeholder must have their own master system external to SHELTER]
Bottom-up	General	The SHELTER solution will be a permanent store of information [each stakeholder mustn´t have their own master system external to SHELTER]	The SHELTER solution will be a permanent store of information [each stakeholder mustn´t have their own master system external to SHELTER]	The SHELTER solution will be a permanent store of information [each stakeholder mustn´t have their own master system external to SHELTER]
Bottom-up	General	The SHELTER solution can be stored and run locally	The SHELTER solution can be stored and run locally	The SHELTER solution can be stored and run locally
Bottom-up	General	The SHELTER system should have functions similar to those offered to its competitors	The SHELTER system should have functions similar to those offered to its competitors	The SHELTER system should have functions similar to those offered to its competitors
Bottom-up	General	The SHELTER roles should be mapped to the local stakeholder roles to comply with appropriate authorisation functionality	The SHELTER roles should be mapped to the local stakeholder roles to comply with appropriate authorisation functionality	The SHELTER roles should be mapped to the local stakeholder roles to comply with appropriate authorisation functionality
Bottom-up	General	The SHELTER solution shall support the rapid deployment and training needs of its direct users		
Bottom-up	General	The systems administrator shall be able to set up interfaces with the relevant SHELTER tools. This includes the ability to configure the interfaces to newer versions of these tools	The systems administrator shall be able to set up interfaces with the relevant SHELTER tools. This includes the ability to configure the interfaces to newer versions of these tools	The systems administrator shall be able to set up interfaces with the relevant SHELTER tools. This includes the ability to configure the interfaces to newer versions of these tools
Bottom-up	General	The stakeholder shall be able to decide if a SHELTER	The stakeholder shall be able to decide if a SHELTER	The stakeholder shall be able to decide if a SHELTER instance is to

		instance is to operate without internet connectivity. SHELTER has to support online and offline mode (with/with-out internet connection)	instance is to operate without internet connectivity. SHELTER has to support online and offline mode (with/with-out internet connection)	operate with-out internet connectivity. SHELTER has to support online and offline mode (with/with-out internet connection)
Bottom-up	General	The Team Manager shall be able to audit past and present activity carried out by the direct users.	The Team Manager shall be able to audit past and present activity carried out by the direct users.	The Team Manager shall be able to audit past and present activity carried out by the direct users.
Bottom-up	General	The Analyst shall be able to modify the SHELTER system to adjust their plans to unfolding events.	The Analyst shall be able to modify the SHELTER system to adjust their plans to unfolding events.	The Analyst shall be able to modify the SHELTER system to adjust their plans to unfolding events.
Bottom-up	General	The SHELTER solution shall support the collection of data from a range of present information sources and the possibility of adding other information sources in the future.	The SHELTER solution shall support the collection of data from a range of present information sources and the possibility of adding other information sources in the future.	The SHELTER solution shall support the collection of data from a range of present information sources and the possibility of adding other information sources in the future.
Bottom-up	General	The analyst shall be able to maintain traceability to source information throughout the process	The analyst shall be able to maintain traceability to source information throughout the process	The analyst shall be able to maintain traceability to source information throughout the process
Bottom-up	General	The collector shall be able to convert audio to text files	The collector shall be able to convert audio to text files	The collector shall be able to convert audio to text files
Bottom-up	General	The collector shall be able to capture clips of audio from videos.	The collector shall be able to capture clips of audio from videos.	The collector shall be able to capture clips of audio from videos.
Bottom-up	General	The SHELTER solution shall support the critical review of the information collected and assess the credibility of the information received	The SHELTER solution shall support the critical review of the information collected and assess the credibility of the information received	The SHELTER solution shall support the critical review of the information collected and assess the credibility of the information received

Bottom-up	General	The Analyst shall be able to disregard information not relevant to the shelter analytical concept	The Analyst shall be able to disregard information not relevant to the shelter analytical concept	The Analyst shall be able to disregard information not relevant to the shelter analytical concept
Bottom-up	General	The SHELTER solution shall support the organisation of the information collected to enable an effective analysis	The SHELTER solution shall support the organisation of the information collected to enable an effective analysis	The SHELTER solution shall support the organisation of the information collected to enable an effective analysis
Bottom-up	General	The Analyst shall be able to index any information collected. This should be run as a background task without hindering system usability	The Analyst shall be able to index any information collected. This should be run as a background task without hindering system usability	The Analyst shall be able to index any information collected. This should be run as a background task without hindering system usability
Bottom-up	General	The analyst shall be able to perform matching checks against database information.	The analyst shall be able to perform matching checks against database information.	The analyst shall be able to perform matching checks against database information.
Bottom-up	General	The analyst shall be able to perform matching checks against available databases. (Images, videos, audio etc.)	The analyst shall be able to perform matching checks against available databases. (Images, videos, audio etc.)	The analyst shall be able to perform matching checks against available databases. (Images, videos, audio etc.)
Bottom-up	General	The SHELTER solution shall support the production of standard reports based on the analysis conducted by the SHELTER tools	The SHELTER solution shall support the production of standard reports based on the analysis conducted by the SHELTER tools	The SHELTER solution shall support the production of standard reports based on the analysis conducted by the SHELTER tools
Bottom-up	General	The SHELTER solution shall support the timely dissemination of the reports and information generated by the system.	The SHELTER solution shall support the timely dissemination of the reports and information generated by the system.	The SHELTER solution shall support the timely dissemination of the reports and information generated by the system.
Bottom-up	General	The Systems Administrator shall be able to delete information used by the system.	The Systems Administrator shall be able to delete information used by the system.	The Systems Administrator shall be able to delete information used by the system.
Bottom-up	General	The SHELTER solution shall support the rapid deployment		

		and training needs of its direct users		
Bottom-up	General	The Systems Administrator shall be able to configure the SHELTER systems user access within a fixed time period per user.	The Systems Administrator shall be able to configure the SHELTER systems user access within a fixed time period per user.	The Systems Administrator shall be able to configure the SHELTER systems user access within a fixed time period per user.
Bottom-up	General	The analyst shall receive SHELTER processing tool training, as and when required	The analyst shall receive SHELTER processing tool training, as and when required	The analyst shall receive SHELTER processing tool training, as and when required
Bottom-up	General	The Team Manager be able to decide if a SHELTER instance is to operate without internet connectivity.	The Team Manager be able to decide if a SHELTER instance is to operate without internet connectivity.	The Team Manager be able to decide if a SHELTER instance is to operate without internet connectivity.
Bottom-up	General	The Systems Administrator shall have a forum to share and update information	The Systems Administrator shall have a forum to share and update information	The Systems Administrator shall have a forum to share and update information
Bottom-up	General	The SHELTER solution shall support the collection of data from a range present and future information sources.	The SHELTER solution shall support the collection of data from a range present and future information sources.	The SHELTER solution shall support the collection of data from a range present and future information sources.
Bottom-up	General	The systems administrator shall be able to identify the issue(s) with faulty collection events	The systems administrator shall be able to identify the issue(s) with faulty collection events	The systems administrator shall be able to identify the issue(s) with faulty collection events
Bottom-up	General	The SHELTER system shall be able to support multiple arguments [search using multiple filters/keywords etc.]	The SHELTER system shall be able to support multiple arguments [search using multiple filters/keywords etc.]	The SHELTER system shall be able to support multiple arguments [search using multiple filters/keywords etc.]
Bottom-up	General	The Analyst shall be able to cross check new information against previously known information from other sources	The Analyst shall be able to cross check new information against previously known information from other sources	The Analyst shall be able to cross check new information against previously known information from other sources

Bottom-up	General	The Analyst shall be able to disregard information which are not relevant for process	The Analyst shall be able to disregard information which are not relevant for process	The Analyst shall be able to disregard information which are not relevant for process
Bottom-up	General	The Analyst shall be able to filter information based on synonym of keywords	The Analyst shall be able to filter information based on synonym of keywords	The Analyst shall be able to filter information based on synonym of keywords
Bottom-up	General	The analyst shall be able to adjust threshold of any automated alerting.	The analyst shall be able to adjust threshold of any automated alerting.	The analyst shall be able to adjust threshold of any automated alerting.
Bottom-up	General	The Analyst shall be able to export the data from the SHELTER tools.	The Analyst shall be able to export the data from the SHELTER tools.	The Analyst shall be able to export the data from the SHELTER tools.
Bottom-up	General	The Analyst shall be able version control the exported data from the SHELTER tools	The Analyst shall be able version control the exported data from the SHELTER tools	The Analyst shall be able version control the exported data from the SHELTER tools
Bottom-up	General	The Systems Administrator shall be able to delete of information used by the system.	The Systems Administrator shall be able to delete of information used by the system.	The Systems Administrator shall be able to delete of information used by the system.
Bottom-up	Models	Implement state of the art models for earthquakes and relevant interfaces	Implement state of the art models for earthquakes and relevant interfaces	Implement state of the art models for earthquakes and relevant interfaces
Bottom-up	Models	Implement forecast models for earthquakes and relevant interfaces	Implement forecast models for earthquakes and relevant interfaces	Implement forecast models for earthquakes and relevant interfaces
Bottom-up	Models	Implement state of the art models for storms and relevant interfaces	Implement state of the art models for storms and relevant interfaces	Implement state of the art models for storms and relevant interfaces
Bottom-up	Models	Implement forecast models for storms and relevant interfaces	Implement forecast models for storms and relevant interfaces	Implement forecast models for storms and relevant interfaces
Bottom-up	Models	Implement state of the art models for flooding (coastal, flash) and relevant interfaces		
Bottom-up	Models	Implement forecast models for flooding (coastal, flash) and relevant interfaces		

Bottom-up	Models	Implement state of the art models for heat waves and relevant interfaces	Implement state of the art models for heat waves and relevant interfaces	
Bottom-up	Models	Implement forecast models for heat waves and relevant interfaces		
Bottom-up	Models	Implement state of the art models for wildfires and relevant interfaces	Implement state of the art models for wildfires and relevant interfaces	
Bottom-up	Models	Implement forecast models for wildfires and relevant interfaces		
Bottom-up	Models	Implement state of the art models for subsidence and relevant interfaces	Implement state of the art models for subsidence and relevant interfaces	
Bottom-up	Models	Implement forecast models for subsidence and relevant interfaces		
Bottom-up	Models	Implement state of the art models for climate change	Implement state of the art models for climate change	
Bottom-up	Models	Implement forecast models for climate change		
Bottom-up	Crowd	Automatically analysis of the SHELTER chatbot content for direct use for analysts	Automatically analysis of the SHELTER chatbot content for direct use for analysts	Automatically analysis of the SHELTER chatbot content for direct use for analysts
Bottom-up	Crowd	Analysts are able to adapt SHELTER chatbot		
Bottom-up	Crowd		Citizens are able to share information via text, audio and video	
Bottom-up	Analysis	Implement algorithms for time series analysis		
Bottom-up	Analysis	Implement algorithms for climate change attribution analysis		
Bottom-up	Analysis	Implement algorithms for risk analysis	Implement algorithms for risk analysis	

Bottom-up	Analysis	Adjust specific parameters and scales for analysis	Adjust specific parameters and scales for analysis	Adjust specific parameters and scales for analysis
Bottom-up	Analysis	Analysis of relations between climate change and local/regional extreme events		
Bottom-up	Data	Implement Application Interface for sending and retrieving data	Implement Application Interface for sending and retrieving data	Implement Application Interface for sending and retrieving data
Bottom-up	Data	Easy export data in defined format	Easy export data in defined format	Easy export data in defined format
Bottom-up	Data	Easy import data in defined format	Easy import data in defined format	Easy import data in defined format
Bottom-up	Data	Easy update of relevant content (e.g. burned or flooded areas, etc.) for system administrator	Easy update of relevant content (e.g. burned or flooded areas, etc.) for system administrator	Easy update of relevant content (e.g. burned or flooded areas, etc.) for system administrator
Bottom-up	Data	Easy integrate new data sources (e.g. additional sensor data) into the system		
Bottom-up	Visualisation	Automatically visualisation of relevant content on digital mapping tool	Automatically visualisation of relevant content on digital mapping tool	
Bottom-up	Visualisation	Visualisation of content following a structured/defined way (alert, information, etc.)	Visualisation of content following a structured/defined way (alert, information, etc.)	
Bottom-up	Visualisation	Specific content is visualised in combination with 3D models	Specific content is visualised in combination with 3D models	Specific content is visualised in combination with 3D models
Bottom-up	Report	Automatically report of content in a defined format	Automatically report of content in a defined format	Automatically report of content in a defined format
Bottom-up	Report	Specify parameters of interests for the report	Specify parameters of interests for the report	Specify parameters of interests for the report
Bottom-up	Models	Implement state of the art models for extreme weather events and climate change		

Bottom-up	Models	Implement state of the art index model with KPIs for resilience		
Bottom-up	Models	Implement state of the art model combining forecast and foresight results		
Bottom-up	Visualisation	Geographic visualisation of risk and resilience measures over time	Geographic visualisation of risk and resilience measures over time	
Bottom-up	Analysis	Decision making tool for the existing as well as new identified and collected data to support decision makers more efficient.	Decision making tool for the existing as well as new identified and collected data to support decision makers more efficient.	
Bottom-up	Analysis	Resilience indicator assessment to map CH correctly due to vulnerability and resilience.		
Bottom-up	Crowd	Platform for private sector to engage. Possibility to share ideas and views to the topic.		
Bottom-up	General	Integration of still existing tools into the SHELTER platform.	Integration of still existing tools into the SHELTER platform.	Integration of still existing tools into the SHELTER platform.
Bottom-up	Crowd		Kind of information platform for adaptation measures for citizens in advance or during event.	
Bottom-up	Analysis			Financial calculation tool about losses. Need to identify financial solutions to protect Cultural/Natural Heritages.
Bottom-up	General	Communication plan or strategy for simulation adaptive maintenance of CH.		Communication plan or strategy for simulation adaptive maintenance of CH.
Bottom-up	General	Implement a territory custody for private sector contracts.		

Bottom-up	Analysis	Real time monitoring system for situation on site.	Real time monitoring system for situation on site.	Real time monitoring system for situation on site.
Bottom-up	Analysis	Risk monitoring system (including frequency, magnitude, probability, etc.).	Risk monitoring system (including frequency, magnitude, probability, etc.).	
Bottom-up	Data	Stakeholder database with real time status information (ready for use, in mission, location, etc.).	Stakeholder database with real time status information (ready for use, in mission, location, etc.).	
Bottom-up	Analysis	Platform with status quo as well as forecasted hydrological and meteorological data.	Platform with status quo as well as forecasted hydrological and meteorological data.	Platform with status quo as well as forecasted hydrological and meteorological data.
Bottom-up	Data	Database about CH in area of interest with several information about status.	Database about CH in area of interest with several information about status.	
Bottom-up	Crowd	Warning messenger including possibility of integration of forecast information, expected impact information, etc.	Warning messenger including possibility of integration of forecast information, expected impact information, etc.	
Bottom-up	Models	Multi hazard early warning system specific for several CH sites.	Multi hazard early warning system specific for several CH sites.	
Bottom-up	Analysis	Flood risk management plan for CH sites	Flood risk management plan for CH sites	
Bottom-up	Data	Emergency, evacuation and communication plans available. The plans must be updated continuously so therefore a database with reminder would be good.	Emergency, evacuation and communication plans available. The plans must be updated continuously so therefore a database with reminder would be good.	
Bottom-up	Data	Location information about CH sites. The locations may be visualized in map.	Location information about CH sites. The locations may be visualized in map.	
Bottom-up	Analysis			Instrument to receive total amount of damage after event.

Bottom-up	Data			Database for stakeholder to support about amount of damage after event.
Bottom-up	Data	Database of owner information of CH sites.		
Bottom-up	Analysis	Vulnerability assessment or analysis of CH in advance		
Bottom-up	General			Post information about the exact causes for damage during event.
Bottom-up	Data	Flood data (return period, height, velocity, water quality).	Flood data (return period, height, velocity, water quality).	
Bottom-up	Analysis			Information about status of measures taken before event starts available after event.
Bottom-up	Analysis	Long term monitoring system of flood damage.		
Bottom-up	Data	Suitable preparedness measurement plan.		
Bottom-up	Equipment	Water pumps (specific for RAVENNA).		
Bottom-up	Models	Flood forecasting system.		
Bottom-up	Data	Database with value of CH not only money based. Value parameters to be defined		
Bottom-up	Analysis	Preview about average costs of adaptation measures		
Bottom-up	Data	Database about the soil conditions (carbon, quality).	Database about the soil conditions (carbon, quality).	Database about the soil conditions (carbon, quality).
Bottom-up	Data	Database about the soil humidity	Database about the soil humidity	

Table 10: UR based on bottom-up and top-down analysis

7 Conclusions

In conclusion, the SHELTER project has an opportunity to apply the knowledge from the bottom-up analysis and top-down requirements explained in this deliverable to propose solutions for improving disaster risk reduction for cultural sites at the European level, and most of all in the 5 Open Labs of the project. These 5 Open Labs have contributed to this research through the filling of questionnaires and participation in the Open Labs meetings and the top-down GLOCAL requirement meeting organized by UNESCO in December 2019. The recommendations derived from these analyses will further be tested in next Open Labs meetings. Key recommendations from the top-down analysis include ensuring that local stakeholders need to be better involved in disaster risk management and climate change adaptation, and the importance of improving and making more efficient local governance and cooperation between different stakeholders.

The bottom-up analysis was done following a designed analysis process. Therefore, the stakeholder prioritized a prepared UR list. In addition, some UR were identified during a workshop with all partners in the General Assembly meeting. According to the task description also a generic Use Case Scenario was generated to develop a situation picture for the five Open Labs. A specific questionnaire was developed to identify additional UR for DRM due to the Use Case Scenarios. The prioritization of the UR done by stakeholders shows in a cross-section analysis that all are highly prioritized. In addition, also a ranking was done due to the result of the prioritization. Therefore 16 "highly ranked" UR were identified, dealing with implementation of state-of-the-art as well as foresight models and visualisation. The UR which were identified during General Assembly meeting as well as output of the Use Case Scenarios were automatically prioritized as "must have" and ranked as number 1 user requirements.

All in all, 146 user requirements were identified during the top-down as well as bottom-up analysis and assigned to the nine identified topics: 1) General; 2) Models; 3) Data; 4) Visualisation; 5) Equipment; 6) Tool/solution; 7) Analysis; 8) Crowd and 9) Report, for structuring the UR.

Key lessons learned from the root cause analysis in the case studies undertaken in the Stakeholders & Social Networks Mapping section include lack of mitigation measures where hazards are foreseeable, not involving local stakeholders sufficiently and ineffective use of ICTs. Finally, the top-down analysis indicates that there is a great diversity throughout Europe in the area of DRR regulations for cultural sites, but that some issues seem to common to many countries, including lack of national data and awareness of the impacts of disasters on cultural sites, a lack of risk assessment procedures for cultural heritage (notably practical hazard specific guides), and difficulty in sharing best practices from the local level. Therefore, some key recommendations would include strengthening coordination between cultural and/or natural heritage authorities and civil protection and local government and incorporating CH into national and local regulations and plans for civil protection/emergency response. Another key area of improvement would be better utilization of new technologies for warning systems and promoting an interdisciplinary approach for disaster management.

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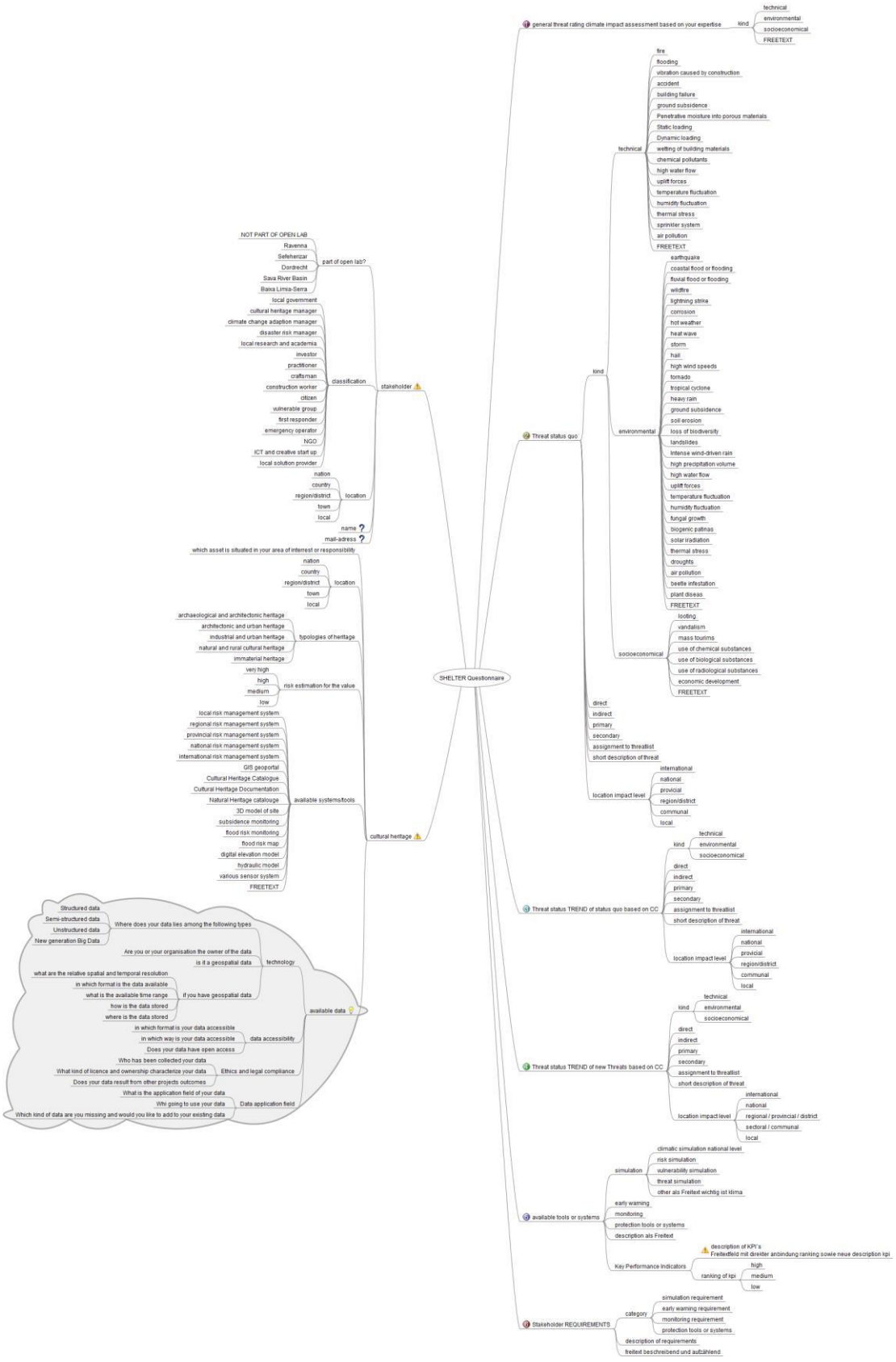
9 Appendices

9.1 Annex I: Concept of digital survey



9.2 Annex II: Answers for the Use Case Scenario questions

Support us with your expertise for Disaster Risk Management (DRM)
Short sentences or describtions are enough. If you have the information, tool, data already available, please mark the next cell AV with an 1

QUESTIONS	OL REGION	BEFORE EVENT	AV	DURING EVENT	AV	AFTER EVENT	AV
Which **data** do you need for an effective risk management? Please name also datas you don´t have available!	RAVENNA	site characteristics (morphology, geology, uban functions, etc...)		site characteristics (morphology, geology, uban functions, etc...)		Report of the data registered during the event	
		DDP		DDP			
		climate data		climate data		Report of the data registered during the event	
		stakeholder database with the related competences		stakeholder database with the related competences		stakeholder database with the related competences	
		heritage charactistics (ICCD data or IBC)		heritage charactistics (ICCD data or IBC)		heritage charactistics (ICCD data or IBC)	
	SAVA RIVER BASIN	NTR		NTR		NTR	
	DORDRECHT	previous flood events data	1			actual damage data	
		value of cultural heritage (not only money)				current value of cultural heritage	
		adaptation measures average costs information					
	SEFEREKO	vulnerability maps - not available on smaller scales		communication data of vulnerable population		detailed surveys of assets - not wholly available	
		social data of vulnerable population - not available					
		monitoring data of assets as risk					
	GALICIA	Meteorological data (T, wind, humidity)	1	Meteorological data (T, wind, humidity)	1	Meteorological data (T, wind, humidity)	1
		Soil data (carbon, quality, other)		Water points	1	Soil data (carbon, quality, other)	
		Soil humidity	1	Vegetation data	1	resilience indicator or the burned area	
		Vegetation data	1	Soil data (carbon, quality, other)			
		Burnt areas	1	Soil humidity	1		
		resilience indicator?					

Support us with your expertise for Cultural Heritage Management (CHM) and Natural Heritage Management (NHM)
Short sentences or describtions are enough.

QUESTION	OL REGION	ANSWER
Do you expect any changes in CHM because of climate change for the hazard/threat and if yes which changes?	RAVENNA	Some parts of the area will not be accessible and partially closed to visitors
		Possible damages and permanet loss
	SAVA RIVER BASIN	If future flood events increase CHM will have to be changed and improved, especially a way how to protect the existing CH during events.
	DORDRECHT	Yes, current maintenance must change to include adaptation measures, private and public owners must be made aware and assisted to make this transition. If this can be done along the line with scheduled maintenance plans the extra costs and effort will be lower.
	SEFEREKO	Yes
		Cultural heritage will be affected by extreme weather events, which will lead to need for reinforced building materials to support restoration works.
		Sea level rises are not an immediate effect in our case study, but around the world this will lead to vacated living CH areas and subsequent detoriariation.
		Extreme temperetures in some CH areas in Turkey (but not our case study) are already threatening livelihoods and are a supporting factor to immigration.
Do you expect any changes in NHM because of climate change for the hazard/threat and if yes which changes?	GALICIA	Yes, the metereological conditions will make the NHM more vulnerable
		For example the reforestation plan wil have to be designed taking that in mind

Support us with your expertise for Climate Change Adaption (CCA)
Short sentences or describtion are enough.

QUESTION	OL REGION	ANSWER
Do you think the hazard/threat will be effected by local climate change and if yes how?	RAVENNA	Yes, the raise of rainfall will increase the risk of flooding connected with local subsidence
	SAVA RIVER BASIN	Yes, but very conditionally.
		In general all literature on floods indicates that future flood events will increase, but there has been no real quantification of this expectation.
	DORDRECHT	yes, floods and water damage will become more frequent, especially in high, unprotected areas of Dordrecht. There will be limited flooding but this still could be very damaging to the cultural heritage. Bigger storms are expected which can lead to localized flooding, extreme river discharge is still uncertain, however as there will be more extreme rainfall, peak discharges will rise.
	SEFEREKO	Yes
		The climate will affect vulnerable population through extreme weather events
	GALICIA	Yes, the dry season is becoming longer and the temperature higher which make the virulence of fires more dangerous
Which are the trends in local extreme events due to the hazard/threat?	RAVENNA	the events are getting more common and worsening
		The last August the area has been flooded with water almost over one meter high
	SAVA RIVER BASIN	Climate change will increase the peak discharges mainly in the head part of the Sava River Basin watershed.
		The maximum daily precipitation in the autumn season, which has proven to produce the largest floods, is expected to increase until the end of the 21st century.
		The hydrologic projections plainly indicate that floods will increase in the future due to climate change. The increase was shown to be greater for 100-year floods than for the 20-year events, thus suggesting an overall increase of the flood risk.
	DORDRECHT	Increasing, especially considering rainfall, draught and heat. The largest threat for Dordrecht is the sea level rise, however this will not become increase the risk for flooding in the coming decades. However if the sea level rises very quickly, by the end of this century large measures will have to be taken to ensure the safety of Dordrecht and the western part of the Netherlands.
	SEFEREKO	Extreme weather events come in two forms that affect rural livelihoods such as agricuşture and fishing, and also tourism:
		Storms affect fishing and agriculture.
		Heat waves affect the whole population.
	GALICIA	If T>30, winds > 30 km/h and humidity <·0% the risk of fire is higher. The probability of having those conditions will be higher because of the climate change and those conditions make wild fires more dangerous
Which impact of future local extreme events do you expect due to hazard/threat?	RAVENNA	The area will be partially unaccessible and closed to visitors
		the area will be abandoned
		Economic loss
		Cultural Heritage loss
	SAVA RIVER BASIN	The flood modeling results indicate that the climate-induced impact will be smaller in the downstream plains than in the upstream mountainous regions.
		The main predicted impact on future flood management is not only climate related, but associated also with future social, economic, and infrastructure development.
		Without a doubt, the impact that climate change will have on flooding in the future is significant and should not be underestimated, since the flood hazard is increasing.
	DORDRECHT	increased impact due to the higher frequency of extreme events. Damage can increase to the cultural heritage, and if the owners (often private) do not want to pay for the maintenance anymore there could be large difficulties with keeping the cultural heritage in its current state.
	SEFEREKO	One can expect deterioration of the citadel and civil architecture due to extreme weather.
		Also, tourism and such CH supporting fields of income will become less predictable.
	GALICIA	An increase in the risk of wild fires and they will be more virulence

9.3 Annex III: Bottom-up UR list

Bottom Up User Requirements (UR) Analysis SHELTER

No	Topic	Description	SEFEREKO	DORDRECHT	ISRBC	UNIBO	Galicia	GA WS results	Use Case Scenario results	Stakeholer comments	Source(s)	highest score	sum	rank
			Priorities	Priorities	Priorities	Priorities	Priorities	Priorities	Priorities					
UR-001	general	The SHELTER solution shall support Direct Users (see glossary) through all phases of DRM.	2	2	2	1	2				DoA, CRCM	1	9	25
UR-002	general	All direct stakeholders shall have controlled access to the SHELTER System.	2		1	1					DoA, CRCM	1	12	69
UR-003	general	All direct stakeholders shall be able to concurrently work [work at the same time]	3	3	3	1	2				DoA, CRCM	1	12	69
UR-004	general	The SHELTER solution shall be able to support different teams working independently	2	1	2	1	2				DoA, CRCM	1	8	13
UR-005	general	All direct stakeholders shall not modify data/information directly associated with source data/information	2	1	1	2	1				DoA, CRCM	1	7	7
UR-006	general	All direct stakeholder's actions, processing and decisions shall be recorded (Who, What, Where, When - and in some cases Why) This can be seen in an audit log file	2	2	1	2	3			this is actually "nice to have" and not a should but I really find it useful	DoA, CRCM	1	10	43
UR-007	general	The analyst shall be able to rely on the information stored on the SHELTER system	1	1	2	1	1				DoA, CRCM	1	6	3
UR-008	general	The SHELTER solution interface(s) shall support the default languages	2	2	2	2	2				DoA, CRCM	2	10	43
UR-009	general	The System Administrator shall be able to assure the team manager that the information processed by SHELTER is secure.	1	1	1	1	1				DoA, CRCM	1	5	1
UR-010	general	The SHELTER solution will not be a permanent store of information [each stakeholder must have their own master system external to SHELTER]	3	1			2			each user may not be able to provide this securely	DoA, CRCM	1	14	79
UR-011	general	The SHELTER solution will be a permanent store of information [each stakeholder mustn´t have their own master system external to SHELTER]	2		1	1					DoA, CRCM	1	12	69
UR-012	general	The SHELTER solution can be stored and run locally	3	2	3	1	2				DoA, CRCM	1	11	60
UR-013	general	The SHELTER system should have functions similar to those offered to its competitors	2	3	3	2					DoA, CRCM	2	14	79
UR-014	general	The SHELTER roles shoud be mapped to the local stakeholder roles to comply with appropriate authorisation functionality	2	1	2	2	2				DoA, CRCM	1	9	25
UR-015	general	The SHELTER solution shall support the rapid deployment and training needs of its direct users	2	3	3	1	2				DoA, CRCM	1	11	60
UR-016	general	The systems administrator shall be able to set up interfaces with the relevant SHELTER tools. This includes the ability to configure the interfaces to newer versions of these tools	2	3	2	2	1				DoA, CRCM	2	10	43
UR-017	general	The stakeholder shall be able to decide if an SHELTER instance is to operate with-out internet connectivity. SHELTER has to support online and offline mode (with/with-out internet connection)	3	3	2	1				very nice to have especially for public bodies with connection limitations.	DoA, CRCM	1	13	76
UR-018	general	The Team Manager shall be able to audit past and present activity carried out by the direct users.	3	3	3	2	2				DoA, CRCM	2	13	76
UR-019	general	The Analyst shall be able to modify the SHELTER system to adjust their plans to unfolding events.	3	2	2	2	2				DoA, CRCM	2	11	60
UR-020	general	The SHELTER solution shall support the collection of data from a range of present information sources and the possibility of adding other information sources in the future.	2	2	1	1	1			gis and xlsx import	DoA, CRCM	1	7	7
UR-021	general	The analyst shall be able to maintain traceability to source information throughout the process	2	1	2	2	1				DoA, CRCM	1	8	13
UR-022	general	The collector shall be able to convert audio to text files			2	3				external tools can be used for these but if it would of course be convenient to have them	DoA, CRCM	2	17	83
UR-023	general	The collector shall be able to capture clips of audio from videos.		3	2	3					DoA, CRCM	2	16	82
UR-024	general	The SHELTER solution shall support the critical review of the information collected and it's source to assess the credibility of the information received	3	3	1	2	2				DoA, CRCM	1	11	60
UR-025	general	The Analyst shall be able to disregard information not relevant to the shelter analytical concept	2	3	1	3	3				DoA, CRCM	1	12	69
UR-026	general	The SHELTER solution shall support the organisation of the information collected to enable an effective analysis	2	2	1	3	2				DoA, CRCM	1	10	43
UR-027	general	The Analyst shall be able to index any information collected. This should be run as a background task without hindering system usability	2	2	1	2	2				DoA, CRCM	1	9	25
UR-028	general	The analyst shall be able to perform matching checks against database information.	2	2	1	2	2				DoA, CRCM	1	9	25
UR-029	general	The analyst shall be able to perform matching checks against available databases. (Images, videos, audio etc.)	2	2	1	2	3				DoA, CRCM	1	10	43
UR-030	general	The SHELTER solution shall support the production of standard reports based on the analysis conducted by the SHELTER tools	2	3	1	1	1				DoA, CRCM	1	8	13
UR-031	general	The SHELTER solution shall support the timely dissemination of the reports and information generated by the system.	3	2	1	1	3				DoA, CRCM	1	10	43

UR-031	general	The SHELTER solution shall support the timely dissemination of the reports and information generated by the system.	3	2	1	1	3				DoA, CRCM	1	10	43
UR-032	general	The Systems Administrator shall be able to delete information used by the system.	3	3	1	3	1				DoA, CRCM	1	11	60
UR-033	general	The SHELTER solution shall support the rapid deployment and training needs of its direct users	2	3	3	1	1				DoA, CRCM	1	10	43
UR-034	general	The Systems Administrator shall be able to configure the SHELTER systems user access within a fixed time period per user.	2		2	2	1				DoA, CRCM	1	11	60
UR-035	general	The analyst shall receive SHELTER processing tool training, as and when required	2	3	2	3	1				DoA, CRCM	1	11	60
UR-036	general	The Team Manager be able to decide if an SHELTER instance is to operate with-out internet connectivity.	3	3	2	3	3				DoA, CRCM	2	14	79
UR-037	general	The Systems Administrator shall have a forum to share and update informations	2	2	2	2	1				DoA, CRCM	2	9	25
UR-038	general	The SHELTER solution shall support the collection of data from a range present and future information sources.	1	3	1	2	1				DoA, CRCM	1	8	13
UR-039	general	The systems administrator shall be able to identify the issue(s) with faulty collection events	2	2	1	1	1				DoA, CRCM	1	7	7
UR-040	general	The SHELTER system shall be able to support multiple arguments [search using multiple filters/keywords etc.]	1	1	1	2	1				DoA, CRCM	1	6	3
UR-041	general	The Analyst shall be able to cross check new information against previously known information from other sources	2	3	1	2	1				DoA, CRCM	1	9	25
UR-042	general	The Analyst shall be able to disregard information whichg are not relevant for process	2	3	1	2	3				DoA, CRCM	1	11	60
UR-043	general	The Analyst shall be able to filter information based on synonym of keywords	3	1	1	2	3				DoA, CRCM	1	10	43
UR-044	general	The analyst shall be able to adjust threshold of any automated alerting.	3	2	1	2	2				DoA, CRCM	1	10	43
UR-045	general	The Analyst shall be able to export the data from the SHELTER tools.	1	1	1	2	1				DoA, CRCM	1	6	3
UR-046	general	The Analyst shall be able version control the exported data from the SHELTER tools	2	1	1	3	2				DoA, CRCM	1	9	25
UR-047	general	The Systems Administrator shall be able to delete of information used by the system.	2	3	1	3	1				DoA, CRCM	1	10	43
UR-048	models	Implement state ot the art models for earthquakes and relevant interfaces	1	2	1	1	3				DoA, CRCM	1	8	13
UR-049	models	Implement forecast models for earthquakes and relevant interfaces	3	2	1	1	3			very difficult?	DoA, CRCM	1	10	43
UR-050	models	Implement state of the art models for storms and relevant interfaces	1	2	1	2	3				DoA, CRCM	1	9	25
UR-051	models	Implement forecast models for stroms and relevant interfaces	2	2	1	2	3				DoA, CRCM	1	10	43
UR-052	models	Implement state of the art models for flooding (coastal, flash) and relevant interfaces	1	2	1	1	3			We have a well accessible flood modelling system in the Netherlands. I don't know if a system designed solely for Shelter will be more suitable.	DoA, CRCM	1	8	13
UR-053	models	Implement forecast models for flooding(coastal, flash) and relevant interfaces	2	2	1	1	3				DoA, CRCM	1	9	25
UR-054	models	Implement state of the art models for heat waves and relevant interfaces	1	2	1	3	2				DoA, CRCM	1	9	25
UR-055	models	Implement forecast models for heat waves and relevant interfaces	2	2	1	3	2				DoA, CRCM	1	10	43
UR-056	models	Implement state of the art models for wildfires and relevant interfaces	1	2	1	3	1				DoA, CRCM	1	8	13
UR-057	models	Implement forecast models for wildfires and relevant interfaces	2	2	1	3	1				DoA, CRCM	1	9	25
UR-058	models	Implement state of the art models for subsidence and relevant interfaces	1	2	1	1	3				DoA, CRCM	1	8	13
UR-059	models	Implement forecast models for subsidence and relevant interfaces	2	2	1	1	3				DoA, CRCM	1	9	25
UR-060	models	Implement state of the art models for climate change	1	1	1	1	1				DoA, CRCM	1	5	1
UR-061	models	Implement forecast models for climate change	2	1	1	1	1				DoA, CRCM	1	6	3
UR-062	crowd	Automatically analysis of the SHELTER chatbot content for direct use for analysts	1	3	2	2	3				DoA, CRCM	1	11	60
UR-063	crowd	Analysts are able to adapt SHELTER chatbot	2	3	2	2					DoA, CRCM	2	13	76
UR-064	crowd	Citizens are able to share informations via text, audio and video	2	2	2	1	3				DoA, CRCM	1	10	43
UR-065	analysis	Implement algorithms for time series analysis	2	2	1	2	3				DoA, CRCM	1	10	43
UR-066	analysis	Implement algorithms for climate change attribution analysis	3	2	1	1	2				DoA, CRCM	1	9	25
UR-067	analysis	Implement algorithms for risk analysis	1	2	1	1	2				DoA, CRCM	1	7	7
UR-068	analysis	Adjust specific parameters and scales for analyis	1	2	1	2	3				DoA, CRCM	1	9	25
UR-069	analysis	Analysis of relations between climate change and local/regional extreme events	2	3	1	1	2				DoA, CRCM	1	9	25
UR-070	data	Implement Application Interface for sending and retrieving data	2	3	1	1	3				DoA, CRCM	1	10	43
UR-071	data	Easy export data in defined format	1	3	1	2	1				DoA, CRCM	1	8	13
UR-072	data	Easy import data in defined format	1	3	1	2	2				DoA, CRCM	1	9	25
UR-073	data	Easy update of relevant content (e.g. burned or flooded areas, etc.) for system administrator	2	3	1	1	1				DoA, CRCM	1	8	13
UR-074	data	Easy integrate new data sources (e.g. additional sensor data) into the system	2	3	1	1	1				DoA, CRCM	1	8	13
UR-075	visualisation	Automatically visualisation of relevant content on digital mapping tool	2	2	1	1	1				DoA, CRCM	1	7	7
UR-076	visualisation	Visualisation of content following a structured/defined way (alert, information, etc.)	2	2	1	1	3				DoA, CRCM	1	9	25
UR-077	visualisation	Specific content is visualised in combination with 3D models	2		1	2	3				DoA, CRCM	1	12	69
UR-078	report	Automatically report of content in an defined format	3	3	1	3	2				DoA, CRCM	1	12	69
UR-079	report	Specify parameters of interests for the report	2		1	3	2				DoA, CRCM	1	12	69
UR-080	models	Implement state of the art models for extrem weather events and climate change	2	3	1	1	2				DoA, CRCM	1	9	25
UR-081	models	Implement state of the art index model with KPIs for resiliance	1	3	1	1	2				DoA, CRCM	1	8	13
UR-082	models	Implement state of the art model combining forecast and foresight results	2	3	1	2	2				DoA, CRCM	1	10	43
UR-083	visualisation	Geographic vizualisation of risk and resiliance measures over time	1	2	1	1	2				DoA, CRCM	1	7	7
UR-084	analysis	Decision making tool for the existing as well as new identified and collected data to support decision makers more efficient.						1			WS 2nd GA			
UR-085	analysis	Resilience indicator assessment to map CH correctly due to vulnerability and resilience.						1			WS 2nd GA			
UR-086	crowd	Platform for private sector to engage. Possibility to share ideas and views to the topic.						1			WS 2nd GA			
UR-087	general	Integration of still existing tools into the SHELTER platform.						1			WS 2nd GA			
UR-088	crowd	Kind of informations platform for adaptation measures for citizens in advance or during event.						1			WS 2nd GA			
UR-089	analysis	Financial calculation tool about losses. Need to identify financial solutions to protect Cultural/Natural Heritages.						1			WS 2nd GA			

UR-090	general	Communication plan or strategy for stimualtion adaptive maintenance of CH.						1			WS 2nd GA					
UR-091	general	Implement a territory custody for private sector contracts.						1			WS 2nd GA					
UR-092	analysis	Real time monitoring system for situation on site including determination of existing deformations.							1		Use Case					
UR-093	analysis	Risk monitoring system (including frequency, magnitude, propability, etc.).							1		Use Case					
UR-094	data	Stakeholder database with real time status informations (ready for use, in mission, location, etc.).							1		Use Case					
UR-095	analysis	Platform with status quo as well as forecasted hydrological and meteorological data.							1		Use Case					
UR-096	data	Database about CH in area of interest with several information about status.							1		Use Case					
UR-097	crowd	Warning messenger including possibility of integration of forecast informations, expected impact informations, etc.							1		Use Case					
UR-098	models	Multi hazard early warning system specific for several CH sites.							1		Use Case					
UR-099	analysis	Flood risk management plan for CH sites.							1		Use Case					
UR-100	data	Emergency, evacuation and communication plans available. The plans must be updated continuously so therefore a database with reminder would be good.							1		Use Case					
UR-101	data	Location informations about CH sites. The locations may be visualized in map.							1		Use Case					
UR-102	analysis	Instrument to receive total amount of damage after event.							1		Use Case					
UR-103	data	Database for stakeholder to support about amount of damage after event.							1		Use Case					
UR-104	data	Database of owner informations of CH sites.							1		Use Case					
UR-105	analysis	Vulnerability assessment or analysis of CH in advance.							1		Use Case					
UR-106	general	Post information about the exact causes for damage during event.							1		Use Case					
UR-107	data	Flood data (return period, height, velocity, water quality).							1		Use Case					
UR-108	analysis	Information about status of measures taken before event starts available after event.							1		Use Case					
UR-109	analysis	Long term monitoring system of flood damage.							1		Use Case					
UR-110	data	Suitable prepareness measurement plan.							1		Use Case					
UR-111	equipment	Water pumps (specific for RAVENNA).							1		Use Case					
UR-112	models	Flood forecasting system.							1		Use Case					
UR-113	data	Database with value of CH not only money based. Value parameters to be defined.							1		Use Case					
UR-114	analysis	Preview about average costs of adaptation measures.							1		Use Case					
UR-115	data	Database about the soil conditions (carbon, quality).							1		Use Case					
UR-116	data	Database about the soil humidity							1		Use Case					

Prioritizsation:
1 - MUST HAVE;
2 - SHOULD HAVE;
3 - NICE TO HAVE;
4 - NOT NECESSARY

9.4 Annex IV: Concept note and agenda

Background & Context

The International workshop on **GLOCAL user requirements for Disaster Risk Reduction and Cultural and Natural Heritage** is organized by UNESCO Regional Bureau for Science and Culture in Europe, at its premises in Venice, Italy, on 5-6 December 2019 with the support of UNESCO's unit for disaster risk reduction based in Paris, France, and guidance of SHELTER project partners, notably the project coordinator Tecnalia.

Sustainable Historic Environments hoListic reconstruction through Technological Enhancement and community-based Resilience (SHELTER) is a Horizon 2020 EU funded 4-year project which was launched in July 2019. SHELTER aims at developing a data driven and community based knowledge framework that will bring together the scientific community and heritage managers with the objective of increasing resilience, reducing vulnerability and promoting better and safer reconstruction in historic areas.

All the developments of the project will be validated in 5 open-labs, representative of main climatic and environmental challenges in Europe and different heritage's typologies. These open labs are situated in the World Heritage site of the Area of Santa Croce in Ravenna (Italy); the coastal district of Seferihisar (Turkey), the old town of Dordrecht and its island (Netherlands), the Baixa Limia-Serra do Xurés Natural Park in Galicia (Spain) and the transboundary Sava River Basin.

The SHELTER project takes place within the global framework of the Sendai Framework for Disaster Risk Reduction 2015-2030, especially "the strengthening disaster risk governance to manage disaster risk" (Priority Action 2), that states "Disaster risk governance at the national, regional and global levels is of great importance for an effective and efficient management of disaster risk. Clear vision, plans, competence, guidance and coordination within and across sectors, as well as participation of relevant stakeholders, are needed. Strengthening disaster risk governance for prevention, mitigation, preparedness, response, recovery and rehabilitation is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development".

Since the project is data and community based knowledge driven, UNESCO will be active in bringing together the scientific community, local stakeholders and heritage managers. This will be conducted notably under the WP 6 (User requirements) where UNESCO has the leadership of specific tasks and sub tasks: 6.1 GLOCAL User requirement; T6.1.3 Top down requirement analysis, as well as under WP 7.

Under WP 6.1.3, UNESCO is responsible for identifying the main top-down user requirements, taking stock of existing frameworks dealing with multi-hazard contexts for DRM in Cultural/Natural Heritage. A multi stakeholders exercise is being organized through a questionnaire and focus group, with the interactive involvement of i) UNESCO world heritage sites managers; ii) civil protection authorities and emergency managers; and iii) Practitioners/Scholars of DRM in Cultural/Natural Heritage.

The exercise will produce a first set of requirements encompassing the entire DRM cycle from early warning to post-disaster scenario, by using a full set of internationally recognized resources and tools. The methodology developed in ST6.1.3 will be implemented under WP 7 through the proposed multi stakeholders exercise at UNESCO Regional Bureau in Venice based upon a DRM cycle scenario, with the interactive involvement of selected: i) world heritage sites managers; ii) civil protection authorities and emergency managers; iii) practitioners/scholars of DRM in CH, and CCA experts.

Structure and Objectives of the workshop

The two days' workshop is structured upon an interactive framework in which international organizations, national governments, local governments, cultural/natural heritage site managers, technical experts and carefully selected international advisors, will interplay with SHELTER project partners to provide substantial feedback on the top down user requirements through stocktaking and discussing of existing frameworks dealing with multi-hazards contexts for disaster risk management in heritage. The feedback will guide all SHELTER developments and will overcome potential regulatory, economic and technical barriers.

The workshop aims to identify the main top-down user requirements, taking stock of existing frameworks dealing with multi-hazards contexts for disaster risk management in heritage. A multi stakeholders exercise will be organized through and international focus group, with the interactive involvement of i) UNESCO world heritage sites managers, ii) civil protection authorities and emergency managers in both national and municipal level, iii) national authorities on cultural/natural heritages, iv) international organizations on heritage disaster risk management, v) technical experts such as engineers.

The exercise will complete the local user requirement, produce a set of requirements for SHELTER developments and their integration with internationally recognized resources and tools. The workshop is a milestone event of the H2020 Project "Sustainable Historic Environments hoListic reconstruction through Technological Enhancement and community based Resilience" (SHELTER), which aims at developing a data driven and community based knowledge framework that will bring together the scientific community and heritage managers with the objective of increasing resilience, reducing vulnerability and promoting better and safer reconstruction in historic areas.

Methodology

The workshop will be organized in two days and based on five main sections.

The first section is introductory, devoted to present the overall concept of SHELTER and how this workshop will feed into the overall goal of the project.

The second section includes the brief overview of the desktop analysis and questionnaire on the existing policy and guidelines related to disaster risk reduction, emergency preparedness and response, and post disaster reconstruction on heritage, from International organizations (ICOMOS, ICCROM, UNESCO), and processes (PDNA), regional (EU directive). This would include an analysis of best practices from multiple national participating countries (and other related countries) of the SHELTER project looking in particular at geographical scope, responsible entity (ies), objective, year, mandatory/voluntary, implementing body (municipality etc.). This part will enable the participants to reflect what are the challenges and good practices on the regulation and its implementation. The participants will have the opportunity to comment on the draft desktop analysis and the results of the questionnaire.

In addition to this, requirements regarding SHELTER methodologies and tools will be presented by the Tecnalia and SHELTER partners.

The third section will consist of short presentations by participants on DRR heritage regulations at their level (national, municipality, site). Following this, participants will undertake scenario exercises (based on 5 open labs) to understand and begin filling in the gaps in knowledge.

The fourth section will be organized in parallel discussion based on the different hazard types such as earthquake, flood, fire and others. The participants will reflect on the challenges and good practices

among the participants on policy and its implementation. Then participants will see the different characteristics of challenges according to different hazards.

The fifth section is the discussion based on key issues, tentatively set as technical issue, (or lack of), regulation issue, awareness issue and financial issues. By reflecting from different angles, participants will organize the challenges on the top down user requirements.

In the concluding session, participants UNESCO will, based on the discussions during the two days, discuss and agree on user requirements (including gaps found during the workshop through discussions, scenarios etc) which UNESCO will then finalize following the workshop and be circulate to the participants for comments and suggestions. The top down user requirements will be finalized by the end of December so that these can feed into the work being done in other WPs and task group of the SHELTER project.

Venue

Palazzo Zorzi , Castello 4930, Venice (Italy)

Organizers

UNESCO Regional Bureau for Science and Culture in Europe

UNESCO Paris

Working Language

English

Contact persons

For queries on the programme agenda and logistics

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AGENDA

Day 1 - Thursday 5 December 2019

Time	Subject	Speaker
8:30 - 9:00	**Registration**	
9:00 - 9:20	**Welcoming speeches**	UNESCO TECNALIA
	Introduction of participants	
9:20- 9:30	SHELTER Partners and sister EU project partners	
9:30-9:50	Invited Participants	
	Session I – Introductory part	
9:50 – 10:20	SHELTER Presentation	TECNALIA
10:20 – 10:30	Task manager presentation, introduction of results matrix for the workshop	UNESCO
10:30 -11:00	**Coffee break**	
	Session II – Stock taking of regulatory system through results of desktop analysis and questionnaire results	
11:00 – 11:30	Presentation of desktop analysis and questionnaire results	Xavier Romao, UNESCO consultant
11:30 – 13:00	Discussion	
13:00 – 14:00	**Lunch Break**	
	Session III – Baseline knowledge from SHELTER and participants on DRR for heritage	

14:00-14:15	Presentation of SHELTER tools	Tecnalia and other SHELTER partners
14:15 - 14:30	Presentation by international level (good practices and challenges)	UNESCO
14:30 –15 :00	Presentation by regional DRR heritage experts (and comments on DA, questionnaire, international level)	DRR heritage experts
15:00- 15:30	Presentation by national (good practices and challenges)	Civil protection, Ministries of culture
15:30- 16:00	Presentation by site managers (good practices and challenges)	Site managers
16:00- 16:30	**Coffee break**	
16:30-17 :00	Presentation by municipal levels	Civil Protection etc. at municipalities
17 :00-17 :30	Presentation by technical experts	Engineers
17 :30-18 :30	Constructing matrix of gaps/challenges	TECNALIA, UNESCO
18:30-19:00	Wrap up and Concluding remarks of the first day	TECNALIA, UNESCO
19:30-21:00	Dinner	All participants

Day 2 - Friday 6 December 2019

Time	Subject	Speaker
9:00 – 9:30	Recap and Intro to day I	UNESCO
	Session IV – Discussion on knowledge on various hazards for cultural and natural heritage	
9:30-11:00	Parallel Sessions on different types of hazards: earthquakes, storms, floods, heat waves, wildfires and subsidence (then reporting to plenary)	Group work, then plenary
11:00-11:30	**Coffee break**	
12:00- 13:30	**Session V – Remaining gaps and Matrix review** **Discussion on DRR for cultural/natural heritage and gaps in knowledge from various perspectives (**regulation/planning, technical, awareness, funding) and review and fill in matrix	UNESCO
13:30 – 14:30	**Lunch Break**	
14:30 -15:00	Discussion and agreement on way forward following workshop	UNESCO
15:00 – 15:15	Concluding remarks and closure	UNESCO

9.5 Annex V: Workshop guide

To identify requirements for SHELTER tools by discussing the gaps on CLT Climate Change and DRR from different angles.

Requirements identified during the workshop will be feed into the implementation of the SHELTER project.

We brainstorm from various angles such as

- Different layers of spatial coverage (session 2 and 3)
- Different hazards (session 4)
- Different issues (session 5)

During the Workshop, we will make

- Matrix of requirements (for each special layer and for different issue)
- Mind Map (each hazard)
- Written questionnaire
- Discussion recorded
- Ppt presentation by participants
- Which will be collected and analyzed for the project implementation.

Session I – Introductory part					
Time	**Subject**	**Speaker**	**Description**	**Methodology**	**Input/ Output**
9:50 – 10:20	SHELTER Presentation	TECNALIA (Project Coordinator Dr Aitziber Ortega)	A presentation about the Shelter Project, covering its overall aim, purpose.	Ppt Presentation Feedback from all	INPUT – ppt presentation OUTPUT – Participates are clear about overall goal of SHELTER project. As well as the tools that TECNALIA is collecting for SHELTER project
10:20 – 10:30	Task manager presentation, introduction of results matrix for the workshop	UNESCO (Soichiro Yasukawa & Jonathan Baker)	Structure of the workshop of 5 different sessions and goals of each session	Ppt presentation	INPUT – ppt presentation outlining the modality of the workshop. OUTPUT – participants are clear about who is running the workshop & its goal
Session II – Stock taking of regulatory system through results of desktop analysis and questionnaire results					
11:00 – 11:30	Presentation of desktop analysis and explaining questionnaire	UNESCO consultant (Xavier Romao)	PPT presentation of desktop analysis on CLT DRR regulation on international level and national level from UK including the trial of requirements finding. Explanation on the questionnaire	PPT presentation and discussion will follow from 11:30	INPUT – ppt presentation and recorded discussion (RD) OUTPUT – Participates understand the desk top analysis. The questionnaire results have been collected
11:30 – 13:00	Discussion	Participants	Xavier Romao, Soichiro Yasukawa will facilitate the discussion.	Presentation and Discussion will be recorded. Based on the presentation and the questionnaire, participants will present on the questionnaire.	INPUT – Reply to questionnaires and Xavier's presentation and RD OUTPUT – Desk top analysis by Xavier. Participants written answers to the questionnaires. And the oral explanation on questionnaires collected.
Session III – Baseline knowledge from SHELTER and participants on CC/DRR for heritage					

14:00-14:15	Presentation of SHELTER tools	Tecnalia and other SHELTER partners	Ppt presentation about shelter tools under development by TECNALIA	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – Feedback to Tools that TECNALIA is developing
14:15 - 14:30	presentation by cross regional level (case model, good practices and challenges)	UNESCO	Ppt presentation on CLT DRR on international level (existing framework, tools and challenges)	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – participants are clear on the requirement at the cross regional lebel
14:30 –15:00	Presentation by cross regional (case model, good practices and challenges)	DRR heritage experts (Sava River Basin)	Ppt presentation on international Sava river basin (responsibility, existing tools, challenge)	Ppt presentation	INPUT – ppt presentation RD OUTPUT – participants are clear on the requirement at the cross regional (river basin) level
15:00- 15:30	presentation by regional (case model, good practices and challenges)	Civil protection, Ministries of culture National level	Ppt presentation on the case of (responsibility, existing tools, challenge)	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – participants are clear on the requirement at the national level
15:30- 16:00	presentation by regional level (case model, good practices and challenges)	Site managers (site manager Italy)	Ppt presentation on the case of CLT site (responsibility, existing tools, challenge)	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – participants are clear on the requirement at the community level
16:00- 16:30	Coffee break				
16:30-17:00	Presentation by regional levels (case model, good practices and challenges)	Civil Protection etc. at municipalities	Ppt presentation on the case of municipalities, (responsibility, existing tools, challenge)	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – participants are clear on the requirement at the municipality level
17 :00-17 :30	Presentation by technical experts	Engineers	Ppt presentation on the engineering on CLT CC and DRR (existing tools, challenge)	Ppt presentation	INPUT – ppt presentation and RD OUTPUT – participants are clear on the requirement of engineers

17 :30-18 :15	Constructing matrix of gaps/challenges	UNESCO TECNALIA, Soichiro Yasukawa Aitziber Egusquiza Ortega Jonathan Baker Xavier Romao	Invite all participants Discussion with separate group 1) cross regional 2) national and 3) local To develop matrix of requirements	White board and post it to list up challenges and categorize the challenges Photo of post it	INPUT – RD and post-it picture OUTPUT – written post it notes and a matrix outlying the different issues on each spatial scales.
18:15-19:00	Wrap up and Concluding remarks of the first day	TECNALIA, UNESCO Aitziber Egusquiza Ortega Soichiro Yasukawa	Invite all participants for the category of challenges of each layer to cross check	White board and post it to list up challenges and categorize the challenges Photo of post it	INPUT – RD of open discussion of different layer OUTPUT – participants are clear on how the requirement of each layer needs be interacted
Session IV – Discussion on knowledge on various hazards for cultural and natural heritage					
9:00 – 9:30	Recap and Intro to day I	UNESCO (Jonathan Baker)	Review of the day 1, tentative frame of challenges, Procedure of day 2	Oral presentation of Day 1 Ppt for the modality of Day 2	INPUT – ppt presentation OUTPUT – participants are clear on how the Day 2 works
9:30-10:30	Parallel Sessions on different types of hazards: earthquakes, storms, floods, heat waves, wildfires and subsidence (then reporting to plenary)	UNESCO (Soichiro Yasukawa Jonathan Baker Xavier Romao)	Invite all participants separate group 1) flood, 2) earthquake, 3) fire and others to develop mind map participants who have presentation can present.	Big white paper to make mind map in A2, A3 paper for each hazard (issues and requirements)	INPUT – RD and mind map for each hazard (picture taken) OUTPUT – participants are clear on the requirement of each layer.
10:30-11:00	Wrap up	UNESCO Soichiro Yasukawa	Invite all participants for the category of challenges of each hazards to cross check	Discussion on mind map for each hazard by all	INPUT – open discussion and RD OUTPUT – participants are clear on how the requirement of each hazard
Session V – Remaining requirements and Matrix review					
12:00- 13:30	Discussion on CCA and DRR for cultural heritage and gaps in knowledge from various perspectives	UNESCO TECNALIA, Soichiro Yasukawa Jonathan Baker Xavier Romao	Invite all participants separate group in 3 topics such as regulation, technical	White board and post it to list up requirements and categorize the challenges	INPUT – open discussion and RD OUTPUT – participants are clear on how the requirement of each issue CLT CCA DRR after discussing different perspective

	(regulation/planning, technical, awareness, funding) and review and fill in matrix		issue, awareness issue etc. to develop requirement matrix	Take pictures	
14:30 -15:00	Prioritization of requirements	UNESCO TECNALIA, Jonathan Baker NESCO	Based on the 2 matrix (session 3 and 5) and mind map (session 4), Participants pick up the most pressing requirement	White board and post it to most pressing requirements to discuss the priority Take pictures	INPUT – priority by post it and RD OUTPUT – participants are clear on the priority of requirement for CLT CCA DRR
15:00 – 15:15	Concluding remarks and closure	UNESCO Jonathan Baker	Closing remarks	Oral presentation of schedule	INPUT – priority by post it and RD OUPUT – Everyone feel comfortable and understands the schedule and tasks (questionnaire)

Parallel Session on different hazards (earthquake, flood, fire) to construct mind map

Parallel Session on different issues (data, assessment, tool, policy) and time (prevention, response, recovery, reconstruction) (12:00-13:00, 13:00-13:30)

One group prevention/reconstruction

	Prevention	Reconstruction
Data/knowledge		
Tool/solution		
Assessment/monitor		
Plan/regulation		

Other group response/reconstruction

	Response	Recovery
Data/knowledge		
Tool/solution		
Assessment/monitor		
Plan/regulation		

9.6 Annex VI: Questionnaire to identify gaps and needs in Disaster Risk Reduction for Cultural and Natural Heritage

International Workshop on GLOCAL user requirements for Disaster Risk Reduction and Heritage

(Venice, Italy 5-6 December 2019)

** If yes, please identify the title, the time of publication, the governing body or institution that published it, its objective(s), and the institutions that are expected to implement it*

*** Describe with some detail*

Priority 1 – Understanding Disaster Risk

1. Do the institutions tasked with the management and the protection of cultural and natural heritage in your country, or any other governmental body, implement (national or regional) actions targeting the enhancement of risk awareness in the heritage sector?

a) If yes, describe these actions and the actors that were targeted by these actions. **

2. Do cultural/natural heritage authorities have a mandate to carry out risk assessments for the heritage sector?

- If so, which institutions/technical agencies/units are tasked with carrying out risk assessments?
- Are roles and responsibilities clearly defined?
- Are there other cultural/natural heritage institutions involved in carrying out risk assessments?
- Do risk assessments cover all dimensions of cultural heritage (i.e. movable and immovable heritage, cultural repositories, intangible cultural heritage)?

3. Do other authorities (e.g. Disaster Risk Prevention Committee) have a mandate to carry out risk assessment for the cultural and natural heritage sector?

4. Is there a coordination mechanism within cultural and natural heritage authorities for risk assessments in the cultural/natural heritage sector?

- How well do different technical units (within cultural and natural heritage and DRR sectors) collaborate together/share information on risk assessments?
- How is information shared between national and sub-national levels?
- How is information shared with the key DRR/DRM stakeholders?
- To what extent are academic/research institutes involved in supporting risk assessments?

To what extent are local communities involved in supporting risk assessments?

5. Are there specific institutions/technical units within cultural and natural heritage authorities tasked with monitoring risk, including disaster risk, for the cultural heritage sector?

- If so, which ones?

Are roles and responsibilities clearly defined?

6. What do you think is missing in your country regarding the availability of technical support for implementing disaster risk management procedures for cultural and natural heritage? Refer to aspects addressed by other questions if necessary. **

Priority 2. Strengthening Governance and Institutions to Manage Disaster Risk

7. In your country, how many institutions are tasked with the management and the protection of cultural and natural heritage (governmental institutions and private institutions)?

8. Does your country have specific legislation for the protection and conservation of cultural or/and natural heritage?

a) If yes, does this legislation have components addressing specifically the implementation of actions for disaster risk reduction in cultural and natural heritage due to intense/extreme natural or man-made events, i.e. events that may have catastrophic impacts? *

9. Does your country have national or regional strategies for disaster risk reduction?

a) If yes, is cultural (and natural) heritage part of these strategies? **

10. Does your country have specific national or regional strategies for disaster risk reduction for the safeguard of cultural or/and natural heritage?

a) If yes, describe those strategies and if they target certain specific hazards or if they are multi-hazard?

11. Is the development of risk management plans for cultural (and natural) heritage mandatory in your country?

a) If yes, what measures are included in these plans for disaster preparedness, response and emergency procedures?

b) If yes, is there a regular implementation of drills and training actions addressing these procedures?

Priority 3: Investing in Economic, Social, Cultural, and Environmental Resilience

12. In your country, do the institutions tasked with the management and the protection of cultural (and natural) heritage have georeferenced inventories of immovable cultural heritage that are publicly available?

a) If yes, how many official cultural (and natural) heritage georeferenced inventories are there? **

b) If yes, what levels of cultural (and natural) heritage protection or listing are included in those inventories? **

c) If yes, do these inventories of immovable cultural heritage include surveyed data related to their geometry, their material(s) or their construction process(es)? **

13. Have the institutions tasked with the management and the protection of cultural (and natural) heritage in your country published application manuals or other types of practical guidelines that provide guidance for assessing and analysing risks in cultural heritage?

a) If yes, what hazards do they cover and what are the types of cultural (and natural) heritage for which procedures are provided? **

14. Does your country have training programmes for civil protection agents dedicated to emergency, response, rescue and safeguard procedures for cultural (and natural) heritage impacted by disasters?

a) If yes, what procedures do they include? **

b) If yes, is there a regular implementation of these training programmes? **

15. Do the cultural (and natural) heritage authorities provide/support insurance schemes for cultural (and natural) heritage? If not:

a. Are there other institutional stakeholders providing risk transfer and/or other mechanisms for cultural/natual heritage?

b. Do the cultural heritage authorities have contingent/emergency financial resources for cultural/natural heritage?

16. If there are uncovered issues or lack of procedures in your country regarding disaster risk preparedness, response or recovery for cultural/natural heritage, do you believe that getting additional funding is the only fundamental aspect to solve the existing gaps?

a) If no, what do you believe are the additional measures that are needed to address the existing gaps? **

Priority 4: Enhancing Preparedness for Effective Response, and Building Back Better in Recovery and Reconstruction

17. Does your country have specific legislation for civil protection authorities that includes specific emergency and response procedures for cultural/natural heritage impacted by disasters? *

18. Does your country have guidelines or other documents providing institutional guidance on post-disaster actions targeting cultural/natural heritage?

a) If yes, are there dedicated forms for performing post-disaster damage surveys in cultural/natural heritage? **

b) If yes, are there documents providing guidance on post-disaster recovery of cultural/natural heritage? **

19. Are there policies, strategies, provisions in place for disaster recovery and reconstruction of cultural/natural heritage?

20. Are there national disaster/emergency response plans for cultural/natural heritage?

21. Is there a mechanism/process in place to coordinate disaster/emergency preparedness and response for cultural/natural heritage?

c) What actors are included?

d) Does in-country capacity exist for the coordination of the international Post-Disaster Needs Assessment (PDNA) process?

22. Are there methodologies (e.g. PDNA) / checklists / protocols / standard operating procedures in place relating to DRR/DRM for emergency response for cultural/natural heritage?

23. Are there data and dossiers that document and digitalize cultural/natural heritage, and are they accessible in case of emergency?

24. Is the information derived from these assessments effectively used to inform planning for recovery and rehabilitation in the cultural/natural heritage sector?

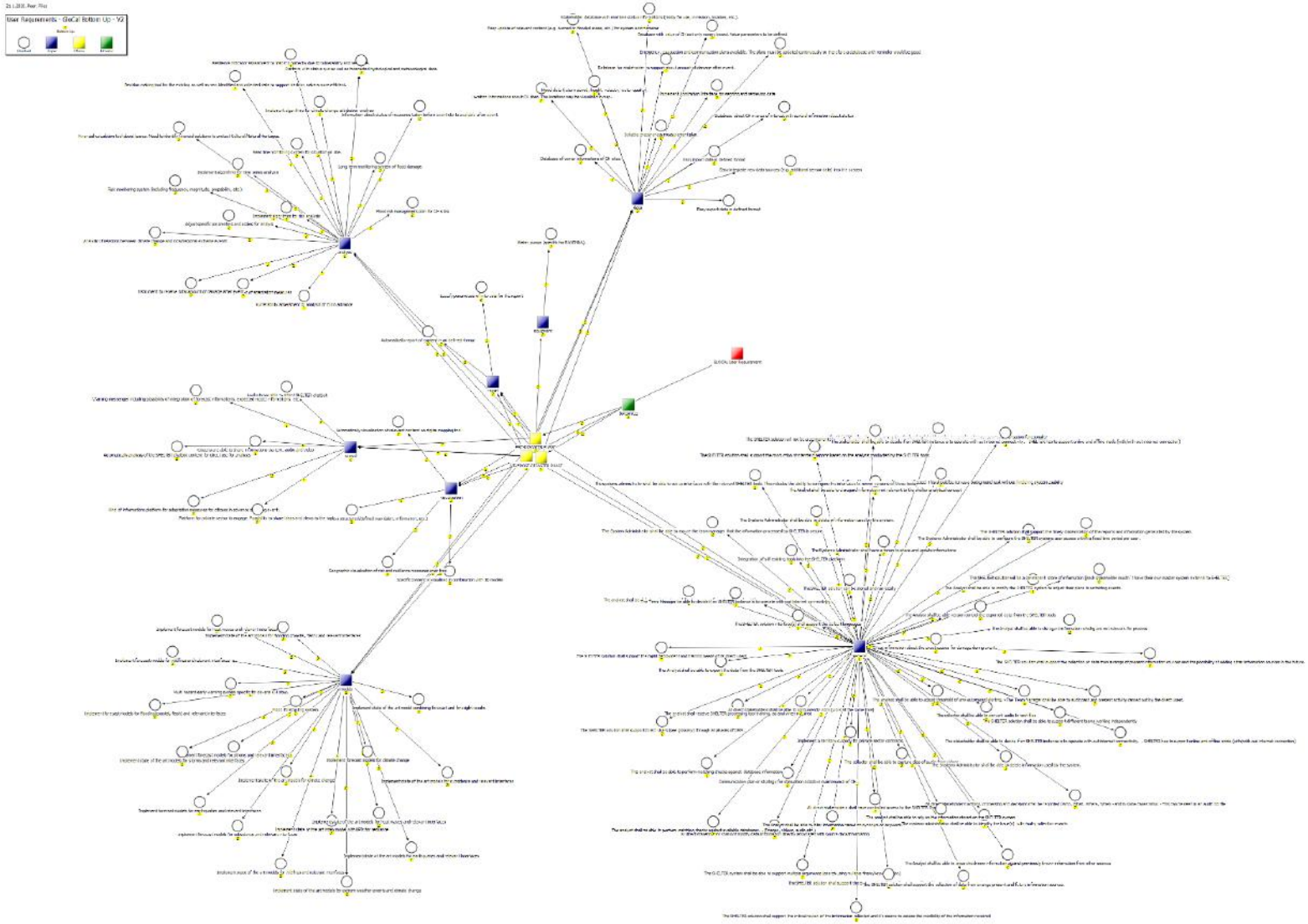
9.7 Annex VII: List of Participants

The list is part as separate file and available for the EC Project Officer upon request.

9.8 Annex VIII: Photos

Some photos of the WS are part as separate file and available for the EC Project Officer upon request.

9.9 Annex IX: Bottom-up Network



9.10 Annex X: Combined Network of both approaches