PANTHEON

Community-Based Smart City Digital Twin Platform for Optimised DRM operations and Enhanced Community Disaster Resilience

D3.2

REPORT ON PARTICIPATORY DESIGN PROCESS

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TASK ABSTRACT

The present Deliverable “Report on participatory design process” is the outcome of T.3.2 “Participatory Design Process”. The aim of this Deliverable is to provide an analysis of the outputs of the WP2 related to the different strategies in term of disaster community risk management and how these outcomes can be implemented in a community-based participatory design. Specifically, the participatory actions carried out include the following: 1. Visioning: used to support communities to develop a vision of the future in pictorial form. 2. Timelines: used to show events or processes by displaying items sequentially along a time-based line. 3. Calendars and activity profiles: a visual way for SSH to show “who does what and when”. 4. Semi-structured interviews: guided conversations to collect information about a specific issue.

[1] **Please indicate the type of the deliverable using one of the following codes**:
R = Document, report
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ETHICS: Deliverables related to ethics issues.
OTHER: Software, technical diagram, algorithms, models, etc.

[2] **Please indicate the dissemination level using one of the following codes**:
PU = Public
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EXECUTIVE SUMMARY

This deliverable is the outcome of Task 3.2 “Participatory Design Process” which provides an analysis of the implemented participatory design process within the field of disaster management. The deliverable includes a first section dedicated to the analysis of previous findings which were identified in Work Package (WP) and deals with applicable regulations, with a special emphasis on the selected pilot areas of the project and how these regulations are implemented in different risk management mechanisms.

After the analysis of the previous findings, the core of the deliverable is based on the definition of an initial approach to a general participatory design process from different perspectives from the SSH experts to stakeholders and end-users with direct application in the PANTHEON pilot areas by the identification of the stakeholders and end-users in these areas and providing an idea of the implementation of the PANTHEON concept using a similar methodology, but of course, with the limitations and peculiarities of PANTHEON concept, methodologies and even, the technologies.

The present deliverable also includes a list of recommendations for the implementation of the PANTHEON system and decision-making process and some requirements for proper implementation.

1 INTRODUCTION

As noted in D3.1 on the "Technology Roadmap for Disaster Resilient Communities" (Tsaloukidis, Petsioti, et al., 2023), technology plays a fundamental role in disaster management. Our society has become increasingly dependent on technology, and first responders have not been immune to this phenomenon. Indeed, there are many technological innovations that enhance the capabilities of disaster management professionals, enabling them to better manage specific crises. However, there is also a significant gap between the needs of potential end-users (civil protection, military, firefighters, police, emergency medical services, etc.) and the products offered by technology providers.

PANTHEON therefore involves a participatory design process that addresses the actual needs of users, bringing the two ends of the market closer together. The benefits of such a process will help to prevent technology suppliers from developing low value-added products that end up not being used, wasting time and money. The aim of the PANTHEON consortium is to provide a practical and reality-based tool that can help relevant actors to manage natural as well as man-made disasters, that are becoming more intense and frequent due to climate change. However, participatory design processes have their limitations and require a thorough analysis of the context in which a system is to be implemented. For this process to have a chance of success, it is therefore important not only to gather information from stakeholders and potential end-users, but also to study the context in which they operate in order to understand their behaviour, needs, desires and fears.

In this sense, the WP2 tasks aimed at analysing the ecosystem in which the PANTHEON platform should be implemented. The respective deliverables provide a solid knowledge base from which design criteria could be extracted. Therefore, a section was included in this deliverable that briefly refers to the results of the relevant Tasks (T) of WP2, in particular T2.1, T2.2, T2.3 and T2.5. Thus, the aim of Chapter 2 is to derive the most relevant design criteria based on the results obtained in WP2. Section 2.1 presents design criteria based on the disaster management regulatory framework. This includes disaster management legislation, the administrative structure of crisis/disaster management, the actors involved and the existing disaster plans in both Athens/Greece and Paris/France. Section 2.2 derives the criteria based on the risks in the pilot areas and the role of the vulnerable population. It explains the risk assessment methodology used by PANTHEON and the vulnerability indicators identified for each specific risk. Particular emphasis is placed on the fact that certain physical, psychological and socio-economic conditions make some people or groups more vulnerable, i.e. more exposed to the effects of disasters. It is therefore necessary to involve them in the decision-making process, not only to address their specific needs, but also because they can provide valuable knowledge and networks in emergency situations. Finally, and in relation to the above, section 2.3 derives design criteria from the results of the participatory governance model, which sought to identify, understand and involve relevant communities - including vulnerable groups - in all phases of disaster management.

Chapter 3 presents PANTHEON's approach to the participatory design process. In section 3.1, the reader will find an analysis of end-users and stakeholders, dividing them into three main groups according to their level of responsibility: (1) administration, (2) first responders and (3) community. Based on this distinction, the actors and potential end-users in Paris/France, Athens/Greece and Vienna/Austria have been identified together with their main responsibilities.

In order to create a common language and facilitate understanding between the different professionals involved in PANTHEON, section 3.2 operationalises the idea of the PANTHEON platform by defining the key concepts and providing an easily understandable description of the system, including a pictogram (see Figure

3). Section 3.3 then lists and describes some participatory design methods for both the understanding phase and the conceptualisation and testing phase. Subsequently, the focus is on the methods used by the Consortium and their respective designs. The chapter ends with section 3.4, which discusses the purpose of involving Social Sciences and Humanities (SSH) experts in the process of producing this report and the design criteria, and presents the analysis carried out in detail.

Chapter 4 presents the results of the participatory actions. Section 4.1 identifies some gaps that the system could address to add value to the potential use of the platform before, during and after the disaster. Section 4.2 looks at potential risks and barriers to the system's implementation and sets out a number of design criteria that emerged from the participatory process. These criteria are systematically summarised in a Design Criteria Catalogue (see Table 13) in section 4.3.

As a main result of this study the analysis allows the formulation of design recommendations based on participatory input from end-users and stakeholders. In any case, the combination of a good methodology, an appropriate and advanced technology and a well-implemented community participatory process is the key to an effective risk management system.

2. DESIGN IMPLICATIONS BASED ON PREVIOUS FINDINGS

For a participatory design process to succeed, it is indispensable to gather information not only about potential users and stakeholders (as described in greater detail in chapter 3). It is also about the specific context in which they are operating, in order to better understand end-users' and stakeholders' behaviour, needs, wishes and fears. This introductory chapter thus mainly serves as a provider of context by giving an overview of the findings of previous tasks of WP2, in particular T2.1 that was dealing, among other things, with regulatory DM (Disaster Management) frameworks in the focus areas, T2.2 that dealt with potential risks and DRM (Disaster Risk Management) mechanisms, T2.3 that analysed the role of vulnerable groups and Task 2.5 that gave recommendations for a participatory governance model. All these results will be briefly summarized here and, more importantly, analysed with respect to their implications for specific design recommendations for PANTHEON.

2.1 ANALYSIS OF THE REGULATORY FRAMEWORK

This section briefly recapitulates the key regulatory frameworks for the corresponding focus regions, Athens and Paris.

2.1.1 REGULATORY DM FRAMEWORKS IN ATHENS/GREECE

The General Secretariat of Civil Protection (G.S.C.P.) of Greece is the main governmental body responsible for the management of disasters, either natural or anthropogenic. The G.S.C.P. was officially formed in 1995 under the Law 2344/1995 (Organisation of Civil Protection and Other Provisions, 1995) in the frame of the Ministry of the Interior. This Law proposed and established the governmental council of civil protection, the General Secretariat of Civil Protection, which is responsible for the preparation, planning, and coordination of the country against potential natural and technological disasters. The main responsibilities of G.S.C.P. include readiness of the personnel and means of civil protection, elaboration of the available scientific information for the mobilization of resources in case of emergencies, as well as coordination of response and recovery actions in emergency situations. With the Law 3013/2002 (Upgrade of Civil Protection and Other Provisions, 2002) the scope and areas of interest of the G.S.C.P. were expanded covering also Chemical, Biological, Radiological, Nuclear and Explosive (CBRNe) hazards.

Considering the provisions and suggestions of the Law 3013/2002, the Hellenic Government issued the Ministerial Decision 1299/2003 ('Xenokratis' General Civil Protection Plan, 2003). This is the general plan which lays the foundation for efficient management of disastrous events, and identifies the first responders, i.e., organizations responsible for the response to the various incidents. "Xenokratis" also maps and assesses risks that can potentially affect the Greek territory and proposes the development of communication and information exchange systems for the efficient cooperation among stakeholders.

A further important step was made in 2014 with the Law 4249/2014 under the provisions of which various operational forces, such as the Hellenic Police and the Hellenic Fire Service as well as the G.S.C.P., restructured with the aim to support and upgrade the services provided by the Ministry of Public Order and Citizen Protection.

In 2020, the Law 4662/2020 was issued (National Crisis and Hazard Management Mechanism, Restructuring of the General Secretariat of Civil Protection, Upgrade of Civil Protection Volunteering System, Reformation of the Fire Brigade and Other Provisions, 2020). In September 2021, the Ministry of Climate Crisis and Civil Protection was established under the Law 161/A/9-9-2021. The G.S.C.P. was transferred from the Ministry of the Interior to the new Ministry of Climate Crisis and Civil Protection.

In Greece, the G.S.C.P. has developed detailed plans for each major hazard affecting the country, providing specific measures and actions for the four phases of disaster management, i.e., prevention, preparedness, response, and recovery. On the other hand, the Hellenic Police has also developed specific plans with the aim to address criminality and potentially high-impact anthropogenic risks. ***Table 1*** presents the plans which have been elaborated for each major hazard affecting Greece. Each plan type contains specific plans (Ministry for Climate Crisis and Civil Protection, 2023) and strategies depending on the hazard type.

Table 1: List of hazards affecting Greece and corresponding disaster management plans.[3]

Natural and anthropogenic hazards affecting Greece	**Plans and strategies implemented in Greece**
Earthquake	• General civil protection plan "Egkelados 2" • Actions implemented by the Earthquake Planning and Protection Organisation, i.e., development of earthquake resilience regulation, pre-earthquake inspection of structures, information campaigns for the public and for specific target groups. • Monitoring of seismic activity by research centres and universities.
Flood	General civil protection plan "Dardanos 2"
Snowfalls and frost	General civil protection plan "Voreas 2"
Forest fire	General civil protection plan "Iolaos 2"
Volcanic eruption	General civil protection plan "Talos"
Climate Change	Climate change adaptation strategy for Greece
Technological accident	General civil protection plan "Irakleitos"
Accident during the transportation of dangerous goods	• General civil protection plan following the ADR/RID European agreements. • General civil protection plan for the management of accidents during the transportation and distribution of natural gas
Multi-casualty incident	Civil protection plan for the management of human loss
CBRN	• General civil protection plan "Pandora" • Hellenic police plan "Thiseas"
Hostage and criminal crisis	Hellenic police plan "Nikias"

One of the main objectives of these contingency plans and strategies is to clarify and define roles and responsibilities of each institution in the event of a disaster. Although both the actors and their responsibilities are clearly defined by law, there is no centralized regulation in place that organizes the

[3] See D2.1 (Tsaloukidis, Condomines, et al., 2023, p. 33).

communication between these organizations. Considering the importance of smooth communication and coordination between different organizations for effective disaster management, the issue of interoperability of the various existing communication systems will be a crucial factor to be considered in the design of the PANTHEON system. Since the situation in France is similar to that in Greece, and to avoid unnecessary repetition, this aspect will be taken up again in the next section and explained in more detail, especially with regard to design implications for PANTHEON.

2.1.2 REGULATORY DM FRAMEWORKS IN PARIS/FRANCE

Law No. 87-565 of 22 July 1987 on the organisation of civil security, the protection of forests against fire and the prevention of major risks in France (Loi N°87-565 Du 22 Juillet 1987 Relative à l'organisation de La Sécurité Civile, à La Protection de La Forêt Contre l'incendie et à La Prévention Des Risques Majeurs, 1987) was a fundamental piece of legislation dealing with various aspects of civil security and protection against natural and technological risks in the country. This law established the basis for the organisation of civil security in France, including the planning and coordination of actions to deal with emergencies and disasters, as well as the mobilisation of public and private resources to ensure the safety of the population in the event of crisis. The legislation also emphasised the importance of coordination between local, regional and national authorities, but also between other actors such as NGOs (non-governmental organisations) and the private sector.

The previous law was repealed by Law No. 2004-811 of 13 August 2004, known as the "Law on the modernisation of civil security" (Loi N° 2004-811 Du 13 Août 2004 de Modernisation de La Sécurité Civile (1), 2004). It aims to update and improve the infrastructure and procedures related to civil security, covering aspects such as prevention and planning in disaster management, coordination and cooperation between local, regional and national authorities, training and education of professionals and the general public, resources and financing of operations, and regular evaluation of response capacities.

Another cornerstone of the emergency management system in France is Law No. 2003-699 of 30 July 2003, known as the "Law on the Prevention of Technological and Natural Risks and the Repair of Damage" (Loi N° 2003-699 Du 30 Juillet 2003 Relative à La Prévention Des Risques Technologiques et Naturels et à La Réparation Des Dommages (1), 2003). In addition to establishing measures for the identification, assessment and prevention of technological and natural risks, it also addresses issues such as urban planning and land use, damage repair, public participation, and sanctions and regulations.

Apart from national legislation, various regions and departments in France have their own regulations and disaster management plans adapted to specific local needs. This is the case, for example, with Decree No. 2005-1156 of 13 September 2005 on the municipal protection plan, which was adopted in application of Art. 14 of the law on the modernisation of civil security (Décret N°2005-1156 Du 13 Septembre 2005 Relatif Au Plan Communal de Sauvegarde et Pris Pour Application de l'article 13 de La Loi N° 2004-811 Du 13 Août 2004 de Modernisation de La Sécurité Civile, 2005). The decree lays down the rules for drawing up and maintaining the local protection plan in each French locality. It also provides a framework for the coordination of regional and national authorities, with the Mayor having primary responsibility for the implementation and execution of the plan in the event of a crisis.

Finally, it is worth mentioning that provisions on disaster and emergency management are included in several general laws, such as the Environmental Code, the Labour Code, the Insurance Code or the Urban Planning Code.

With regard to the administrative structure of disaster management, it is important to note that it is not centralised in a single government agency, but that several ministries have roles and responsibilities in its management. The main actors are on the one hand: the Ministry of the Interior, which is responsible for crisis preparedness and management; the Ministry of the Environment, which is primarily concerned with risk reduction and prevention; the Ministry of Housing, which is responsible for urban planning and ensuring compliance with building regulations; and the Ministry of the Economy, which is responsible for economic compensation in the event of disasters. On the other hand, the Ministry of Agriculture, the Ministry of Health, the Ministry of Foreign Affairs and the Ministry of Education are also involved in disaster risk reduction (for a more detailed overview of the responsibilities of each actor, see pp. 75-76 of D2.1: Tsaloukidis, Condomines, et al., 2023).

In terms of the tools with which the French authorities have equipped themselves to deal with disasters, the most important are (1) the Natural Risks Prevention Plan, which includes a consultation process with local authorities, the definition of risks and, among other things, the development of regulations focused mainly on urban planning and land use (see also chapter 3.1.1); (2) the Technological Risks Prevention Plan, which consists of a technical study of risks and vulnerabilities, as well as a plan for cooperation between the various actors involved; and (3) the Information Document on the major risks affecting France. In addition to these general documents, there are also specific plans for preventing forest fires and floods, as well as earthquakes, coastal risks (tsunamis) and terrorism.

As already mentioned, local authorities play an important role in disaster management, with the Mayor being the main authority responsible for disaster management at local level. It is under his/her responsibility that risk management plans are drawn up, identifying the relevant municipal actors and their roles and responsibilities. The Mayor is also responsible for informing citizens, mobilising resources and emergency services, and maintaining the flow of information to increase situational awareness. At the local level, in addition to the Communal Safeguarding Plan, there is also the Inter-Communal Safeguarding Plan, which connects the disaster management plans and policies of different municipalities that have similar interests and/or are exposed to similar risks.

Therefore, one of the conclusions we can draw from the regulatory framework for disaster management in France is that it is very decentralised, both at the legislative level and in terms of the actors involved in the whole process. On the one hand, there are specific laws for disaster management, but there are also provisions for disaster management in other more general legal texts in the country. On the other hand, disaster management involves a variety of actors from different fields, so it would be logical to say that such a distributed management structure could pose challenges for cooperation and coordination. Indeed, both laws and management plans emphasise this fundamental aspect in crisis situations.

As outlined in the case of France, disaster response consists of a number of organisations from different sectors and levels, with different responsibilities and different organisational cultures. The coordination of all the actors involved is often identified as a problem during major disasters, as the latter are too complex and disruptive for contingency plans to be effectively implemented (Boin & Bynander, 2015). Studies have shown that coordination is one of the fundamental challenges in the face of an emergency and that coordination is frequently inadequate (Bahadori et al., 2015, pp. 274–275).

The existence of different actors involved in crisis management often leads to collisions and conflicts between them, and consequently has a negative impact on both human resources and economic assets. The roles, responsibilities and commitments of some actors are sometimes unknown to other organisations, creating a state of confusion. Similarly, the lack of trust between them is also a major constraint in effectively

responding to an emergency (Bahadori et al., 2015, pp. 275–278). This is exacerbated by communication problems, with first responders (police, fire, ambulance, etc.) using different radio frequencies and unable to communicate with each other (Prizzia, 2008, p. 83). Thus, Prizzia (2008, p. 96) summarises the problems of cooperation in the low interoperability of communication systems, lack of joint training, inadequate equipment and inter-agency rivalries, and proposes coordination training as a solution. Other authors also add that the key to good cooperation depends on understanding the partners, pointing to a lack of understanding of the different parts involved in disaster response as one of the causes of cooperation failures (Davis et al., 2015, p. 43).

In all of this, it is important to remember that local communities are the first on the scene and can and should also play a relevant role in the response. Indeed, Aldrich (Aldrich, 2019, p. 308) states that the ideal response to a disaster is based on the simultaneous cooperation and interaction of local human and material resources with formal organisations within the framework of national emergency plans. However, it should be borne in mind that the nature of the circumstances caused by a major disaster can overwhelm existing plans and quickly turn them into overly rigid and unhelpful documents (Boin & Bynander, 2015). On the other hand, the emergence of spontaneous volunteers from local communities - usually without any disaster training - and their willingness to participate and help also clashes with the formal response structure and the professionals in charge of implementing contingency plans. In addition, these informal 'networks' have usually not had the opportunity to work together, which makes coordination even more difficult (ibid). Therefore, it must be considered that balancing and coordinating bottom-up and top-down approaches is a rather complex issue (Aldrich, 2019).

When faced with problems of cooperation and coordination, it is usually pointed out to prepare, train and create platforms to enable different actors to develop joint actions as part of the solution (Boin & Bynander, 2015). Joint training and education allows different organisations to understand the plans, roles, responsibilities and authorities of other actors (Bahadori et al., 2015, p. 278) as well as the value of individual activities in the framework of joint actions. It also allows to evaluate certain scenarios to better understand the development of a team in a specific situation, as well as to test different coordination strategies to identify weaknesses and correct them (Hashemipour et al., 2017).

Given the importance of cooperation and coordination in crisis management, the PANTHEON system could serve as a platform for linking the many actors involved in disaster management at all stages of a disaster. One of the objectives would be to bring their organisational cultures closer together and make everyone aware of their respective roles and responsibilities in an emergency situation, thus avoiding collisions and potential conflicts. It is important to highlight the role of local communities, which could benefit from disaster training and education, thus equipping groups on the front line of a disaster with the tools they need. Similarly, they could offer alternative perspectives to crisis professionals, resulting in positive feedback. It would also provide an understanding of the role of authorities and different crisis management organisations, thus fostering critical trust in extraordinary times.

The platform could also evaluate the quality of joint work and test different coordination strategies in order to identify and improve the weakest points. In the same way, it could improve local, regional and national disaster management and response plans and legislation. It would therefore be a kind of laboratory for testing the existing disaster response structure. Finally, it would also be able to facilitate the flow of information between actors, especially in the response phase. It has already been mentioned how often communication problems arise during a crisis, and PANTHEON could help to improve communication and thus increase situational awareness.

In view of the above, we recommend the following:

- *The system to be developed by the PANTHEON consortium should identify and integrate all relevant emergency management actors present in the pilot region, taking into account both professionals and local communities. This requirement would be useful during the response phase, in order to be able to coordinate the different professionals and communities in real time, but it would also be useful for the preparedness phase, allowing for prior training that would bring together all the actors and at the same time evaluate cooperation and coordination strategies.*
- *The PANTHEON system should provide a common and unified channel of communication between all identified actors in order to avoid communication problems. Although information sharing between actors is important, we should not forget that informing citizens about potential risks and emergencies is a fundamental right, and PANTHEON should thus integrate the necessary means of communication to reach as many people as possible.*
- *The system should be adapted to the emergency plans and legislation in force in the region. However, there should be some flexibility to allow for solutions that are not covered by emergency plans, as long as this does not lead to serious breaches of law and order.*

2.2 RISKS IN THE PILOT AREAS AND THE ROLE OF VULNERABLE GROUPS

In the context of the participatory design process, it is essential to have a clear overview and analysis of the potential risks affecting a community. An extensive analysis of the multi-hazard risk identification has been already done in WP2 with a special focus on the two pilot areas selected for the project study. The aim of this chapter within D3.2 is to assess and analyse what implications the identified risks for both pilot areas have in regards to concrete design recommendations for PANTHEON. For this purpose, we will first briefly recapitulate the results from D2.2 (Triantafyllou & Apostolopoulou, 2023) and D2.3 (Apostolopoulou et al., 2023), before giving some indications on how this may affect and influence the design of PANTHEON.

Risk analysis is a complex field requiring specific knowledge and expertise and currently, there is no universally agreed upon risk analysis method applicable to all types of hazards that would be valid for all regions since the regulations often differ depending on the region. This can generate different results for the same hazard. It is also important to consider the difficulty to quantify different terms. The PANTHEON project has proposed a risk assessment methodology based on two main factors, the “exposure to hazard” and the “impact from hazard”, which are quantified in a scale of low, medium and high. T2.2 (Triantafyllou & Apostolopoulou, 2023) assessed the two pilot regions regarding a number of hazards according to this assessment system. As part of the review of practice, interviews were carried out with seven key stakeholders representing seven respective stakeholder organisations. Systematic data collection about exposure, vulnerability and impact was highlighted by several stakeholders as a key barrier for advancing the state-of-the-art of multi-hazard disaster risk management approaches. They also underlined the lack of maintenance and/or upgrading of equipment as well as the need for interoperability and coordination between the relevant sectors.

In terms of hazards, D2.2 (Triantafyllou & Apostolopoulou, 2023) focused on wildfires, earthquakes, floods, heatwaves, landslides, cyber-attacks, technological accidents and terrorist attacks. The result of the semi-quantitative risk assessment analysis showed that for the region of Île-de-France, terrorist attacks have the most relevance with high exposure to the hazard and high impact from the hazard (the authors cite the incident at the Bataclan in Paris in 2015 as an example, where 90 people lost their lives). This was followed

by floods (medium exposure and high impact) and heatwaves (high exposure and medium impact). The risk for technological accidents was listed as medium and for earthquakes as low, the authors did not show an analysis for wildfires, landslides or cyber-attacks (see ***Table 2***). An analysis done for D2.3 (Apostolopoulou et al., 2023) revealed that when experts were asked to list the top 5 relevant hazards in their region, the most listed hazards for France/Paris were floods and droughts, followed by landslides, storms, technological accidents and terrorist attacks. Interviewees in T2.3 also highlighted once more that droughts are an important threat in France. For the Attica region, D2.2 (Triantafyllou & Apostolopoulou, 2023) lists wildfires as the most relevant hazard, with high exposure and high impact. This is followed by earthquakes (medium exposure, high impact) and heatwaves (high exposure, medium impact). Floods are described to have medium exposure and medium impact (see ***Table 3***). In D2.3 (Apostolopoulou et al., 2023), experts mostly listed earthquakes and wildfires among the top 5 hazards, followed by floods, heatwaves, and epidemics/pandemics.

Table 2: Matrix of semi-quantitative risk assessment for natural and human-made hazards in the Île-de-France region[4]

	Earthquakes	Floods	Heatwaves	Technological Accidents	Terrorist Attack
Exposure to hazard	Low	Medium	High	Medium	High
Impact from hazard	Low	High	Medium	Medium	High

Table 3: Matrix of semi-quantitative risk assessment for natural and human-made hazards in the Attica region[5]

	Earthquakes	Floods	Wildfires	Heatwaves	Landslides	Terrorist Attack	Cyber Attack
Exposure to hazard	Medium	Medium	High	High	Low	Low	Medium
Impact from hazard	High	Medium	High	Medium	Low	Low	Low

Taken together, these data indicate that terrorist attacks, floods, droughts, technological accidents and heatwaves are the most relevant hazards in the Île-de-France region and that the PANTHEON project should aim to focus on one or more of these scenarios, while in the Attica region, the focus should be on wildfires,

[4] Taken from D2.2 (Triantafyllou & Apostolopoulou, 2023).
[5] Taken from D2.2 (Triantafyllou & Apostolopoulou, 2023).

earthquakes, heatwaves, and/or floods. Ideally, a Digital Twin would serve to prepare for and deal with these identified hazards. Practical considerations and limitations may however steer the project into a different direction.

In D2.3 (Apostolopoulou et al., 2023) a number of vulnerability indicators were identified for specific hazards. This data should ideally be included in a Digital Twin if it is supposed to be used for risk assessments and/or include simulations of vulnerable and resilient areas. Additionally, D2.2 (Triantafyllou & Apostolopoulou, 2023) described risks and multi-hazard-interaction associated with these hazards, related to the specific regions:

- For terrorist attacks, there can be very different scenarios which require specific approaches and data. Terrorist attacks can for instance target public places (wherein places with a high density of people are especially vulnerable), critical infrastructure (such as hospitals or power plants) or cyber-infrastructure or data (such as patient data or classified military plans). D2.2 states that for Île-de-France, "[i]t has been found that the most likely scenarios for terrorist attacks were suicide bombings, shootings, and vehicle attacks." (Triantafyllou & Apostolopoulou, 2023, p. 41). Concerning impact, terrorist attacks of these kinds can cause deaths, injuries, trauma (including long-lasting psychological effects), as well as economic impacts, a decrease in tourism, damage to buildings, infrastructure and property, and disruption of trade and commerce. It can also lead to increased social isolation within the community and decreased trust in authorities. Furthermore, political changes can follow, such as an increase in surveillance and a change in foreign or domestic policy. D2.2 cites a study conducted by the French Institute of International Relations which identified potential targets of terrorist attacks in the Île-de-France region which include public spaces and critical infrastructure, and a report by the French Ministry of the Interior which identified densely populated neighbourhoods with high unemployment rates and a lack of social cohesion as particularly vulnerable areas. These data should be included in a Digital Twin. The French Ministry of Defense published a report stating that a lack in communication and coordination between different agencies might lead to problems in the case of a terrorist attack – a problem which the PANTHEON system could aim to solve (see also the recommendations in chapter 2.1).

- For floods, D2.3 (Apostolopoulou et al., 2023) states that measures like shoreline elevation, coastline vulnerability and river flooding vulnerability as well as generally a proximity to bodies of water increase the risk for flooding and the vulnerability to flooding for a certain area. An interviewee in T2.3 mentioned that flood risk maps exist for the city of Athens – these data could be incorporated into a Digital Twin. There is also a multitude of indices available to measure flood risk and flooding vulnerability (see Nguyen et al., 2016). D2.2 (Triantafyllou & Apostolopoulou, 2023) reported on interactions with other hazards: floods can be caused by storm surges, tsunamis, or heavy rainfall, and can lead to landslides or damage critical infrastructure and lead to technological hazards and problems for emergency services. They can further lead to a contamination of the water sources with pollutants, posing a threat to public health. Possible sources of contamination as well as critical infrastructure should therefore be mapped within a Digital Twin used to simulate the effects of a flood. In general, floods can cause a disruption of infrastructure, transportation, the economy (e.g., due to the temporary closing of businesses), health risks through contaminated water, and psychological impacts due to stress and loss. Paris has flood protection infrastructure such as a drainage system and flood walls, the location of which should be included in a Digital Twin. There are also early warning systems in place. The French Ministry of Ecology, Sustainable Development, and Energy published an assessment on the most flood-prone areas in Paris, which include areas

surrounding the river Seine. Flooding usually occurs between November and March. There was also an impact assessment conducted on the region, and hazard forecasts for specific areas are available on the website of Météo-France[6], which is meant to warn the public of certain threats (high winds, heavy rainfalls, thunderstorms, snow/ice, avalanches, heat waves, and cold waves) within 24 hours. In Attica, flash floods are a major risk. For Attica, a study conducted by the Ministry of Environment and Energy identified the most flood-prone regions in the area, which was updated by Feloni et al. (2020). In addition, several flood defence and water regulation measures were implemented and are planned for the region.

- For wildfires, the fuel load (amount of flammable material in the form of trees, houses, or other materials) and the strength and direction of the wind are important to consider in simulations, as well as other criteria such as defendability and firefighting access (the location of the nearest fire station, the nearest water points, and the location and condition of the roads) (Apostolopoulou et al., 2023). The Canadian Forest Fire Weather Index (Karali et al., 2023) or the Revised Universal Soil Loss Equation (Efthimiou et al., 2020) can be used to determine a region's vulnerability to forest fires. D2.2 (Triantafyllou & Apostolopoulou, 2023) did not deal with wildfires in the region of Île-de-France, however, a description of wildfires in the region of Attica was provided. Attica is very prone to wildfires due to the decline of pastoralism and rise of more profitable ventures, such as vineyards and wood- and cropland, as well as urban settlements. This led to more severe wildfires and a higher spatial heterogeneity of fire events. One devastating wildfire in 2018 caused 104 fatalities in the region. Wildfires can cause death and injuries, although these effects can be mitigated by advanced warning systems leading to early evacuations. The presence of such warning systems should be included in a Digital Twin as a factor for increasing disaster resilience. Wildfires can also cause severe damage to the ecosystem as well as the underlying soil (a lack of root stabilisation can cause erosion issues, leading to mudslides, flooding, and land degradation). Nature reserves or other vulnerable ecosystems should thus be mapped in a Digital Twin, as they need special protection. In the region of Attica, warning systems are in place which can be accessed by the public: The FireHub of BEYOND[7], established at the National Observatory of Athens, provides real-time data on fires in the region and is also used by the responsible organisations such as the fire brigade authorities and ministerial services. The FireHub system uses satellite images gathered by the antennas of the BEYOND Center. A Digital Twin providing real-time or also historical data on wildfires should certainly try to integrate these available data.

- D2.3 (Apostolopoulou et al., 2023) described some vulnerabilities to heatwaves. Heatwaves are especially adverse in urban areas, where temperatures tend to be higher than in rural places, and, within cities, especially in so-called urban heat islands. High levels of air pollution can additionally raise temperatures. Particularly in top-floor apartments, temperatures can reach life-threatening levels. Insulation measures, green roofs and air conditioning can mitigate the effects of a heatwave on urban housing, therefore information on such building measures should be included in a Digital Twin simulating effects of heatwaves. D2.2 (Triantafyllou & Apostolopoulou, 2023) described the impact of heatwaves on Île-de-France and Attica. In general, heatwaves can cause adverse health effects and deaths, particularly among vulnerable people such as children, elderly people, or people with underlying health problems. In France, heatwaves have caused the most fatalities out of all

[6] See: https://vigilance.meteofrance.fr/fr [last access: October 31, 2023].
[7] See: https://firehub.beyond-eocenter.eu/ [last access: October 31, 2023].

natural disasters since 1900. Heatwaves can also have an economic impact in that energy consumption increases due to an increase in air conditioning while productivity decreases, they can impact water and air quality as well as social life, and can even affect infrastructure when rail tracks buckle under the heat. The two regions will see an increase in heatwaves over the following decades due to climate change. In response to this threat, the French government has taken a number of measures: green infrastructure such as green roofs have been installed, and a heatwave early warning system has been established. The Greek government has vowed to implement similar measures. In Attica, heatwaves may increase the likelihood of flash floods occurring. A novel app called EXTREMA[8], which uses real-time data of cell phone users as well as satellite data, alerts users if the health risk at their current location is high. The app was endorsed by multiple European cities, including Paris and Athens. EXTREMA uses data such as current hazard maps and can therefore also be used to determine those areas of a city where the most victims are to be expected. A Digital Twin of the cities should aim to incorporate these data to allow simulations based on historical data or even enable planning based on real-time data.

- D2.3 (Apostolopoulou et al., 2023) describes that the effects of earthquakes can be mitigated by erecting earthquake-proof buildings and following up-to-date building regulations. These data should therefore be collected and utilized in a Digital Twin to simulate the structural integrity of neighbourhoods in cases of earthquakes. The risk of soil liquefaction (which depends on the physical properties of the soil, groundwater level and water-permeability, and stress characteristics) is another physical measure that could be used in a Digital Twin, as it determines the vulnerability to earthquakes of a certain region. The 2020 European Seismic Risk Model could be utilized, which incorporates the likelihood of earthquakes occurring in specific areas, soil conditions, as well as measures of soil conditions, building vulnerability, and exposure (EFEHR, 2021). In D2.2 (Triantafyllou & Apostolopoulou, 2023) it is stated that earthquakes are relatively rare in Île-de-France and tend to be mild to moderate. Nevertheless, seismic surveys have been conducted in the region and building codes have been implemented to ensure that buildings are earthquake-resistant. In contrast, in the Attica region they happen more frequently and also tend to be stronger. Key impacts of earthquakes are damage to buildings, infrastructure, energy and water supply, telecommunication, transportation, economic losses, social and psychological impacts, as well as loss of life and injuries. In terms of interactions with other hazards, earthquakes can cause ground displacement which can cause changes to the water supply or infrastructure such as railway tracks, they can lead to soil liquefaction as described above, or cause landslides which in turn can cause flooding. Instances of soil liquefaction have already been observed in several regions in Attica in association with earthquakes, as described in D2.2. A strong earthquake could also cause a tsunami, which is especially relevant for the Attica region due to its proximity to the ocean. A Digital Twin used for earthquake preparedness should incorporate data on all of these hazards that may occur in interaction with an earthquake.

- "Technological accidents" can encompass a variety of hazardous events, from a road or train accident to a chemical spill or a nuclear disaster. Technological accidents can be especially dangerous when hazardous materials are involved, in which case meteorological conditions such as wind strength and direction can determine which areas are particularly vulnerable (Apostolopoulou et al., 2023). A Digital Twin should therefore incorporate data on chemical plants, nuclear power plants, or other

[8] See: https://extrema.space/ [last access: October 31, 2023].

relevant infrastructure which may leak hazardous material, and should be able to simulate the spread of these materials under different environmental and meteorological conditions. Data on particularly vulnerable environments such as nature reserves should also be included. D2.2 (Triantafyllou & Apostolopoulou, 2023) describes that both pilot regions are home to several large industrial sites such as chemical plants, oil refineries, and storage tanks, as well as extensive railroad systems, highways and airports. Technological accidents can be the cause of other hazards, such as floods or cyber-attacks. A technological accident can cause adverse health outcomes, e.g., when toxic chemicals are released into the air, it can cause delays in transportation and therefore have economic impacts, it can impact the environment through pollution, and can cause social isolation and a reduced trust in institutions. Technological accidents can often be prevented or mitigated through regular safety inspections and emergency response plans. A study by the French Environment and Energy Management Agency in 2016 identified vulnerable areas in Île-de-France and this data should be included in a Digital Twin. A further study by the French National Institute for Industrial Environment and Risks identified areas with a high density of chemical facilities and assessed consequences of chemical accidents. Further data could be taken from ARIA[9], which is a database listing technological accidents in France or abroad, and Copernicus[10], an EU (European Union) programme which maps current hazards throughout Europe.

- Droughts usually go hand in hand with heatwaves and can threaten local agriculture as well as the surrounding ecosystem. In addition to agriculture, industry and river operations may also be impacted by a drought, as the (Mairie de Paris, 2018) pointed out using the Seine as an example. The most relevant indicator for droughts in Europe is baseline water stress, measured by the ratio of withdrawals to renewable supply (see Apostolopoulou et al., 2023).

2.2.1 THE ROLE OF VULNERABLE GROUPS

D2.3 deals with vulnerabilities and vulnerable groups (Apostolopoulou et al., 2023). The following subchapters are a summary of information from D2.3. Vulnerability is the human dimension of disasters and results from a range of economic, social, cultural, institutional, political and psychological factors. The vulnerability of individuals, communities and the environment is a major factor in terms of exposure to disaster risk that limits resilience. However, the most vulnerable people are often not sufficiently considered when it comes to prevention strategies or operational guidelines.

Vulnerability changes over time as many of the processes that affect vulnerability are dynamic, including rapid urbanization, environmental degradation, market conditions and demographic change. Since we cannot reduce the frequency and severity of natural disasters, reducing vulnerability is one of the main opportunities for disaster risk reduction. Empowering vulnerable groups is an important element in building resilience. For instance, immigrant communities on the one hand face higher levels of vulnerability to natural disasters and climate change, but on the other hand their strong social ties can help in rebuilding community resilience. This means it is important to create formal spaces where representatives of vulnerable groups can organize to participate in recovery efforts and to share resources and roles among affected groups.

[9] See: https://www.aria.developpement-durable.gouv.fr/?lang=en [last access: October 31, 2023].
[10] See: https://www.copernicus.eu/en [last access: October 31, 2023].

2.2.2 THE IMPACT OF DISASTERS ON VULNERABLE GROUPS

The term "vulnerable groups" is described in D2.3 as: "[...] people with characteristics that put them at higher risk of injury, death, financial or other ruin during or after a disaster situation [...]. [T]hese characteristics can be physical, such as the construction material of the houses that people live in, and social, such as financial means or physical or mental disability" (Apostolopoulou et al., 2023, p. 13)

The following main vulnerable groups in the pilot areas of Athens and Paris were identified after an extensive literature assessment of community vulnerability and capacity in D2.3: children/minors; elderly people; pregnant people; single parent families with minor children; people with low income; homeless people; people with mental disorder/disability/illness; people with physical disorder/disability/illness; migrants, refugees, and asylum seekers. Expert surveys further revealed people with reduced mobility, elderly people living alone, linguistically isolated individuals or communities, people with increased exposure to the hazard, people living in houses/areas with poor housing quality or insufficient regulations, students, people staying in special accommodations (e.g., hospitals, prisons), those untrained or uneducated on disasters, and workers as particularly vulnerable in disaster situations.

Regarding the specific scenarios listed above, people with respiratory and cardiovascular diseases are especially vulnerable to wildfires due to the ash and the smoke, and people in public places are especially vulnerable to terrorist attacks. People with increased exposure (e.g., because they live next to a forest or because they live in an area where heat islands form) are always more vulnerable to hazards. Most vulnerable to floods are elderly and pregnant people among others, but also tourists and those with poor flood awareness or limited access to information, as well as people relying on homecare or important medication (which has to be taken into account in case of evacuation) and those with limited mobility. Heatwaves most affect people in urban areas who live in top-floor apartments directly under the roof, and oftentimes extremely socially isolated people, including the elderly, people living in poverty, those suffering from addictions and those with mental disabilities, suffer the most. Droughts may particularly impact farmers as they may threaten their livelihoods. They can also have an impact on the elderly and those with underlying health conditions, as they may be more susceptible to dehydration and other heat-related illnesses. Lastly, on the questionnaire used in T2.3, one respondent mentioned that earthquake and flood vulnerability is associated with vulnerable living conditions (poor quality housing), difficulties in emergency evacuation (e.g., because of disabilities), and a lack of earthquake/disaster awareness. In many disaster situations, including earthquakes, vulnerable people like children, elderly people, people with low income, and people with physical as well as mental illnesses and disabilities, are at significantly increased risk of dying.

2.2.3 THE ROLE OF VULNERABLE GROUPS IN DECISION-MAKING DURING NATURAL DISASTERS

Natural disasters such as earthquakes, hurricanes, floods, fires, tsunamis, and other catastrophes can cause destruction and suffering on a massive scale. In such emergencies, vulnerable groups become particularly susceptible to risks and difficulties, and their role in decision-making becomes critical. During natural disasters, it is crucial to ensure their safety, well-being, and effective disaster management. Vulnerable groups, such as children, elderly people, persons with disabilities, and those with low socio-economic status, often suffer disproportionately from natural disasters due to factors like limited resources, mobility constraints, and social marginalization. Therefore, their involvement in decision-making processes is

essential to meet their specific needs, enhance their resilience, and promote fair disaster response and recovery.

One key aspect of involving vulnerable groups in decision-making is acknowledging their unique capabilities and knowledge, for instance:

1. Identification of Unique Needs: Vulnerable groups have specific needs that may differ from the rest of the population. For example, children and the elderly may require special care and protection, while people with disabilities may need accessible evacuation methods and assistance.

2. Experience and Knowledge: Vulnerable groups may have valuable experience in coping with disasters in the past, as they may face risks more frequently due to their conditions. Their knowledge and experience can be valuable in decision-making during crises.

3. Development of Fair Solutions: Involving vulnerable groups in decision-making contributes to the development of more just and inclusive crisis management strategies. This can help avoid additional marginalization and inequality during disasters.

4. Tailoring Solutions to Needs: Vulnerable groups can provide insights into what solutions can best suit their needs and limitations. This helps government agencies, civil society organizations, and volunteers adapt their actions and resources to serve all members of society effectively.

5. Raising Awareness of Inclusion Importance: Participation of vulnerable groups in decision-making processes raises awareness about their issues and needs, thus increasing society's understanding of the importance of including all citizens in crisis plans and actions.

6. Building Resilience and Support: Involving vulnerable groups in decision-making helps strengthen their resilience to future natural disasters. Creating stronger communities and support systems contributes to increased resilience and recovery after crises.

However, it is important to consider that the participation of vulnerable groups in decision-making may entail certain challenges. Some individuals may encounter difficulties in participation due to physical, cultural, economic, or social barriers. Therefore, it is crucial to ensure equal opportunities and remove obstacles to the active participation of all members of society in decision-making, especially in the context of disasters. Overall, the involvement of vulnerable groups in decision-making during natural disasters is a crucial aspect of effective crisis management and helps ensure a more just, humane, and inclusive response to natural calamities. This contributes to building a more resilient society capable of effectively addressing challenges related to natural disasters and minimizing their impact on vulnerable groups and the entire community. Analysis of survey responses from participants in France and Greece provides valuable information about awareness, involvement, and support for vulnerable groups in these countries.

In both France and Greece, approximately half of the participants indicated that they or their organizations work with vulnerable groups. In France, the most mentioned vulnerable groups were the elderly, single parents, and individuals with mental and physical disorders. These groups reflect a focus on meeting the needs of an aging population and individuals with specific challenges. However, other vulnerable groups such as pregnant people, homeless individuals, and people with low income were mentioned less frequently, indicating a potential need for more attention and resources for these populations. In Greece, the most mentioned vulnerable groups were children/minors, individuals with mental disorders/disabilities/illnesses, as well as migrants/refugees/asylum seekers. This highlights the importance placed on supporting the next

generation, addressing mental health issues, and helping displaced individuals. However, attention should also be paid to other vulnerable groups, as mentioned in the context of France.

Approaches to working with vulnerable groups in Greece included various strategies such as providing recommendations, targeted dissemination of information through social networks, research and development projects, disaster preparedness training, primary medical and sanitary assistance, emergency aid, and street work for the homeless. These approaches emphasize an active and diverse approach to meeting the needs of vulnerable groups, with a particular focus on education, community engagement, and direct support. Responses from France were sparser – one respondent indicated that they were primarily transporting people belonging to vulnerable groups (railroad sector) and one wrote that they provide an early warning system.

The survey participants were also asked about their opinion on measures that are important for recovery efforts. Respondents from both France and Greece emphasized the importance of infrastructure restoration. This includes repairing damaged buildings, roads, and other vital infrastructure to enable community functioning. Building strong social connections within the community was also noted as an essential factor in helping people recover from natural disasters. These findings underscore the significance of both physical and social recovery processes in post-disaster conditions. Regarding vulnerability after a natural disaster, respondents in both countries recognized pre-existing vulnerabilities, lack of government support, and economic losses or poverty as key factors. These findings highlight the importance of considering the socioeconomic context and support systems when addressing vulnerability issues. Additionally, in the French context, particular attention was given to addressing psychological consequences or trauma after a natural disaster, while in the Greek context, injuries and deaths were mentioned. These results emphasize the need to address mental health needs and provide immediate physical support for affected populations.

Should the PANTHEON system be used as a tool in recovery efforts, these results can inform the decision on where to lay the focus and which data should be incorporated into the Digital Twin. The responses highlight the importance of infrastructure restoration, indicating that especially data on damaged buildings and critical infrastructure has to be included. Results on the importance of strong social connections underscore that the community has to be included in the recovery efforts, and that providing infrastructure and measures to ensure social connectedness within neighbourhoods and between the emergency services and the locals is crucial for building a resilient community. Although difficult to achieve, ideally measures on social connectedness would also be incorporated into the Digital Twin. The experts' views on post-disaster vulnerabilities further highlight that support from the government, including financial support for rebuilding efforts, and special attention to vulnerable groups are important resilience measures. Simulations of the recovery phase should include data on these parameters, as well as data on injuries, deaths, and available mental and physical health support.

2.2.4 MEASURES AND STRATEGIES FOR REDUCING THE RISK OF VULNERABLE GROUPS

Knowing the importance of vulnerabilities and potential impacts of disasters on different segments of the population the important question is how they can be implemented in decision-making and what individualized approaches can be used to ensure their safety and well-being. Inclusive emergency management methods that consider the diverse needs of all population groups are essential to achieve equal preparedness and responsiveness to disasters. Policymakers and decision-makers must collaborate with

relevant stakeholders, including representatives from vulnerable communities, to develop effective measures and strategies for combating natural disasters, aimed at addressing their specific vulnerabilities and issues.

1. Identification of Vulnerable Groups: The first step in risk reduction is identifying vulnerable groups who may face the greatest difficulties and dangers during a disaster. This can be accomplished through demographic analysis, surveys, and community consultations. D2.3 includes a list of indicators for social, physical, economic, environmental, political, and cultural vulnerability.

2. Development of Preparedness and Evacuation Plans: Creating preparedness plans that consider the needs of vulnerable groups helps reduce risk and improve the effectiveness of evacuations. This includes providing access to disaster information and instructions, offering special evacuation routes and transportation for people with disabilities, and establishing shelters and temporary accommodations that address the needs of different vulnerable groups.

3. Education and Training: Increasing awareness and educating the population, including vulnerable groups, about safety measures and precautions before natural disasters, help reduce risk and enhance preparedness for emergencies.

4. Inclusive Planning: It is essential to include representatives of vulnerable groups in the development and implementation of preparedness and disaster response plans. This allows for consideration of their needs and experiences, ultimately enhancing the effectiveness and fairness of risk reduction measures.

5. Building Resilient Communities: Promoting the development of resilient communities that can better cope with the consequences of natural disasters helps reduce risk for all members. This includes improving infrastructure, protecting natural resources, developing emergency response plans, and implementing climate adaptation measures.

It is crucial to emphasize that reducing the risk of vulnerable groups should be a priority in disaster risk management. This requires coordinated efforts from governments, state agencies, non-governmental organizations, communities, and all stakeholders to ensure the safety of all segments of the population during crises.

The participation of vulnerable groups in decision-making during natural disasters not only ensures better protection for this population but also contributes to the development of more effective and humane crisis management strategies for the entire community. This helps to create a more resilient and compassionate society, prepared to cope with the challenges of natural disasters and minimize their consequences.

In the PANTHEON project, data on where especially vulnerable people and communities live should be included in the Digital Twin. In practice, it may not be possible to include data on single households and their occupants, but institutions (e.g., hospitals, kindergartens, schools, nursing homes, prisons) or neighbourhoods (data on median income or percentage of residents with a history of immigration) could be mapped, giving a rough overview of the concentration of social vulnerabilities within an area. Ideally, the Digital Twin could also be used to inform people belonging to vulnerable groups, for instance children, in the form of school trips or workshops. These could introduce the children to the Digital Twin, teach them about disaster preparedness, and show them the basic workings within first responder organisations.

2.3 PARTICIPATORY GOVERNANCE RESULTS

In *Deliverable 2.5* (Bittner et al., 2023) several ways to inform, involve and mobilize communities in all phases of DRM were analysed based on an extensive literature research as well as two workshops and an online survey with stakeholders, community representatives and academic experts in the field of community engagement. A model guiding general approaches to participatory governance was designed according to the findings and supplemented by specific recommendations:

- **Community profiling**: In order to provide an understanding of specific community features, local resources, capacities and risks. In urban areas, it is recommended to focus on small-scale areas. This facilitates the inclusion of a representative sample of the population and the establishment of relations to the communities at hand.
- **Establishing of relationships**: Local NGOs, cultural and sports organisations may serve as social hubs and are recommended entry points to local networks. These can be approached in order to initiate meetings and help identifying respected persons in the community that can be utilised as facilitators. Persons holding high trust in the community and potentially have some DRM-related expertise (e.g., doctors, nurses, firefighters) may be appointed as community liaison officers, serving as community-based points of contact in all phases of a disaster, both for the community and institutions. When organising meetings, potential barriers for participation should be addressed and inclusivity should be provided through good communication channels, inclusive language and the involvement of marginalized groups. Potential trust issues towards authorities and emergency organisations should be taken into consideration and proactively approached.
- **Community engagement measures including participatory decision making**:
    - **Preparedness**: Raising risk-awareness as well as knowledge about the right behaviour in certain disaster situations is a crucial aspect in community-based disaster preparedness. Therefore, the educational system may be utilized. Though, more engaging forms of community participation are highly recommended. These may include exercises and trainings with the participation of both first responders and community members, collaborative DRM-planning utilizing local knowledge and vulnerability mappings, where community members help identifying physical and social vulnerabilities of citizens and critical infrastructure in their neighbourhoods. All of these measures can help in sensitizing, training and empowering community members while having the potential to raise trust in institutions through active cooperation.
    - **Response:** While trained volunteers can be deployed (e.g., volunteer firefighters), untrained volunteers should only be involved sparsely and when urgently needed. The focus should lie on the evacuation as well as accurate and timely informing of the people. Therefore, early warning systems should be in place in order to inform community members about relevant hazards as soon as possible. Social media is good to spread information but may be unreliable during disasters. Due to the lack of coordination and information of spontaneous volunteers and donors of aiding resources, they often bear the risk of harming themselves or hindering ongoing operations. Ways to improve this coordination through digital platforms or community liaison officers would be useful and could proactively prevent spontaneous activities of volunteers on their own initiative.

- **Recovery:** Decisions during recovery may affect a communities' future resilience and living environment. Therefore, a high degree of participatory decision making is recommended. Community members will not only provide relevant knowledge and input, they should have the chance to build back on their own terms. While community meetings, workshops, citizen committees and participatory budgeting may be used as ways to enable community-led decision-making, grass-root initiatives should be encouraged and supported.

- **Vulnerable groups:** As already indicated in chapter 2.2, the most vulnerable groups of a population should be specifically addressed along the whole process. This starts with the identification of those vulnerable groups. Communication channels should be adapted in order to let early warnings and instructions reach all parts of the community (e.g., multiple languages, sign language, large letters). Special efforts should be made to include vulnerable groups in meetings and exercises. For this, measures to ensure accessibility for all groups have to be provided. Engagement of vulnerable groups may unveil unique perspectives and needs; help promoting their self-empowerment; and sensitize other participants (also involved DRM-experts) on the importance of inclusion.

According to the presented findings of *Deliverable 2.5,* a few design criteria can be derived for the development of the PANTHEON system:

- It is recommended to include the affected local communities when creating disaster response plans according to simulations within their area. This way, local knowledge can be integrated in the plans and community members can be sensitized and empowered in the process.
- Locations of local NGOs, sports clubs and cultural institutions should be available and visible within the SCDT (Smart City Digital Twin), as they might serve as useful contact points to the local community and could be able to provide a space that can be used for building emergency structures during disaster response operations.
- The contacts of recruited community liaison officers should be embedded in their respective neighbourhoods within the SCDT. In case of an emergency or disaster, these can then be informed early on to disseminate behavioural instructions to the local community within their communication channels.

3. APPROACH TO PARTICIPATORY DESIGN PROCESS

This section presents an analysis of potential stakeholders and end-users for the PANTHEON system, both in general, and more specifically for the focus regions Athens/Greece, Paris/France and Vienna/Austria. The identification and thorough analysis of potential stakeholders and end-users allows us to provide an activity profile of the relevant organizations at the end of each sub-section to demonstrate *who* does *what* and *when* in the case of a disaster.

3.1 STAKEHOLDER AND END-USER ANALYSIS

According to the Oxford dictionary, the term "stakeholder" represents a person or institution with an interest or concern in something, especially a business. In the case of hazards, the list of people concerned with it is quite extensive, including for instance the following profiles: citizens, social workers, NGOs, first responders, city managers, city planners, transport experts, scientific community, civil protection, regulatory agencies, health professionals, environment experts, sociologists, psychologists, local authorities, drone operators, weather agencies, etc.

The present report uses the classification provided in the PANTHEON Grant Agreement, which classifies the stakeholders concerned by a hazard as DRM stakeholders and Community stakeholders.

- The listed DRM stakeholders are: Civil Protection Authorities, First Responders and emergency services, utilities and infrastructure providers, private companies, media, donors, governmental and policy making authorities.
- Listed community and citizens stakeholders are: Local communities and citizens, NGOs/associations, charities and informal groups.

In this section a more exhaustive list of stakeholders is provided, which is divided in three groups and expanded into 2 to 3 sub-layers. The initial classification has no relation with the level of the hazard (and of the stakeholders affected), which can be world-wide, National level, regional or local. This is a 4th dimension that will apply to all the profiles as described below.

For our purposes we propose to divide stakeholders into three large groups, according to their level of responsibility:

1. Administrations – high level and political decisions.
2. First responders – operative and on-site responsibilities.
3. Communities – with no responsibility a priori.

Table 4 shows the second layer and, when applicable, the third layer of the profile of degrees of responsibility proposed above.

Table 4: Stakeholder overview, sorted by level of responsibility

First Layer	Second Layer	Third Layer
Administration	Governments	
	Regulators	
	Agencies/Institutes	Satellite, Weather, Environment, Transport, Earth Observation, Maritime, Volcanic, Earthquakes, ...
	Planners	City planners
	Managers	City managers
First Responders	Civil Protection Agencies	112
	Military	
	Police	
	Fire fighters	
	Municipality services	Food distribution, Hosting
	Paramedics	
	NGO	
	Social workers	
Communities	Citizens	
	Scientific community	Experts, Researchers, Sociologists, Psychologists
	Mass media	
	Collective representatives	Teachers, Staff at hospitals, Charity.
	Enterprises	
	Insurance companies	
	Vulnerable groups	Low income, children, elder, pregnant, homeless, mentally ill, physical disabled, migrant and refugees and linguistic isolated

3.1.1 IDENTIFIED STAKEHOLDERS/END-USERS RELEVANT FOR THE REGION OF PARIS/FRANCE

In Table 5, the stakeholders and end-users that were identified as relevant for the region of Paris/France are listed schematically in accordance with the subdivision introduced in chapter 3.1.

Table 5: Stakeholders identified for Paris/France, sorted by level of responsibility

First Layer	Second Layer	Third Layer
Administration	Ministry of Environment	General Directorate for Risk Prevention (DGPR)
	Ministry of Housing	
	Ministry of Economy	
	Ministry of the Interior	General Directorate of Civil Security and Crisis Management (DGSCGC)
	Regulators	
	Agencies/Institutes	Météo France Secrétariat général de la défense et de la sécurité nationale (SGDSN) Gestion des milieux aquatiques et prevention des inondations (GEMAPI) Service hydrographique et océanographique de la Marine (SHOM) Institut National de l' Environment Industriel et des Risques "INERIS"
	Planners	Plan local d'urbanisme (PLU)
	Managers	
First Responders	Civil Protection Agencies	112, European Civil Protection and Humanitarian Aid Operations
	Military	Gendarmerie de Haute Montagne
	Police	Préfecture, Police Nationale, Gendarmerie Nationale
	Fire fighters	250,000 firefighters, 78% of whom are volunteers and 22% are civil or military professionals
	Municipality services	Mayor and city council
	Paramedics	Service d'aide medicale urgente, SAMU
	NGO	Haut comité français pour la résilience nationale Croix rouge Française Protection Civile
	Social workers	
Communities	Citizens	
	Scientific community	Experts, Researchers, Sociologists, Psychologists
	Mass media	
	Collective representatives	Teachers, Staff at hospitals, Charity.
	Enterprises	
	Insurance companies	
	Vulnerable groups	Low income, children, elder, pregnant, homeless, mental illness, physical disabled, migrant and refugees and linguistic isolated

Building on the results presented in chapter 2.1.2 and the above schematic representation of the relevant actors in disaster management for Paris/France, the next two tables (Table 6 and ***Table 7***) provide an activity profile by mapping in greater detail *who* does *what*, *how* and *when* in the event of a disaster.

Table 6: French Public Sector DRR plan.

WHAT	WHO	HOW
Knowledge of the hazard	Ministry of the Environment Ministry of Agriculture (forestry)	Funding of scientific studies and technical and data acquisition.
Monitoring, Forecasting and warning	Ministry of the Environment Ministry of Agriculture Ministry of the Interior Ministry of Education	Specific human organization and equipment Territories in means and tools for surveillance and the forecasting of hydro-meteorological phenomena, marine-weather, hydrogeological, movements terrain, volcanism...
Information	Ministry of the Environment Ministry of the Interior Mayor	The Prefet establishes the DDRM. The mayor establishes the DICRIM. The Ministry of the Environment ensures national dissemination of information via the Internet. The Ministry of the Environment informs in real time citizens of the relative data monitoring, vigilance, and forecasting.
Education	Ministry of National Education Ministry of the Environment Ministry of National Education	Enrolment in programs. Network of coordinators with rectors National Risk Day. Training of risk management professionals, building, development, etc.
Taking risk into account in the Urban development	Ministry of the Environment Ministry of Housing Mayor	Implementation of risk management flood plans (PGRI). Establishment of prevention plans Risk (PPR). Compliance with national prevention regulations seismic risk (seismic zoning, seismic construction), monitoring compliance with the rules. Consideration of risks in documents urban planning and legality control
Mitigation	Ministry of the Environment Ministry of Housing Communities	Training of professionals (architects, engineers, craftsmen). Financing of seismic reinforcement work of vulnerable buildings in the West Indies. Funding for vulnerability reduction work floods.

		Realization of hydraulic works (retention basin, dynamic slowdown systems, etc.) Realization of vulnerability diagnosis and work. Vulnerability reduction (cofferdam installation). Relocation of assets and activities outside the risk areas.
Crisis preparedness	Ministry of the Interior Mayor	The civil protection services or the mayor prepare for the crisis.
Crisis management	Ministry of the Interior (Prefect) Mayor Departmental Fire Department and Rescue (SDIS)	Mobilization of resources (civil servants, services), public, communal reserve of civil security
Return on experience	Ministry of the Environment Ministry of Housing Ministry of the Interior	Disaster Analysis Missions (REX). Capitalization of all data allowing improve knowledge of risks, improve management and prevention plans, to revise the planning documents, etc.
Indemnification	Natural Disaster Commission (Ministry of the Economy, Ministry Department of Environment, Department of the Interior, Caisse centrale reinsurance)	Once the natural disaster order has been issued, the insurance companies set up a special procedure Compensation

While the Table 6 focuses on what steps need to be taken by whom in the different phases of disaster management, ***Table 7*** offers an overview of the most common hazards affecting the city of Paris and alongside the more concrete actions, plans and strategies for the prevention of and response to the related emergencies.

Table 7: Overview of most common hazards affecting Paris and corresponding actions.

Natural and man-made hazards affecting the city of Paris	Actions and plans for prevention and response to related emergencies
Flood	• The flood risk prevention plan (Plan de prevention du risqué d'inondation, PPRI) following the European Directive 2007/60/EC. • The local urban plan of Paris (Plan Local d'Urbanisme, PLU), which integrates the PPRI. • The flood prevention action program (Programme d'action de prevention des inondations, PAPI) for the Seine and the Marne department aims at reducing the vulnerability of the city of Paris to the risk of flooding.

	• Additional measures, such as the construction of dams controlling the overflows of Seine and its tributaries.
Drought	• Monitoring of the weather and of water levels. • The Eau de Paris authority, responsible for supplying drinking water to the city, distributes 480,000 m^3 of water every day. • Water from the Seine and the Marne rivers is stored in drinking water treatment plants and is distributed with consumption restrictions in case of a drought.
Storm	• In case of strong winds, authorities prohibit citizens from accessing parks and groves. • Messages are broadcasted to citizens through messages, the city of Paris website and social media. • After the storm, authorities remove debris and fallen trees, with priority for major avenues.
Extreme temperatures	• Extreme weather forecasts are issued in cases of extreme temperatures. • There is a winter emergency plan, in force from November to March, and a heatwave plan in force, from June till August. • Protection guidelines are issued for vulnerable groups e.g., elderly people or people with disabilities. • Citizen awareness is raised through a well-developed communication system
Technological accident	• In case of an accident to an ICPE (Installation Classee pour la Protection de l'Environment), the authorities of the city, along with the urban ecology agency, issues protection measures for the potentially affected population and orders the cessation of the activities of the ICPE.
Transportation accident	• In case of a transportation accident the urban transportation plan of the Ile-de France Region (Plan de deplacements urbains d'Ile de France, PDUIF) is activated. • The Chamber of Commerce and Industry of Paris (Chambre de commerce et d'industrie de Paris, CCIP), along with major transportation companies, launch protection campaigns for the population, regarding transportation risks. • Messages are distributed to the population for information purposes, in case of an accident. • Proper maintenance of canals is ensured for the safety of river traffic.
Transportation of dangerous goods	• Specific regulations are integrated in the PLU and applied to pipeline transport. • Speed and other restrictions are applied to vehicles containing dangerous goods. • The Fire Brigade is responsible for the response to such incidents with its adequately equipped vehicles.
Risk to power and gas network	• Companies managing the power and gas network i.e., ERDF (electricite reseau distribution France), GRT Gaz and GrDF (for the management of gas pipelines) and the Paris district heating company CPCU (compagnie

	Parisienne de chauffage urbain) have internal operation plans (plan d'operation interne, POI) to manage potential incidents
Nuclear risk	• The Interministerial circular No. DGS/DUS/DSC/2011/64 of July 2011 controls the provision of potassium iodide tablets to the affected population, especially those not covered by an intervention plan (PPI). • The establishment, responsible for the response to health emergencies (L'etablissement de preparation et de response aux urgences sanitaires, ERPUS), suggests that each prefecture, with the assistance of the respective municipalities, is competent for the organisation and the methods of provision of these tablets.
Biological risk	• The city has a business continuity plan (Un plan de continuite d'activite, PCA)

3.1.2. IDENTIFIED STAKEHOLDERS/END-USERS RELEVANT FOR THE REGION OF ATHENS/ GREECE

In analogy to the analysis of stakeholders and end-users for Paris/France, ***Table 8*** presents the identified relevant stakeholders and end-users for the region of Athens/Greece, listed schematically in accordance with the subdivision introduced in chapter 3.1.

Table 8: Stakeholders identified for Athens/Greece, sorted by level of responsibility.

First Layer	Second Layer	Third Layer
Administration	Greek Government	
	Ministry of Climate Crisis and Civil Protection	General Secretariat for Climate Crisis and Civil Protection
	Ministry of Education & Ministry of Development (General Secretariat of Research and Innovation)	National Observatory of Athens, National Research and Technology Network, National institution of Research, National Center for Natural Sciences Research "Democritus", Hellenic Center for Marine Research, Renewable Energy Center
First Responders	Civil Protection	112
	Military	General Staff of National Defense
	Police Headquarters	General Police Directorate of Attica
	Fire Department Headquarters	Regional Fire Department of Attica Volunteer Firefighters
	Municipality services	Municipal Region of Attica National Centers for Emergency Aid (EKAB)

	Voluntary First Responder Organizations	Forest Prevention Action-FPA Forest Firefighting Action-FFA Urban Firefighting Action-UFA First Aid Action-FAA Search and Rescue-SaR Aid and Support Action-ASA Com Support Action-CSA Psychological Support Action-PSA Public Awareness Action-PAA Relief and Support Action-ReSA Transportation Action-TRAct Shelter Monitoring Action-SMA
	Ministry of Education	Teachers at schools & Kindergartens
Communities	Ministry of Health	Staff at hospitals
	Ministry of Education	Staff at churches
	Critical entities (infrastructures)	Energy, water, food, health, economy, public safety, transports, industry, nature, defense, information and communication technologies
	Vulnerable groups	Low income, children, elder, pregnant, homeless, physical disabled, migrant and refugees

The National Center for Natural Sciences Research "Democritus"[11]

Founded in July 1961 as a Research Centre for Nuclear Research, Demokritos is today the largest multidisciplinary Research Centre of Greece with approximately 180 Researchers in tenured and tenure-track positions and over 500 Research Personnel working in projects funded mainly by grants from State Funds, the European Union and Private Industries.

The Centre consists of five independent Institutes focusing on different scientific fields. It is governed by the Board of Directors and is supervised by the General Secretariat of Research and Innovation, which is in the Ministry of Development & Investments.

[11] See https://www.demokritos.gr; [last access: October 20, 2023].

Hellenic Police Forensic Science Division (FSD)[12]

Hellenic Police Forensic Science Division (F.S.D.) is the National Forensic Service of Greece and provides significant scientific support and assistance to the work of the Police, but also to the work of all Prosecuting Authorities and Law Enforcement Agencies.

Duties

- Investigation of the crime scene.
- Collection and utilization of marks and evidence with the employment of modern scientific equipment.
- Composition of expert opinion reports, by applying modern, scientifically proven, internationally acclaimed and legally admissible methods.
- Coordination of the forensic searches for the tracing of wanted criminals and the tracking of missing persons,
- Provision of professional education on the scientific and technical methods of forensic science to the personnel of the Division and other entities, in order to include forensic methods in their procedures.
- Provision of advisory role in fields of the Service's jurisdiction, e.g. composition of technical specifications for security documents, such as identity cards and passports.
- Humanitarian contribution of Forensic Sciences, such as the identification of victims of mass destruction/ identification of migrants' corpses/ family reunions.

International Cooperation – Co-Financed European Programs

The Forensic Science Division:

- Has access to the European Network of Forensic Science Institutes (ENFSI),
- Exchanges information among Member States of the E.U. via INTERPOL, EUROPOL, EURODAC, SCHENGEN Treaty etc.,
- Is represented by expert Officers in Working Groups of the E.U., for subjects in fields of Scientific – Forensic interest.

The Service actively participates in a multitude of co-financed programs of research and development in the field of security in cooperation with entities in a National and European level.

Hellenic General Secretariat for Civil Protection[13]

The GSCP belongs to the Ministry of Climate Crisis and Civil Protection. It is the Hellenic competent authority for the planning and set-up of the national policy and actions in matters of prevention, preparation, public information, management and mitigation of natural, technological and other major hazards.

[12] See https://www.astynomia.gr/hellenic-police/special-services/hellenic-police-forensic-science-division/?lang=en; [last access: October 20, 2023].
[13] See http://www.gscp.gr/; [last access: October 20, 2023].

The main areas of activity of GSCP include:

- Readiness of the personnel and means of CP (Civil Protection).
- Elaboration of the available scientific information for the mobilization of resources in case of emergencies.
- Coordination of response and recovery actions in emergencies.
- Coordination of emergency planning actions at national level.
- Cooperation with the competent authorities towards preparing regulations, codes and legislation in the field of prevention.
- Programming, based on the annual national civil protection planning, of the necessary annual provisions of means and human resources in cooperation with competent authorities.
- Monitoring and control of the Annual National Planning implementation at regional and local level in cooperation with competent authorities.
- Coordinate the distribution of State funds for CP to the local authorities.
- Preparation of special reports for every major disaster. Revisions, amendment and improvement of existing planning proposals are included.
- Operate a Civil Protection Operation Centre on a 24 hours basis.
- Assessment of information on weather forecasting and other precursory phenomena related with natural hazards, for the early notification and warning of the competent authorities and the general public.
- Public information and awareness.
- Organization and promotion of volunteer organizations work in the field of CP.
- Support and promotion of the research, education and training in the field of CP.
- Promotion of the country's relations with International Organizations and CP authorities, including representation in International Organizations.
- Coordination of the assistance provided to Greece and assistance provided to other countries.

Joint Coordination Center for Operations and Crisis Management

Establishment – Mission

The Joint Coordination Center for Operations and Crisis Management (E.S.K.E.D.I.K.) of the Hellenic Police Headquarters, was established with the provisions of Law 4249/2014 (A΄73/2014) and as they were replaced by the art. 231 of Law 4281/2014 (A΄160), in the context of which the Crisis Management Directorate and the Joint Operations Center of the Headquarters were merged, in order to ensure the immediate and more complete coordination and guidance of the Greek Police Services in dealing with emergencies and internal security critical incidents.

With the provisions of the Presidential Decree 178/2014, is defined as a central Service of the Hellenic Police Headquarters, which operates at Directorate level, is supervised and controlled by the Deputy Head of the Corps and its mission consists of:

- The coordination and the achievement of the interoperability of the Greek Police Services, to deal with all forms of crime and especially organized crime.

- The staff planning, organization and testing of the critical incident handling system of the Hellenic Police.
- Adherence to operational response plans.
- The advisory support of the management structure of critical incidents during their management. The provision of advisory support to the political leadership of the Corps, in cases of generalized internal security crises at national level, whether the main responsibility for response belongs to the Greek Police, or it functions in support of another competent body.

Structure

The E.S.K.E.D.I.K. is structured in four Departments:

1. Department of Coordination, Administrative and Technical Support
2. Department of Operational Planning, Cooperations and Exercises.
3. Operations Center.
4. Surveillance systems recording.

Responsibilities

The E.S.K.E.D.I.K. is a purely staff and advisory body, which does not manage operational or communication critical incidents or emergency situations, the responsibility of specific Corps Services, which institutionally have the main operational responsibility for response, or act in support of other Bodies or Authorities.

On the basis of the above institutional operating framework and the multi-level responsibilities arising from it, the E.S.K.E.D.I.K. participates in a number of actions, with the aim of advisory support, of all levels of administration and critical decision-making bodies of the Hellenic Police.

– Elaboration of Special Operational Plans

The responsibilities of the E.S.K.E.D.I.K. include the preparation, observance and constant updating of the Special Operational Plans, safety training manuals and Standard Safety Procedures (S.D.A.), in cooperation with the respective relevant central and regional Services of the Greek Police:

✓ Incident and Crisis Management System of the Hellenic Police, with the code name "POLYDEFKIS".

✓ Special Operational Plan for dealing with CBRN threats, under the responsibility of the Hellenic Police, under the code name "THISEAS".

✓ Special Operational Plan for Dealing with Hostages and Crises with the code name "NIKIAS".

✓ Assistance and advisory support, to the competent Services of the Greek Police or to other bodies, for the preparation of operational security plans.

– Preparation of Vulnerability Assessments

The E.S.K.E.D.I.K. is responsible for the preparation of vulnerability assessments of vital facilities and critical infrastructures of police interest, as well as the provision of directions and instructions to the competent Services of the Hellenic Police, as well as to other services, organizations and utilities, to draw up protection

plans and take necessary security measures for their facilities. In this context, the formation (as the case may be) of the Permanent Interdepartmental Working Group is also included.

– Police Training – Organization of Exercises

The E.S.K.E.D.I.K., in the context of the preparation of the police response mechanism, takes care of the preparation of manuals and memoranda of basic actions of the first police response, as well as the preparation of special training programs, with the aim of training both the students of the Schools of the Police Academy, as well as the other staff of the Hellenic Police Services.

– Organization of Greek Police Negotiators Team

The E.S.K.E.D.I.K. has the institutional responsibility for the formation, planning, organization and expansion of the Negotiators Team, as well as basic and conservative training in collaboration with the special training team and the competent Directorates of the Headquarters. The Negotiators Team, as an operational arm in dealing with hostage incidents and crises, is a strategic choice of the Hellenic Police Headquarters. For its long-term use, it is constantly updated and revised, based on assessments of actual events, international practices and collaborations, the results of the Plan's test dealing with Hostages and Crises, as well as the utilization of modern operational equipment.

The electronic database and the Special Register of Negotiators are maintained by the Department of Operational Planning, Cooperation and Exercises of ESKEDIK, which cooperates with the relevant Directorates for the participation of negotiators, both in training programs of foreign Security Agencies, as well as other institutionalized agencies, with the aim of transferring and exploiting relevant know-how and experience.

– Cooperation at National and International Level

Through the development of cooperation with domestic or foreign Services, Centers or other Agencies, the development of a more general two-way process is sought, with respect for the distinct and institutional role of each involved, both for everyday issues (exchange of know-how and experience, planning and organization of joint preparedness and training exercises programs, assessment of actual incidents, etc.) or during the management of critical incidents and emergency situations, as well as in the context of developing cross-border collaborations through joint trainings, conducting Readiness Exercises, etc.

– Operations Center

The ESKEDIK Operations Center, based on its institutional operating framework and the obligations arising from it, ensures the immediate hierarchical information of the Hellenic Police Leadership, through the continuous reception and transmission of operational information.

In order to ensure the successful and safe conduct of large-scale police operations throughout the territory, to deal with emergency and very serious incidents, which can develop into internal security crises, it provides immediate hierarchical information on their development and management.

In this context, it ensures the coordinated, timely and effective mobilization, guidance, supervision and control of the central and regional Services of the Corps, through the direct transmission of the leadership's directions and orders at the political, strategic, operational and tactical level, as well as to ensure the operational coordination of the action of the Corps Services, in the execution of operations and the implementation of special security plans and memoranda of actions.

The Operations Center of the E.S.K.E.D.I.K. is interconnected with the corresponding Operations Centers of Emergency Response Agencies and provides them with all the necessary assistance, during dealing with natural disasters and other emergency situations under their jurisdiction, as well as managing related consequences.

Hellenic Fire Service

The Hellenic Fire Service is a special Civil Protection Corps, which is managed by its Chief and constitutes an operational structure under the General Secretariat of Civil Protection of the Ministry of Climate Crisis and Civil Protection, with competence that extends throughout the Greek territory.

The Hellenic Fire Service, as part of its mission, participates in dealing with any emergency that arises in times of peace or war, and in cooperation with the competent authorities and services, contributes to ensuring the civil protection and civil defense of the Country.[14]

Its main mission is:

- The safety and protection of life and property of the citizens and the State, the natural environment, especially the forest wealth of the Country, from risks of natural and technological disasters and other threats.
- The responsibility and operational planning of dealing with fires and floods, as well as the provision of assistance for the rescue of people and material goods threatened by them.
- The responsibility for the conduct of the fire-rescue operations of the Civil Protection of the Country.

"Operational planning" includes actions that ensure early detection, notification, and intervention, in order to achieve an immediate and effective response not only to fires and the risks arising from them, but also to any risk from natural and man-made disasters.

Responsibilities of the Hellenic Fire Service

The Hellenic Fire Service, in order to fulfil its mission, is exclusively responsible, in particular for:

- Dealing with the consequences of natural, technological and other disasters, such as earthquakes, floods, chemical - biological - radiological - nuclear (CBRN), meteorological, hybrid threats, as well as the rescue of people and property at risk from the above-mentioned disasters. For this purpose, it utilizes available scientific data and information, prepares, organizes, and mobilizes firefighting forces, means and equipment and requests the assistance of other authorities, services and agencies.
- The rescue and provision of assistance to persons whose life and physical integrity are threatened or exposed to danger by any type of accident, such as air, rail, traffic, work, accidents from entrapment in elevators or other places and facilities, from blockades in inaccessible mountainous

[14] See: https://www.fireservice.gr/el_GR/apostole-armodiotetes; [last access: October 17, 2023].

areas, caves, as well as the notification of the competent services for their transfer to institutions providing medical assistance or care.

- The preservation and protection of social security from the crimes of arson and flooding.
- The establishment and control of the implementation of fire protection legislation.
- The operational coordination and cooperation of all co-competent services in the context of the implementation of the National Civil Protection Planning of the Country at national, regional and local level.
- The provision of special fire protection services and firefighting cooperation, through the conclusion of contracts and program agreements with public and wider public sector bodies, research or other institutes, bodies, companies and organizations of the private sector of the Country or abroad.
- The certification of volunteer firefighters and are active in the context of the mission of the Hellenic Fire Service, as well as the fire safety personnel of businesses and other entities.
- The monitoring, management, and utilization of European or other programs and resources at national, regional, and local level.

To fulfill its mission, the Hellenic Fire Service carries out the appropriate policies and outreach actions with the aim of raising awareness and informing the public through lectures, publication of brochures, broadcasting of television and radio broadcasts and broadcasting of messages in the press, on the internet and online social media.

In the spirit of international solidarity, the Hellenic Fire Service provides assistance to other countries, within the framework of applicable international agreements and the obligations arising from European and international law.

Directorate of Civil Protection of the Region of Attica

The establishment of the Regional Administrations of Greece defines the administration of the State based on a decentralized system. The "Region of Attica" is an autonomous administrative unit responsible for the planning and organization, in matters of prevention, information and response to disasters or emergency situations in accordance with the existing legislation, as well as for the coordination of all Services, to ensure preparedness, response to disasters and the restoration of damages in its respective territory.

In addition to the Hellenic General Secretariat of Civil Protection, who has the responsibility of coordinating and supervising the work of civil protection throughout the territory, decentralized bodies for the planning and implementation of civil protection measures are the General Secretaries of the Regions. Under the Law 3013/2002, regional Directorates of Civil Protection are established, which are under the supervision of the Secretary General of the respective Region[15].

[15] See: FEK-2002-Tefxos A-00102-downloaded -17_10_2023.pdf; [last access: October 17, 2023].

Responsibilities of the General Secretary of the Region:

1. The General Secretary of the Region has the following responsibilities:

- It coordinates and supervises the work of civil protection for the prevention, preparedness, response, and recovery of disasters.
- He is responsible for the implementation of the annual national civil protection planning, according to the part that refers to the program, measures and actions concerning his Region.
- It formulates proposals for the design of civil protection, in relation to programs, measures and actions, which refer to its Region. These proposals are submitted to the General Secretary of Civil Protection in order to be the subject of the recommendation, for the annual national planning of civil protection, by an Interministerial Committee.
- Recommends to the Secretary General of Civil Protection the issuance of the decision to declare a state of emergency of civil protection, in the case of local disasters, and issues decisions declaring a state of emergency, in the case of local disasters of low intensity, after prior authorization by the Secretary General of Politics Protection.

2. At the headquarters of each Region, a Directorate of Civil Protection is established, which reports directly to the General Secretary of the respective Region.

3. The above Directorate, which is responsible for the planning and organization, in matters of prevention, information and response to disasters or emergency situations, as well as for the coordination of all the services of the region, and the public, private potential and means, to ensure preparedness, deal with disasters and restore damages, is made up of two departments:

a. Department of Planning and Prevention

b. Disaster Response and Recovery Department.

4. Each Directorate of Civil Protection of the relevant Region, is staffed with permanent employees, which may belong to the disciplines of Geologists, Topographical Engineers, Foresters, Chemical Engineers, Chemical Engineers and Civil Engineers. These employees, after previous training, are qualified officers of civil protection of the Region. For the above qualified civil protection officers, their reassignment is not permitted for a decade from their appointment. It is also not possible to move them to another organic unit of the Region.

5. The National Centre for Emergency Aid (EKAB), the exclusive Greek EMS organisation, is entirely funded by the government under the supervision of the Ministry of Health and consists of 12 EKAB stations covering 96,2% of urban areas with Emergency Medical Health Care. EKAB plays a key role in supporting primary care and acting as a gateway to more specialized care through the provision of more than 740 basic life support ambulances and 174 Mobile Intensive Care Units. All EKAB stations and substations provide medical staff administrators and a call centre (Kotsiou et al., 2018, pp. 2–5).

Hellenic Rescue Team[16]

HRT (Hellenic Rescue Team) is a Non-Governmental Organization, whose members participate in Search and Rescue missions on a voluntary basis since 1994. In addition to the operational department, the Hellenic Rescue Team has established the Department of Research and Technology whose purpose is to introduce new technologies in the context of its operations.

The mission of the Hellenic Rescue Team is:

- To provide aid to the whole of society in the form of humanitarian missions, provision of first aid, supporting life, preventing dangers, preparation and education on search and rescue work in Greece and abroad through the Team's branches, in situations of:

1. Emergencies and national need, to combat disasters and serious environmental dangers, such as earthquakes, entrapments (snow, floods, fires, missing persons investigations especially in mountain and sea zones, collapsed buildings and open areas). The Team can provide aid in the form of human resources and technical equipment to anyone who requests it, as part of a rescue operation outside of Greece too.
2. Natural disasters (earthquakes, floods, avalanches, etc.).
3. Man-made disasters (fires, mass accidents, etc.).
4. Man-made crises (wars and their repercussions).
5. In every other exceptional situation comparable with a natural or man-made disaster.

- The provision of emergency humanitarian, food, development and every other form of aid, such as restructuring and rehabilitation for the populations of third and, especially, developing countries, as well as taking initiatives to contribute to the economic and social development of these countries. This may be in collaboration with the Directorate General of International Development Cooperation-Hellenic Aid and the National Advisory Board for NGO issues of the Ministry of Foreign Affairs, or the Ministry of Economy, the Ministry of Education, the Ministry of Defence, the Ministries of Development and Health and Welfare, etc. as well as the Inter-Ministerial Committee for the Organization and Coordination of International Economic Relations. Such actions will be taken through Bilateral Development Cooperation programs and the aid and foreign relations programs of the European Union, the DAC and other multiparty international organizations or international cooperation agencies, especially programs that are funded by the European Community Humanitarian Office (ECHO). The implementation of these programs by the HRT's members can be done in collaboration with a dependable local partner or through the mobilization of the local community.

- Conducting research primarily into applied technology and the experimental development of innovative methods, products and services in the following fields: 1) technology and equipment for rescue, prevention and safety; 2) IT, telecommunications and robotics; 3) medicine, particularly for first aid and treating wounds; 4) innovative technologies and improvements to means of transport that can be used in rescue situations and disasters (vehicles, floating, submarine and airborne means); 5) technologies and methods for countering extreme weather phenomena and environmental destruction (prevention, weather forecasting, monitoring, etc.); 6) any other field that may contribute to the HRT's mission.

[16] See: https://www.hrt.org.gr/our-mission.en.aspx; [last access: October 17, 2023].

- The provision of social services, aid, and financial assistance to support vulnerable social groups and people with disabilities.
- Strengthening social awareness and the spirit of voluntary work among the public and different population groups, through information campaigns, promotional activities, education and awareness raising.
- The creation of a training centre and academy wherever and in any possible form, with the objective of rescue and training in first aid, life-saving, mountaineering, hiking, skiing, mountain climbing, the handling of speedboats, sailing vessels, survival at sea, diving with or without breathing equipment using compressed air or gas mixtures, handling of snow vehicles, special rescue and non-rescue vehicles, handling of experimental machinery or vehicles, training and handling of rescue dogs, use of specialist rescue equipment, joint operation with airborne means, simulation exercises, extrication with a rescue lift, etc. in which our members, members of other associations, government agencies, foundations and all other interested parties may participate.
- The creation of bases of operational preparedness, branches for the provision of aid in situations of emergency need in Greece and abroad, which will support the HRT's immediate and rapid response.
- Strengthen social awareness and the spirit of voluntary work also through the branches.
- Provide aid during operations for prevention and preparations for countering disasters, in similar situations, to search and rescue operations.
- Holding related events, conferences, seminars, excursions and leisure activities in which our members, members of other associations, government agencies, foundations, vulnerable social groups, people with disabilities and all other interested parties may participate.

HRT provides aid without any racial, religious, political, economic, social, or other type of discrimination.

Mission of HRT's Department of Research and Technology

The purpose of the HRT's Department of Research and Technology is to propose and manage subjects in the areas of technical communications, IT, electronic equipment as well as to introduce new technologies within the framework of HRT's operations. Moreover, it designs and develops innovations and improves the existing electronic and information technology systems.

The Department's activities include, among other things, the creation and development of pioneering and innovative technological products and services as well as the design and management of the HRT's nationwide radio network, in order to cover long-distance telecommunications needs, thus securing the ability for up-to-date and quality communications. At the same time, the Department develops software and internet applications and manages the HRT's information systems while also performing statistical analysis and data documentation.

Some of the Department's most important achievements thus far are:

Design and development:

- Autonomous mobile telecommunications system using VHF (very high frequency)/UHF (ultra high frequency)

- Repeaters and transponders throughout Greece

- Micro-cameras for searching among ruins

- Point-to-point microwave radio link

- Remote control for electrical loads

- Mobile Voice and Data telecommunications system using HF (high frequency)/VHF/UHF

- Unified database of personnel and equipment

One particularly important milestone in the Department's history has been the development of the "HERMES" mobile operations telecommunications centre, which was equipped thanks to a donation from Cosmote. This vehicle has contributed to all the HRT's search and rescue operations.

Finally, in the past few years the HRT has participated in **European research programs** whose goal is the use and/or development of new (or existing) technologies and procedures that would be useful in dealing with emergency needs. [17]

3.1.3 IDENTIFIED STAKEHOLDERS/END-USERS RELEVANT FOR THE REGION OF VIENNA/ AUSTRIA

As in the previous sections, ***Table 9*** gives an overview of the most relevant actors in disaster management that were identified for the city of Vienna in Austria, before providing an activity profile of these actors to demonstrate their roles and responsibilities in the event of a disaster.

Table 9: Stakeholders identified for Vienna/Austria, sorted by level of responsibility.

First Layer	Second Layer	Third Layer
Administration	Austrian Government	
	Ministry of the Interior	Department for crisis management, situation information and control centre matters
	Federal Ministry for Climate Protection, Environment, Energy,	

[17] See: Research and Technology (hrt.org.gr); [last access: October 17, 2023].

	Mobility, Innovation and Technology	
	Ministry of Defence	Disaster Relief Unit of the Austrian Federal Army
	Municipal Administration of Vienna	• Municipal Department 68 - Professional Firefighters and Civil Protection Vienna • Municipal Department 70 – Professional Emergency Service Vienna • Crisis Management of the City and federal state of Vienna • Die Helfer Wiens – Network of First Responder Organizations in Vienna • Acute care Vienna
First Responders	Civil Protection	
	Military	
	Police	Vienna State Police Directorate
	Municipality services	Professional Firefighters Vienna (MA68) Professional Emergency Service Vienna (MA70)
	Voluntary First Responder Organizations	• Österreichisches Rotes Kreuz • Johanniter-Unfall-Hilfe Österreich • Arbeiter-Samariter-Bund (ASB) • Grünes Kreuz • Sozial Medizinischer Dienst Österreich (SMD) • Malteser • Local voluntary firefighter associations (outside of Vienna) • Water rescue service • Mountain rescue service
Communities	Ministry of Education	Teachers at schools & Kindergartens
	Ministry of Health	Staff at hospitals
	Ministry of Education	Staff at churches
	Critical entities (infrastructures)	Energy (Wien Energie), water (Wiener Wasser; Vienna Canal), food, health (Vienna Health Association), economy, public

		safety, transports (Wiener Linien), industry, nature, defense, information and communication technologies
	Vulnerable groups	Low income, children, elder, pregnant, homeless, physical disabled, migrant and refugees

Ministry of the Interior (MoI) (BUNDESMINISTERIUM FÜR INNERES, n.d.a)

- Department for crisis management, situation information and control centre matters
- National crisis and disaster protection management (SKKM as a German abbreviation)
- Key player in Austrian disaster management

In Austria, the defense, elimination or alleviation of the effects of impending or occurring disasters (disaster relief, emergency preparedness) is predominantly a matter for the federal states. The legal basis is formed by the disaster relief laws of the federal states, which primarily determine the determination of the disaster and the official management of operations in the communities, districts and states.

In the event of crises and disasters, there is an increased need for coordination, which in Austria is guaranteed by the SKKM. The office is located at the MoI. The SKKM enables efficient disaster relief in Austria and abroad through the cooperation of all responsible federal agencies with the disaster control authorities of the federal states as well as the relief and rescue organizations.

Figure 1: State crisis and disaster protection management

Tasks of the National Crisis Committee SKKM

- Guidelines, principles and coordination of training and further education for staff work and call centres
- Guidelines, principles and coordination for a situation report including definition of standardized and event-related reporting processes
- Evaluation
- Shared Service Centre Communication and coordination platform of the central office
- National and international 24/7 contact point, especially in security police and immigration law matters
- National and international affairs of the Federal Warning Centre and alarm precautions including 24/7 contact point tasks
- Call centre of the central office
- Structured data collection in major incidents and information call centre
- Coordination board for crisis security and civil protection
- National and international civil protection and disaster relief issues
- National and international crisis security matters, provided that the competencies of other ministries or countries are not affected
- Crisis preparedness
- Crisis plans
- Development of crisis partnerships with crisis actors
- State crisis facilities (special objects)
- Affairs of fire departments as well as relief- and emergency organizations
- Training and further education in the context of disaster management, civil protection and crisis management
- Coordination board and quality circle for emergency call and control centre matters
- Matters relating to all emergency call channels to the police control centres
- Quality assurance and analysis
- Guidelines, principles and coordination of operational and organizational matters of the operations control and communication system (ELKOS as German abbreviation)
- Training and further education in emergency call and control centre matters
- Operational and organizational matters relating to the further development of the “emergency call” – NG112 (“Next Generation” emergency calls in accordance with European standards) (BUNDESMINISTERIUM FÜR INNERES, n.d.b).

Vienna State Police Directorate

The Policy Affairs Department is responsible for:

a) Basic specifications of the spatial and functional plans;

b) the approval of forms and the production of printed matter;

c) the organization and thematic preparation of intra-agency meetings and conferences in which the head of the agency takes part;

d) the coordination of civil protection matters;

e) the evaluation of statistics.

Social Media Department

Event-related tactical communication within the framework of the deployment of combined police forces (GSOD as German abbreviation) in cooperation with the command staff.

Department of General Operations Affairs

a) the planning and implementation of measures to deal with GSOD (large security police order service situations);

b) the planning, coordination and management of supra-regional operations - as long as these are not reserved for other organizational units;

Vienna Special Operations Unit (WEGA) is responsible for:

- Performance of special tasks within the framework of the GSOD (including special resources), such as nationwide support in law enforcement situations that can be classified in advance as semi-peaceful or non-peaceful and require the intervention of specially trained and equipped units, or the closed one;
- Deployment of officers specially trained for law enforcement; participation in the conduct of operations in the event of incidents involving radiation materials or chemical/biological warfare agents; participation in search, aid and rescue operations as part of general first aid;
- Function of a nationwide competence and information centre in matters of the large security police order service (GSOD);
- Ensuring uniform quality criteria nationwide;
- Development of training regulations, the implementation and coordination of nationwide training courses, as well as special training courses related to the GSOD, in consultation with the BMI II/2 specialist department;
- Nationwide implementation and optimization of the preservation of evidence in GSOD operations; police service dog unit.

State Office for the Protection of the Constitution and Combating Terrorism

The State Office for the Protection of the Constitution and Combating Terrorism is responsible for issuing orders to the police commissioners to monitor meetings and, on its own, for managing the GSOD at meetings that are likely to pose a threat to public peace, order or security on a large scale.

Regional Police Commissariats

The Regional Police Commissariats are responsible for matters relating to events, unless the weapons and events department is responsible, such as issuing notices ordering or authorizing special surveillance services, provided that the surveillance is not initiated by a central office, and issuing decisions based on these notices (Bundesministerium für Inneres, n.d.).

Ministry of Defence

The Austrian Ministry of Defence is the ministry responsible and superior for the Federal Army. Among other things, it is responsible for matters relating to defence policy contributions to international crisis management. The Ministry of Defence is also responsible for crisis communication agendas as well as media analysis, media monitoring and documentation (Parlamentsdirektion, 2019).

Austrian Armed Forces

The tasks of the Austrian Federal Army are regulated in § 2 of the Defense Act 2001[18].

The Federal Army is also responsible, beyond the area of military national defence, for protecting the constitutional institutions and their ability to act and the democratic freedoms of the residents, as well as maintaining order and security internally, as well as providing assistance in the event of natural disasters and accidents of an extraordinary extent.

Unless independent military intervention is permissible, assistance missions are only to be carried out to the extent that the lawful civil authority requires the cooperation of the Federal Army.

The requirements for an assistance mission state that all federal, national and local authorities and bodies within their respective spheres of activity are entitled to call in the Federal Army for assistance missions, provided that they can only carry out a task assigned to them with the cooperation of the Federal Army (Bundesministerium für Finanzen, n.d.).

Disaster Relief Unit of the Austrian Federal Army

The "Austrian Forces Disaster Relief Unit" (AFDRU) is the disaster relief element for "Urban Search and Rescue" (USAR) of the Austrian Armed Forces. AFDRU is only set up when necessary from active and militia volunteers and is supplemented, if necessary, by civilian specialists such as rescue dog handlers. The responsibility for the deployment and formation of AFDRU lies with the command of the NBC defence centre in Korneuburg (Bundesministerium für Landesverteidigung, n.d.).

Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology

Tasks:

- Analysis of the crisis situation
- Instruments for risk prevention and crisis management energy nationally and internationally; Handbook for Crisis Preparedness Management Energy Matters relating to the enforcement of the Energy Control Act;
- Energy Steering Advisory Board Implementation of the EU regulation on risk prevention in the electricity sector;

[18] See: https://www.ris.bka.gv.at/eli/bgbl/i/2001/146/P2/NOR40218172 [last access: October 31, 2023].

- Implementation of the EU regulation to ensure secure gas supplies;
- Enforcement of the Petroleum Stockpile Act, representation in various European working groups as well as the BKA's hybrid threats working group for the energy sector, national and international crisis exercises;
- Creation and updating of the supply security strategy in accordance with Section 88a ElWOG.

Consultations take place in advance with experts from the regulator, the federal states, the affected energy suppliers and other stakeholders.

Development of a regulation, possible adaptation of the prepared regulation ("drawer regulations").

- Advice to the Federal Minister for Climate Protection, Environment, Energy, Mobility, Innovation and Technology in the Energy Steering Advisory Board. The advisory board includes 3 representatives from the BMK, 1 representative each from the Federal Chancellery (BKA) as well as the Federal Ministry for European and International Affairs (BMEIA), the Federal Ministry of Finance (BMF), the Federal Ministry of the Interior (BMI), and the Federal Ministry for National Defence (BMLV), the Federal Ministry of Labour and Economic Affairs (BMAW) and the Federal Ministry of Agriculture, Forestry, Regions and Water Management (BML), 2 representatives each from the Austrian Chamber of Commerce, the Austrian Chamber of Agriculture, the Federal Chamber of Labour, the Austrian Trade Union Confederation and the Industrial association, 1 representative of E-Control, 1 representative of each of the states, 1 expert each in the fields of the mineral oil industry, energy trading and gas and heat supply, 1 representative of Austria's e-economy, each 1 representative of the parties represented in the main committee of the National Council. A key task of the Energy Control Advisory Board is to discuss whether the requirements for the application of control measures in accordance with Section 4 EnLG 2012 are met.
- Present the ordinance to the National Council and obtain the approval of the main committee.
- If there is imminent danger, regulations that require the approval of the Main Committee of the National Council must be issued at the same time as the application for the approval of the Main Committee of the National Council.
- After approval, the issue and announcement take place.
- After three months, the Federal Minister for Climate Protection, Environment, Energy, Mobility, Innovation and Technology must submit a report to the National Council on the functioning of the measures taken, thereafter at two-month intervals.
- The regulations expire ex lege six months after their issuance.
- If an end to the crisis situation is not yet foreseeable after six months, the regulation can only be extended for a further six months with the consent of the Main Committee of the National Council.
- Once the circumstances giving rise to it no longer apply, the regulation must be repealed immediately (see Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology, n.d.)

Crisis Management of the City and federal state of Vienna

Crisis management of Vienna becomes the active coordinator when a large number of emergency services, departments and other organizations work together.

Tasks:

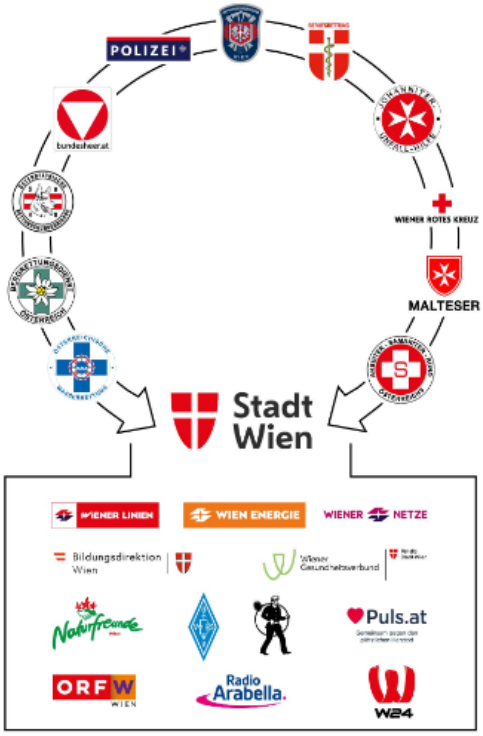
- Creation and management of the disaster protection plan - including the so-called "resource file", a database with all information important for a disaster response (addresses, telephone numbers, etc.)
- Development and updating of operational plans at crisis management level
- Organizational management of the warning and alarm system as well as the BOS-AUSTRIA digital radio system for the state of Vienna
- Organizational management of Akut Betreuung Wien (ABW)
- Execution of the internal security agendas of the City of Vienna Municipal Council
- Organization and execution of operational exercises such as evacuation of a ship, mass casualty incident or evacuation of buildings and subway trains (Aufgaben des Krisenmanagements der Stadt Wien, n.d.).

The "K-Circle" (in German “K-Kreis”)

The “K-Kreis” is a globally unique association focused on the topic of security. It consists of all Viennese emergency services and aid organizations, all security-relevant departments of the City of Vienna, companies affiliated with it and private partners.

The "K" stands for disaster relief, disaster protection, communication and competence.

In the event of an emergency, the “K-Kreis” guarantees the Viennese population rapid, highly professional and well-organized help at any time (Stadt Wien, n.d.).



Emergency organizations
Acute care Vienna
Workers' Samaritan Association Austria - Regional Association Vienna
Mountain rescue service Austria - Vienna/Lower Austria
Vienna professional fire department
Vienna professional rescue service
Johanniter Accident Help
Municipal Directorate / Crisis Management and Security
Municipal Directorate / Emergency Measures Group
Malteser Hospitaldienst Austria - Vienna area
Austrian rescue dog brigade - Vienna regional group
Austrian Water Rescue - Vienna Regional Association
Austrian Armed Forces
Police - LPD Vienna
Vienna Red Cross
Municipal companies
Education Directorate
Vienna Energy
Vienna Health Association
Vienna canal
Wiener lines
Vienna networks
Viennese living
Municipal departments
MA 15 - Health Service
MA 31 - Vienna Water
MA 33 - Vienna Shines
MA 40 - Social, Welfare and Health Law
MA 45 - Vienna waters
MA 46 - Traffic organization and technical traffic matters
MA 48 - Waste management, street cleaning and vehicle fleet
MA 49 – Climate, forestry and agriculture
MA 53 - Press and information service
MA 59 - Market Office
MA 60 - Veterinary Services and Animal Welfare
City service
Friendly organizations and clubs
Nature Friends Vienna
Austrian experimental transmitter association
Puls Association - Association to combat sudden cardiac death
Viennese chimney sweep

Figure 2: Vienna K-Kreis[19]

Acute care Vienna

Acute Care Vienna (ABW as German abbreviation) looks after those affected, relatives, friends and eyewitnesses directly on site in the first hours after an exceptionally stressful event.

This care is not only intended to help those affected acutely, but also to help prevent secondary illnesses such as post-traumatic stress disorders, addictions or depression.

The ABW consists of over 60 specially trained psychosocial professionals. These have around 600 missions per year. The ABW services are free of charge for those affected during an operation.

[19] See: Stadt Wien (n.d.) https://diehelferwiens.wien.gv.at/k-kreis; [last access: October 20, 2023].

The ABW is used in the following events, which are divided into 4 groups: the groups relevant to disaster and crisis management including tasks are:

Major damage events

- Railway, subway, tram, bus, elevator, cable car and ship accidents
- Plane crash
- Longer-lasting searches, for example when a child is drowning
- Operations by special police units, for example in the event of terrorist attacks or assassinations
- Hostage taking and prolonged raids
- Help for helpers in acute situations
- Care for helpers after traumatizing missions

Catastrophic events

- Natural disasters, for example earthquakes, floods, avalanches
- Various catastrophic and major damage events in a federal state - especially when residents of the respective federal state are affected - or throughout Austria, for example in the fire disaster in the Kaprun glacier railway![20]
- Major damage events with catastrophic consequences, for example fires, explosions, roof collapses
- Care for psychologically traumatized refugees and displaced persons

Planned large-scale operations

- Events in the past for example Love Parade, New Year's Eve Trail, UEFA EURO 2008TM [21]
- Coordinated exercises (Stadt Wien, Magistratsdirektion - Krisenmanagement und Sicherheit, n.d.)

Workers' Samaritan Association Austria - Regional Association Vienna (German abbreviation "ASBÖ")

The ASBÖ's tasks include rescue services, patient transport, health and social services as well as care for asylum seekers, assistance to the homeless and development cooperation. Even in the event of a disaster, the Samaritan Association is active at home and abroad with highly trained employees (Kammer der Steuerberater und Wirtschaftsprüfer, 2021a).

Mountain rescue service Austria - Vienna/Lower Austria

The Austrian Mountain Rescue Service is an aid organization that provides mountain rescue services in Austria. The area of responsibility mainly includes rescuing injured people from impassable terrain. We are deployed wherever the fire department, Red Cross, etc. are no longer able to help due to their equipment and geographical conditions (Österreichischer Bergrettungsdienst, n.d.).

[20] See: Stadt Wien (n.d.) https://presse.wien.gv.at/2000/11/13/akutbetreuung-wien-fuer-betroffene-der-katastrophe-in-kaprun; [last access October 31, 2023].
[21] See: Stadt Wien (n.d.) https://www.wien.gv.at/menschen/sicherheit/krisenmanagement/akutbetreuung/indikationen.html; [last access October 31, 2023].

Vienna professional fire department

The Fire Department and Civil Protection Department (MA 68) is part of the "Finance, Economic Policy and Vienna Public Utilities" business group of the Vienna City Council. As part of crisis and disaster management, the following tasks are their responsibility:

- Assistance in the event of fires and other emergencies caused by natural events
- Assistance for people and animals in difficult situations
- Perception of the disaster relief service in the areas of disaster protection, disaster alarm and disaster response
- Immediate measures in public emergencies
- Construction and other technical defects
- Radiation accidents
- Providing assistance upon request of authorities or other public services
- Management and maintenance of fire stations, alarm systems and EMS telecommunications cable network (Feuerwehr Wien, 2020).

Vienna volunteer fire departments

There are 2 voluntary fire brigades in Vienna. The voluntary fire brigades are alerted via the Vienna professional fire brigade's message center and, depending on the type of operation, respond to the area alone or in support of the professional fire brigade's emergency services. During large-scale or disaster operations, the fire departments are integrated into the alarm organization and are called upon to man other fire stations. The volunteer fire brigades are equipped with vehicles and equipment by the fire department of the city of Vienna (Stadt Wien, Feuerwehr und Katastrophenschutz, n.d.).

Vienna professional emergency service

The Vienna professional emergency service is the medical emergency organization of the city of Vienna. It is available around the clock, 365 days a year, to offer the city's citizens life-saving measures and optimal emergency first aid as quickly as possible in the event of medical emergencies (Stadt Wien, Berufsrettung Wien, n.d.).

Vienna Red Cross

Vienna Red Cross is a voluntary organization and part of the international red cross association. The Red Cross disaster relief service is available at any time for national and international operations. Numerous specialists with the latest equipment have set themselves the goal of helping people quickly in emergency situations. The tasks include, among others: medical assistance in the event of major accidents, care and accommodation after evacuation, food for evacuated people, training and further training of emergency experts, drinking water treatment, training and use of search dogs, missing persons search service and family reunification (ÖSTERREICHISCHES ROTES KREUZ, n.d.).

Johanniter Unfall-Hilfe

The Johanniter are one of the world's leading aid organizations and look back on a history rich in tradition. Their tasks include medical assistance, social support, care and support, as well as training and further education in the areas of nursing and first aid. The research and development of offers of help for a healthy life in old age is just as much a part of their tasks as foreign and disaster aid and the search for missing people with the rescue dog team. Johanniter provide short-term help in emergency situations as well as long-term support and can rely on a broad base of volunteers (Die Johanniter, 2022).

Green Cross (Grünes Kreuz)

The Green Cross - Rescue and Social Services Community GmbH serves the well-being of patients as a competent ambulance and rescue transport company in the areas of rescue and patient transport, ambulance services and intensive care transport (Grünes Kreuz, 2023).

Sozial Medizinischer Dienst Österreich

The Social Medical Service - SMD for short - is a non-profit organization that was founded in 1995 and serves the general public. The focus is on people and their individual needs. The SMD strives to protect the life and health of those who need assistance, without regard to political, ethnic, national or religious affiliation. This means that the association operates apolitically, non-denominationally and independently. In addition to rescue services, patient transport and mobile care, the SMD is involved in various social areas (Kammer der Steuerberater und Wirtschaftsprüfer, 2021b).

Municipal Directorate / Emergency Measures Group

The tasks include, among other things: checking hospitality businesses and event venues with regard to security requirements as well as breaking up illegal events and betting operations (Stadt Wien, Magistratsdirektion - Geschäftsbereich Organisation und Sicherheit - Gruppe Sofortmaßnahmen, n.d.).

Auxiliary Service of the Order of Malta -Section Austria - Vienna area

The name “MALTESER” brings together several MALTESER relief organizations that were founded by the Sovereign Knights of Malta and are subordinate to the Grand Priory of Austria.

The MALTESER has more than 2,200 volunteer members in Austria. These take care of the care of disabled people, they provide visiting services to sick and lonely people, support those affected by HIV and accompany terminally ill people and their relatives. They give young people inspiration and support through joint spiritual and charitable activities. In addition, MALTESER offers rescue and patient transport services, ambulances and first aid courses in some federal states.

In addition, MALTESER provides disaster relief in Austria and abroad if necessary. The Grand Priory of Austria is therefore a member of MALTESER International, the worldwide religious organization for humanitarian aid for people in need (MALTESER Austria, n.d.).

Austrian Rescue Dog Brigade (German abbreviation "ÖRHB") - Vienna regional group

The ÖRHB provides trained rescue teams for people in Austria and abroad who are in distress due to carelessness or suicidal behavior, avalanches, house collapses, as well as disasters such as earthquakes and the like.

They have special search teams trained for foreign operations. These teams are part of the AFDRU (Austrian Forces Disaster Relief Unit)[22] unit of the Austrian Armed Forces. These teams have to pass a special test in order to be prepared for missions abroad. We currently have 4 certified AFDRU teams in the ÖRHB (ÖRHB, 2023).

Austrian Water Rescue - Vienna Regional Association

Austrian Water Rescue - Vienna Regional Association is a voluntary aid and rescue organization whose activities are non-profit, non-political and not aimed at profit. The association's primary goal is to create and promote all measures that serve to combat drowning. This is done preventatively, by holding swimming and lifesaving courses, as well as by securing sporting events, swimming areas and other events on the water. Lifeguards, emergency divers and ship captains work hand in hand in emergency service (Österreichische Wasserrettung Bundesleitung, 2023).

Wien Energie

Wien Energie is responsible for the legally compliant provision of basic energy supplies in Vienna. It is the largest energy service company in Austria. Wien Energie ensures that the city of Vienna and its surroundings are supplied with energy around the clock (Wien Energie GmbH, Wien Energie Vertrieb GmbH & Co KG, 2023).

Vienna Health Association

is responsible for medical hospital care services in Vienna. The Vienna Health Association is the largest healthcare provider in Austria and the backbone of healthcare in the city of Vienna. 30,000 employees work in 8 clinics and 9 nursing homes as well as the Ybbs therapy center to ensure that the residents of the federal capital receive the best medical, nursing and therapeutic care around the clock (Wiener Gesundheitsverbund, 2023).

Vienna Canal (Wien Kanal)

The purpose of the "Wien Kanal" company is to ensure the environmentally friendly collection and purification of wastewater. Accordingly, the purpose of the "Wien Kanal" company includes the planning, construction, maintenance and management as well as the further use of canals, sewer systems and sewage treatment plants as well as the necessary operating facilities including real estate, advice on wastewater

[22] See section "Ministry of Defense", page 2 of the present document

disposal matters and the inspection of existing wastewater disposal facilities (*V001-295 - Statut Für Die Unternehmung „Wien Kanal“*, n.d.).

Wiener Linien

Operating public transport in Vienna with the exception of the federal railways. There are emergency call facilities in all trains and on all platforms, consisting of a train emergency stop and an emergency call button, which can be used to contact the driver or the control centre (Wiener Linien, 2023).

Vienna networks

The distribution network operator Wiener Netze GmbH, a subsidiary of Wiener Stadtwerke Holding AG, ensures the smooth distribution of natural gas and electricity every day to around 2 million residents in Vienna, parts of Lower Austria and Burgenland. In addition, the Wiener Netze also operate the district heating network and a fiber optic network for the technical communication of the energy networks. Secure natural gas distribution Wiener Netze GmbH distributes natural gas to around 665,000 network customers via a distribution network that is around 4,682 kilometres long and around 122,500 house connections. In terms of throughput volume, the company is the largest natural gas distribution network operator in Austria. A 24-hour emergency service with specially trained employees, state-of-the-art regulation and control technology as well as innovative and sustainable pipe network renovation ensure a high level of safety and efficiency in natural gas distribution. Secure power supply Wiener Netze GmbH provides the cables and systems needed to bring electricity to customers. This includes around 3,700 kilometres of overhead lines, 19,000 kilometres of cables, 45 substations and over 10,700 network substations (Wiener Netze GmbH, 2023).

Wiener Wohnen

The company "City of Vienna - Viennese Living" manages, renovates and manages Vienna's urban residential complexes. This includes around 220,000 municipal apartments (including around 1,400 housing service apartments and 7,500 apartments under external management), 5,129 restaurants and over 47,000 garage and parking spaces (Stadt Wien - Wiener Wohnen, n.d.).

Municipal departments

MA 15 - Health Service: Whether it is about children's health, adult prevention or vaccination protection: the MA 15 - Health Service of the City of Vienna is responsible as the contact person for health questions.

MA 31 - Vienna Water: The MA 31 ensures a secure water supply for the city of Vienna. The tasks include the maintenance and expansion of the pipe network as well as the maintenance of spring catchments, the two high-source pipelines, 30 water tanks, pumping stations and water pipeline power plants.

MA 33 - Vienna Lights: MA 33 plans, builds, operates and maintains the lighting of streets, squares and paths, the illumination and effect lighting of buildings, the public clocks and the traffic light signals (traffic lights), wien.at Public WLAN, the location-dependent information system the city.

MA 40 - Social, Welfare and Health Law: With its social centres and the service point in TownTown, MA 40 is the point of contact for social and financial problems. Essential legislative and official approval and supervisory functions are carried out in social and health law.

MA 45 - Vienna waters: MA 45 – Vienna Waters is the responsible department for Vienna's surface waters and groundwater. The most important water bodies managed include the Old Danube, the New Danube (including the Danube Island), the Liesing, the Vienna River and the Vienna Woods streams. The MA 45 continually improves flood protection, particularly on the Danube, and maintains the water habitat in the spirit of natural conservation

MA 46 - Traffic organization and technical traffic matters: MA 46 carries out traffic planning and creates official regulations. It also makes an important contribution to road safety for all road users. This includes defusing accident hotspots through measures such as the regulation of 30 km/h zones, traffic lights or sidewalk advances, but also the coordination and control of construction sites. The "Safebike" campaign has become an annual benchmark for the road safety of single-lane vehicles. The state vehicle testing centre approves vehicle conversions and cooperates with 500 workshops in the statutory § 57a assessment ("Pickerl"). MA 46 also carries out expert work, prepares annual school route plans for primary schools and much more.

MA 48 - Waste management, street cleaning and vehicle fleet: MA 48 is responsible for waste management, street cleaning and the municipal vehicle fleet. Waste avoidance and waste separation are among the central goals of this municipal department.

MA 49 – Climate, forestry and agriculture: The MA 49 – Forestry Office and Agricultural Company of the City of Vienna manages an area about the size of Vienna. In addition to recreational areas in Vienna, MA 49 manages the city's spring protection forests in the Rax, Schneeberg and Hochschwab areas. The city has one of the largest agricultural operations in Austria, on whose land the MA 49 grows crops largely according to the guidelines of organic farming.

MA 53 - Press and information service (PID): Current information about the city on all channels - social media, print, videos and online n Contact point for journalists from home and abroad n Timely information in the event of crises and disasters.

The PID is in constant dialogue with people. It provides information about the latest news from the Vienna city administration and stories from city life. The PID also publishes numerous media for Viennese people: the monthly wien.at information sheet for all 950,000 households, the five wien.at Magazines with a free subscription, the Club wien.at, wien.at TV and the city's administrative portal www.wien.at.

MA 55 Bürgerdienst: The employees of the district community service are the good spirits of the districts. They always have an open ear for all concerns and quickly take action to remedy the situation. The mobile citizen service moves its office to heavily frequented places and residential areas. He also looks for damage and contamination. The dialogue centre is the city administration's modern telephone exchange and also manages the events database on www.wien.at. The city information centre in the town hall is the competent point for information and concerns. An important part of the Vienna service network. In order to be able to help citizens quickly, good cooperation with all specialist departments in the City of Vienna is important. Together with them, the citizen service creates a service network.

MA 59 - Market Office: In addition to managing Vienna's markets, MA 59 - Market Office is the city's consumer protection department. Unannounced, efficient hygiene controls in food establishments, from the

food industry to restaurants, are part of the agenda, as are controls in accordance with the trade regulations and other consumer protection regulations. The MA 59 - Market Office is responsible for food controls and sampling in all businesses in Vienna, trade controls in all sectors, from plumbers to builders, controls according to the opening hours law, the measurement and calibration law, the price labelling law and other consumer protection regulations, the administration and ongoing attractiveness of the Viennese Markets and approval of commercial and charitable street stalls.

MA 60 - Veterinary Services and Animal Welfare: Animal disease control and disaster control. The aim of MA 60 is to maintain the health of animals, prevent animal diseases and protect people from diseases that can be transmitted from animals to people, so-called zoonoses (Stadt Wien, Veterinäramt und Tierschutz, n.d.).

City service

Help, information about the city of Vienna and reports of illnesses or incidents: The Vienna City Service is the number 1 contact point for all Viennese (Stadt Wien, Stadtservice Wien, n.d.).

3.2 OPERATIONALIZING THE IDEA OF PANTHEON

In this chapter we provide a definition of several essential key terms relevant for the PANTHEON project, before presenting an easily understandable description of PANTHEON – both in pictorial and in text form. Operationalizing the idea of PANTHEON is crucial to create a common language and an understanding between different actors involved in the PANTHEON project such as technicians, developers, end-users, SSH experts and other stakeholders.

In addition to the introduction of the most important aspects of PANTHEON by means of key terms, the pictogram alongside with the easily understandable description of PANTHEON will hopefully help in conveying a consistent and readily comprehensible vision of the key features of the PANTHEON system, reducing the risk of misinterpretation.

The PANTHEON pictogram was developed to visually convey the project's significance. Instrumental collaborative efforts and the quest of excellence have risen the bar for the entire Pantheon team in the creation of the pictogram.

3.2.1 KEY TERMS OF PANTHEON

Disaster risk management refers to the systematic process of identifying, analysing, and reducing the risks associated with natural, technological, or human-made hazards. It encompasses the planning, coordination, and implementation of strategies and measures to mitigate the impact of disasters and enhance community resilience. Protecting lives, minimizing damages, and promoting sustainable development in disaster-prone areas is not really possible without identifying primary terms. In the context of disaster risk management, key terms play a crucial role in understanding and effectively addressing potential hazards and disasters. Clear and concise definitions help to grasp their significance in mitigating and responding to disasters.

Therefore, essential key terms of the PANTHEON project were collected and defined. These contain general terms, as well as specific terms that are related to risk assessment, mitigation, preparedness and planning,

recovery and reconstruction, disaster types, evaluation, etc. The list of defined key terms was added to the Appendix due to its length and can be found in Appendix A – List of Key Terms. The establishment of a coherent terminology makes it easier for the different project stakeholders coming from different fields and having diverse approaches and expertise to understand and manage the diverse aspects of the project. However, it is important to note that some key terms may overlap between groups, as disaster risk management is an integrated and multi-faceted field that requires comprehensive approaches. While this operationalization through the collection and definition of key terms was implemented with the work of T3.2 in mind, it is recommended to use the resulting list in all subsequent tasks of the project.

3.2.2 EASILY UNDERSTANDABLE DESCRIPTION OF PANTHEON

As described below in Chapter 3.3.1, one method of participatory governance in a project is *informing*. Infographics are an appealing medium to summarize the principles and goals of a project and bring them into an easily understandable form. Due to the simplicity and the absence of written language, they can also make the project and its ideas more accessible for people belonging to vulnerable groups, such as children, elderly persons, or persons who do not speak English or any of the languages in which informative material is distributed. As part of Task 3.2, a pictogram was therefore devised to function as a vision of PANTHEON in pictorial form (see Figure 3). In combination with the key terms listed in Chapter 3.2.1 and the short project description provided below the pictogram, it can serve as a simple introduction to the project and its key messages, which can be presented to stakeholders, end-users, and members of the community.

Figure 3: A vision of PANTHEON in pictorial form

PANTHEON is a digital platform for fostering a sense of community among residents, volunteers, and organizations involved in disaster management, as well as for helping to mobilize resources effectively during and after disasters, using a community participation approach.

PANTHEON aims to integrate strategies and measures to minimize the consequences of natural hazards and man-made disasters, to accelerate recovery efforts, to speed-up and increase urban resilience to existing hazards and risks such as extreme weather forecasts, wildfires, floods, earthquakes, technological accidents and traffic conditions, etc.

PANTHEON will establish a central hub for sharing critical data, related disaster preparedness, early warning systems for local citizens, response strategies and plans, facilitating real-time contact between community members and relevant stakeholders. It is a disaster risk management initiative, which emphasizes the importance of participatory governance models to effectively engage the community in all aspects of preparedness, response and recovery. Effective coordination and bundling of human and material resources to better recover is another main goal of PANTHEON.

Due to the implementation of cutting-edge technologies, PANTHEON will assist utilizing observation and sensor technologies to provide situational awareness and support to decision-making processes.

Improved risk assessment through evidence-based information, reduced vulnerability through well-developed safety and security guidelines, enhanced social resilience through capacity building- these are PANTHEON's overall goals.

3.3 METHODOLOGY AND PARTICIPATORY METHODS

To get an overview of existing participatory design methods, a literature review was conducted in which numerous texts dealing with this topic were researched. The central methods that resulted from an analysis of these texts is presented below and the empirical design implemented in PANTHEON is outlined in the subsequent section.

In the 1960s, an increased sense of social responsibility led to the constitution of a new movement of citizen participation. As a consequence, "community design centres aiming to offer design and planning services to enable the poor to define and implement their own planning goals, were established in the United States and the United Kingdom" (Sanoff, 2011, p. 11), and even nowadays, "[v]olunteer citizen participation continues to be one of the key concepts in American society" (Sanoff, 2011, p. 11). In the European context, participatory design was advanced in Norway in the 1970s by computer professionals, union leaders, and members of the Metalworkers Union who wanted to ensure that workers had more influence when computer systems were introduced in the workplace (Sanoff, 2011). In the course of this movement, it was emphasized that users, designers and practitioners should work together in the planning, design and implementation of different systems, since users possess the necessary practical understanding, but may lack insight into technical possibilities that technicians and designers can provide. Thus, participatory design can cut across the boundaries of different professional sectors and harness the practical knowledge and creative potential of citizens through community participation, rather than treating them as mere consumers (Sanoff, 2011).

In order to address participation effectively, it should be made clear when in the planning process and what for whose participation is needed and how this participation should look like. The AAL (Ambient Assisted Living) toolbox (YOUSE GmbH, 2013) distinguishes between three phases of the participatory design process, namely understanding, conceptualizing and testing. Understanding means the gathering of information about potential users and stakeholders, as well as their specific context in order to understand their behaviour, their needs, wishes and fears. Conceptualizing refers to the development of ideas and concepts to satisfy user needs in a potentially new way. This includes specifying the target group and creating ideas that should help in fulfilling the needs formulated in phase 1, e.g., by developing use cases. The testing phase consists of testing new concepts or products by users or experts by discerning potential usability problems. This last phase may not be relevant for our purposes at hand, since the end product is very unlikely to be finished by the end of the task. In the following, we explain in greater detail the methods that were actually implemented during the participatory design process conducted for PANTHEON.

3.3.1 METHODS IMPLEMENTED IN PANTHEON'S PARTICIPATORY DESIGN PROCESS

A wide variety of different methods exist for participatory design processes, yet not all methods are equally suitable for all purposes. The SSH experts involved in the PANTHEON project thus carefully selected suitable methods that enable community participation and stakeholder/end-user involvement from an early point in the project cycle with special consideration of *visioning* and *timelines.* For this purpose, the methods of group discussion in the form of semi-structured interviews, brainstorming/brainwriting, timelines, Walt-Disney Method and the use of the interactive online whiteboard 'Conceptboard' were applied in several workshops with stakeholders and end-users from the focus areas of PANTHEON, which we describe in greater detail in the following chapter.

Workshop design

In order to assess typical problems that end-users and stakeholders face in the context of disaster management and to jointly develop ideas and solutions that could help them manage disasters more efficiently, three participatory design workshops were conducted. The workshops were conducted online via Zoom and Microsoft Teams; two of them with experts in the field of disaster management that are active in Vienna/Austria and one workshop with relevant end-users and stakeholders in Athens/Greece. The aim of the workshops was twofold: first, to elicit requirements for a system that would help the relevant experts in disaster response planning by using a digital twin environment. Second, to derive and develop thereupon concrete design criteria that can be passed on to the technical developers to make the PANTHEON system useful and meaningful to end-user organizations and/or civil protection authorities.

A total of ten experts from the field of disaster management from different civil protection and end-user organizations such as the Ministry of Defence, the Ministry of the Interior, the Chief Executive Office Organisation and Security of the City of Vienna, professional rescue and fire departments and different voluntary rescue organizations took part in the two Viennese workshops. Each of the workshops lasted two hours. The Viennese workshops were conducted in German and findings were later on translated to English.

One workshop was conducted in Greece with 18 participants from the Directorate of Civil Protection of the Attica Region, the Hellenic Police, namely from the Anti-Terrorist Service and the Unified Operations and Crisis Management Coordination Center, the Fire Service and from the Hellenic Rescue Team, a volunteering organisation engaging in search and rescue operations. Further, the Greek workshop was complemented by an online survey. While this covered the same content (tasks and questions) as the workshop, it served to give less responsive participants the chance to give their feedback in written form. The Greek workshop was conducted in Greek and findings were translated to English.

The workshop was designed as a group discussion and held like a semi-structured interview, during which experts should discuss several topics that were provided by the workshop leaders, with the following guiding questions:

- How can the disaster resilience of communities be improved?
- How can disaster management be made more efficient?
- What would PANTHEON need to be like to contribute to efficient disaster management and increase disaster resilience of communities?

In the case of the two Viennese workshops, the group discussion was supported by using the interactive browser-based collaboration tool 'Conceptboard' which allowed participants to write and comment

simultaneously on an online whiteboard (see Appendix A). For the Greek workshop, an online form containing the guiding questions was shared with the participants.

The workshops covered the following methods:

Brainstorming/brainwriting: Participants collected ideas and thoughts individually by writing them down on the digital whiteboard (and in the online form in the case of the Greek workshop). Those were then presented by each participant and discussed within the whole group.

Timelines: A timeline of the specific disaster scenarios "terror" and "large-scale forest fire" was created and elaborated together with the participants. This timeline was used to visualize the evolution of a disaster and to discuss at what point in the disaster management cycle the use of PANTHEON would make sense. Another important question was what the PANTHEON system would have to look and be like to make it a useful tool for different actors active in disaster management.

Visioning, following the Walt Disney method (adapted and sequential): This method was used to let the participants assume the role of a 'dreamer', who may state their ideal ideas about what PANTHEON may provide for DRM without limiting their imagination by realistic means. Subsequently, the participants were asked to assume the role of a critic/realist and discuss about how these identified aspects could be adapted to be realistic or what would be needed to actually implement them.

Semi-structured interview: The guiding questions listed above served as a rough interview guide for the workshop, which was complemented by spontaneous follow-up questions that resulted from the input of the workshop participants.

Specific topics discussed during the workshops were the following:

- Introduction of moderators, project and aim of the workshop
- Introduction of participants and personal experience with disaster management
- Brainstorming/Brainwriting on typical problems and challenges that participants encounter during their work in disaster management or civil protection
- Joint elaboration of a timeline to indicate what will have to be done by whom and when in case of a disaster
    - Discussion of phases/processes when the support of a digital twin could be useful
    - Discussion of other aspects that need to be considered and problems that may arise in these phases/processes
- Visioning by using the Walt-Disney-Method: Discussion of participants' ideal vision of an efficient disaster management and the potential use of PANTHEON/ a digital twin
- Subsequent critical assessment of each of the presented ideas with regards to how this ideal vision may be realized and what possibly stands in the way of its realization
- Concluding discussion on the greatest potential and hurdles that participants see for using a digital twin to promote community disaster resilience.

3.4 OVERVIEW OF SSH EXPERT INVOLVEMENT

SSH-experts within the consortium were involved in all phases of the production of this report. The steps conducted with engagement of SSH-experts included:

- Developing a time schedule and work plan for the preparation of the report
- Literature research on methodological approaches to participatory design processes
- Selection of suitable methods and developing a participatory design process and workshop guidelines
- Co-creating timelines for common disasters with CBDRM-experts, to be used during the workshops
- Conducting participatory design workshops
- Analysing the data collected
- Translating findings to design criteria

3.4.1 ROLE OF SSH EXPERTS IN TRANSLATING FINDINGS TO DESIGN CRITERIA

When analysing workshop and interview material, the focus lies on the reduction of large amounts of data into understandable information. This information is used to draw well-supported and well-argued conclusions, by cross-checking statements and looking for patterns within the data (DeWalt & DeWalt, 2011, p. 179). The analysis of data for this report serves as the foundation for creating design criteria, since the findings drawn reflect requirements and assessments of stakeholders and end-user experts. To reach valid conclusions, the collected data was processed by SSH-experts in the following steps:

Reduction through open-coding: Workshop data was transcribed and the scope of the transcription's content was reduced, leaving only the relevant statements for the respective topic. This process was done by a combination of indexing and coding. First, a code matrix was developed according to theory, covering categories reflecting the material from previous Deliverables of the PANTHEON project. From this code matrix, codes were assigned to statements within the transcription (indexing). Whenever the previously developed code matrix failed in providing adequate categories for the analysed material, new emic categories were established, reflecting the statements (coding). Figure 4 shows all codes that were used more than 3 times during this process with more frequently used codes being displayed bigger than less frequently used codes.

Figure 4: Frequently used codes

Reduction through paraphrasing: All text passages that received a code were then paraphrased and translated from German and Greek to English to further reduce the amount of data, while facilitating the identification of connections and contradictions (Mayring, 2002).

Structuring according to categories: The paraphrased segments were structured and organized according to their respective codes. The resulting structure contained the following categories that is also represented in the structure of chapter 4. Results of Participatory Actions:

- Vision of PANTHEON --> Potential applications for PANTHEON; Issues and gaps in DM
- Design Criteria and Decision --> Potential risks for the implementation of PANTHEON; Design recommendations

Interpretation and translation of findings into design criteria: All segments categorized as design criteria during qualitative content analysis were again paraphrased to represent clear statements on features that would be beneficial according to end-users' input. These features were put into the context of PANTHEON, while the potential applications apply to where they are highlighted.

3.4.2 LIMITATIONS

To cover the limitations of collected data and its effects on the interpretation, it has to be mentioned that specifics regarding technical implementation and feasibility were not addressed as part of the participatory design process. Therefore, the implementation of the design criteria presented below cannot be conditioned, but is rather encouraged, to best serve the end-users' needs and requirements. Further, the data analysed only refers to the focus regions of PANTHEON and cannot necessarily be generalized for other European countries. As last limitation, it should be mentioned that the content discussed with stakeholders during the workshops covers the application of SCDT technology in DM on a rather abstract level. This leads to the

definition of different possible applications of the PANTHEON system on the one hand, but on the other hand also means that each of the possible applications was not discussed in-depth. Therefore, it is recommended to continuously involve stakeholders and end-users in the development process to refine recommendations and requirements for the specific applications targeted with PANTHEON.

4. ELABORATING A VISION OF PANTHEON BY PARTICIPATORY DESIGN

The following sections serve to elaborate an end-user driven vision of PANTHEON by presenting the results generated through the participatory design process, as well as the analysis of previous work done in the project with regard to design implications. Starting from the identification of gaps in disaster management, potential applications of a SCDT in DM are derived and briefly discussed. Then, all identified design recommendations are presented before shedding light on possible issues that might be avoided if addressed early on. Finally, Table 13 consolidates all design recommendations identified throughout the work for this report and presents them structured according to possible applications of PANTHEON.

4.1 IDENTIFIED ISSUES AND GAPS IN DISASTER MANAGEMENT

During the end-user workshops, frequently faced issues and problems in disaster management were discussed, regardless of their relevance for PANTHEON's aim. In the following section, all identified issues and gaps are presented. Further, issues that may be addressed with the PANTHEON system are highlighted and potential applications for the system are derived.

- Instructions for the general public on how to behave during the disaster are often not followed. This problem may further intensify by the spread of false information (fake news) through social media, which tends to undermine public trust in institutions. Also, there may be a lack of understanding on how to address the public efficiently in different scenarios.
- Designation of the capacity and also vulnerabilities of disaster management organisations is a very important aspect. A SWOT (Strength, weaknesses, opportunities, and threats) analysis should be performed to identify strengths and weaknesses of first responders' organisations regarding their operational potential.
- Accurate compliance with statutory civil protection plans and guidelines.
- A deficit of clear definitions, responsibilities and contact persons may obstruct efficient communication and coordination during disaster management operations. As a solution for this issue, cross-organisational exercises and trainings lead to the identification of gaps and exchange between organisations in times without disasters.
    - PANTHEON: If the system is used to facilitate cross-organisational trainings and exercises, it can help identify gaps in communication structures and procedures. - Recommended Application: *Training and Exercises*; *Cross-organisational communication* (see chapter 4.2).
- Planning of resources and reserves. This is especially true for large-scale events that last for several days or weeks. In the beginning all units (also volunteers and off-duty professionals) want to help, but a reserve has to be held back for deployment in the following days.
- During the chaos phase (early phase of a disaster/emergency, where little is known about the incident), different information exists and little is known about the actual reality on site. Further, situation assessment still works like years ago, by relying on one scout entering the incident site with a radio and delivering the assessment. This leads to drastically different results depending on their experience.
    - PANTHEON: With real-time sensor data and models, the system could help to depict a realistic situational picture that may be distributed to all emergency organisations. – Recommended Application: *Situational picture*; *Cross-organisational communication* (see chapter 4.2).

- The first 30-45 minutes of an emergency are crucial for response, since the organisation on site within this timeframe builds the foundation for a proper operation.
  - PANTHEON: Quickly identify vulnerable buildings and infrastructure at risk as well as sites and zones to develop structures and on-site organisation. - Recommended Application: *Situational picture* (see chapter 4.2).
- The fast evolution of some disaster situations may cause changes in requirements and available information every minute. This can pose challenges for classic top-down leadership structures used in DM.
- Clear response structures and preparedness plans for CBRNe events are missing for Austria/Vienna (except for nuclear events). While the work on such events might be successful due to personal contacts among stakeholders, clear structures would enable proper preparation.
  - PANTHEON: Simulation and modelling of CBRNe events could support the definition of response structures and preparedness plans. - Recommended Application: *Planning and early warning according to simulations* (see chapter 4.2).
- Federalism poses an administrative risk during disasters. While responsibilities differ between federal states and cooperation may be complex, disasters do not care about administrative borders.
- Spontaneous volunteers and donors of support material may pose a burden for disaster logistics and may threaten themselves by approaching hazardous sites.
- The flow of information between different organisations is often flawed and leads to different situational pictures or a lacking exchange of vital information.
  - PANTHEON: The system could be used as a cross-organisational tool to share information on situational picture. - Recommended Application: *Cross-organisational communication* (see chapter 4.2).
  - PANTHEON: Trainings may improve the flow of information between different organisations. - Recommended Application: *Training and exercises* (see chapter 4.2).
- Highly politicized hazards tend to receive more focus in preparedness by political actors than hazards that are the highest according to the risk-assessment matrix.

4.2 POTENTIAL APPLICATIONS IDENTIFIED FOR PANTHEON

The following section discusses different applications where a SCDT was assessed to be potentially useful during DM by end-users and stakeholders. Alphabetic codes are assigned to each presented application possibility (A-E). Throughout the presentation of participatory design criteria in the subsequent section, these codes serve as a reference. Therefore, most findings refer to one or more potential applications and should be considered respectively when approaching the development of the system.

Before a disaster:

- **Planning and early warning according to simulations (A)**

Using models and simulations based on big amounts of valid data to calculate possible evolutions of scenarios. Especially for scenarios for which little experience exists in the region, this could enable the development of emergency plans. Certain structures (e.g., staging areas) could be pre-defined for specific locations. Also, large-scale evacuations that cannot be trained in reality may be planned according to

simulations. The system might be used to give a prognosis of best-case and worst-case consequences for different scenarios that can be adapted or it may serve as an early warning system, constantly monitoring the modelled area.

- **Training and exercises (B)**

Training realistic scenarios is very important for first responders and disaster response but large-scale exercises are very complex to organize and expensive. Table-top exercises, on the other hand, tend to require high levels of phantasy. A SCDT could fill this gap and even facilitate regular cross-organisational trainings increasing the mutual understanding of other organisation's needs. Models can simulate the evolution of situations and shed light on approaches and priorities that have not been thought of yet. Also, the system may be used to map and develop different scenarios for large-scale exercises.

During a disaster:

- **Situational picture (C)**

During the first phase of an emergency (chaos phase) the system might be helpful to assess the situation on site and help in the early estimation of potential damage. It may also allow to quickly identify surrounding vulnerabilities (critical infrastructure, schools etc.), classify the incident and deliver crucial data for the orientation of emergency services.

- **Cross-organisational communication (D)**

Different organisations have different information available (especially during the early phase of a disaster). If all involved organisations have real-time access to the system, it may serve to share information across organisational boundaries and enhance cross-organisational communication and coordination.

After a disaster:

- **Documentation and evaluation (E)**

Operations may be documented within a SCDT. In other words, a digital twin of operations is designed within the SCDT. This could either happen according to the input during the disaster response and its storage or through the replication afterwards. This application could facilitate better understanding and transparency of actions taken and support legal security of operations, while providing an ideal foundation for evaluation of operational strategy.

4.3 RECOMMENDATIONS FOR DESIGN CRITERIA AND DECISION

4.3.1 PARTICIPATORY DESIGN CRITERIA

Table 10, all design criteria are listed that were derived from the data collected through participatory activities. Therefore, they represent the needs and requirements of stakeholders and potential end-users of the system developed in PANTHEON. The design criteria are listed alphabetically and assigned to application-specific codes.

Table 10: Design criteria derived from participatory activities

Title	Description	Application
Access on site	PANTHEON could serve as an information interface for arriving units of all organisations, who then have the same level of situational overview.	**C, D**
Accurate and safe data and information exchange	In times of large disasters there is a need for cross-border and cross-sector response with a plethora of different first responders simultaneously operating at the scene. The system has to acquire information from various but reliable resources and disseminate accordingly to stakeholders. However, sensitive data should be protected not to fall in the wrong hands.	**C, D**
Capacity for further editing of the received data	Commanders at the strategic level should have, apart from the simple visualisation of data, the capacity to process the data with the aim to make significant assumptions to facilitate decision making.	**C, D**
Communication hub	All organisations have the possibility to access PANTHEON and both enter and receive information/numbers.	**D**
Data of buildings	Buildings in PANTHEON should contain information on: Number of flats, floors and residents. Businesses, their employees and working times. Building fabric and entries. Further building plans and information could be embedded within the system, if available.	**A, B, C, D, E**
Defining zones	The operators of the system should be able to mark and define zones with polygons. These should include danger zones (red, yellow, green) or also defined areas for specific purposes (e.g., patient collection, staging areas for ambulances or firefighter).	**B, C, D, E**
Deliver information to on-site units	While the units on site might not have the time/resources to browse through the data in the system, the command centre should have ways of delivering specific information to those units. For example, streams of highly relevant CCTV (closed-circuit television) or screenshots of drone pictures etc. There is a need for accurate exchange of information between the different levels of first response, from the operational level to the tactical and vice versa.	**C, D**
Embedding documents	An option to embed documents within the SCDT. Therefore, building plans, emergency plans or other documents can be added to specific buildings and places, if available.	**A, B, C, D, E**
Embedding instructions	For specific hazards and locations, behavioural or safety instructions should be embedded in those areas.	**A, B, C, D**
Filtering	Both automatic and manual filters are very important to enable usability and usefulness. The vast amounts of data should not overwhelm the operators, while leaving them the option to take all data into account.	**A, B, C, D, E**
Levels of permission	As soon as different persons and different organisations are working with the system, there have to be different levels of permission that regulate the scope of competencies within the system. It may for example define the data and information that one can see, import, export and adapt and also differences in their display.	**B, C, D**

Manual adaptability of incident data	The operator has to be able to add incidents, change times, change locations and other variable values.	**A, B, C, D, E**
Marking resources	Function to mark resources (units, vehicles, personnel etc.) within the SCDT.	**B, C, D, E**
Media communication	System could provide media with information points, where they can safely receive information without entering the incident area.	**D**
No decision-making	The system should support operators by providing information but should not make the decisions for them.	**B, C**
Parallelism of operations	When adding/depicting emergency operations within PANTHEON, it has to be clear that those do not follow strict chronology. Operations are happening in parallel in different organisations and on different levels. This has to be reflected.	**B, D, E**
Phone data (google maps)	An estimation of the number of people in specific areas could be very helpful. Primarily to generate quick expectations on the number of casualties or to estimate the need of evacuation volume. It may also help with the legal deployment of drones (depending on people in the area).	**C, D**
Picture comparison	Extent of damage might be estimated by comparing real time pictures (e.g., drones) with historical pictures or SCDT model.	**C, D**
Prioritisation of action	According to simulation and modelling, the system might suggest a prioritisation of actions to be taken according to calculations of probable consequences (e.g., in order to bypass cascades). While this should just be supportive information without any compulsion to act accordingly, it could point to measures that otherwise might get lost or undervalued.	**A, B, (C, D)**
Satellite data and remote sensing	The acquisition of data from sensors, UAVs, aircrafts and satellites is crucial in order to obtain a clear picture of the evolution of a crisis and to adopt a common operational picture among stakeholders. Moreover, remote data can provide an overview of the extent of the damage and, therefore, of the measures that need to be implemented for the recovery of the affected area after the disaster.	**C, D, E**
Size detection of spaces	The system should be able to detect on-site spaces according to their size. This will lead to the quick identification of the right sites to designate and build structures (for example 25m x 25m for a helipad). There could be a set of predefined structures and their respective sizes, where suitable sites can be identified, while leaving the option to change dimension requirements.	**A, B, C, D**
Social media sensing	The system could be capable of acquiring information from social media, since these are the primary source of information exchange for the general public. However, attention should be paid regarding the filtering of this information for the avoidance of fake news spreading.	**C, D**
Socio-demographic data	For operations, information on the quantity as well as the quality of affected people is of high relevance. For example, the evacuation efforts are very different for a student's home and an old people's home. Therefore socio-demographic data on population in the area might be of high importance.	**A, B, C, D**

Standard interfaces	The use of normed standard interfaces is very important. There are many systems already being used by emergency organisations and these have to be able to communicate or exchange data. Also, data import and export should be as easy as possible by using standard interfaces.	**A, B, C, D, E**
System resilience in harsh environments	In many cases of disasters communication collapses. The PANTHEON system should be able to operate on such occasions and thus, to have the capacity to send and receive all relevant information independently of communication failure.	**C, D**
Time-stamps	When items (zones, resources, etc.) or data is added to the SCDT, they should receive a time-stamp for better traceability.	**B, C, D, E**
Uniform language	Clear and precise wordings and professional jargon have to be used, that are understood by all operators and emergency organisations.	**A, B, C, D, E**
Usable infrastructure on-site	Identify (ideally public) spaces and buildings in or next to the incident area, that can be used to build structures with low efforts.	**B, C**
User-friendliness	The system should be easy to use and not require significant technical or scientific expertise from the operator's side.	**A, B, C, D, E**
Utilization in everyday emergencies	To ensure appropriate use in disaster situations, the system might also be used during everyday small-scale emergencies. This would keep the end users engaged with the system and facilitate regular training.	**C, D**
Warning notices	(Automatically) mark vulnerable buildings (schools, hospitals, old people homes, etc.) with according warning messages. For this, week days and day times should be factored in to draw an accurate picture of vulnerability.	**A, B, C, D**
Zooming in and out	When zooming in and out using the SCDT, marked elements (like zones or resources) on the map should neither change their size nor their place.	**B, C, D, E**

4.3.2 POTENTIAL RISKS, HURDLES AND ISSUES FOR THE IMPLEMENTATION OF PANTHEON

As an addition to design criteria, all potential risks, hurdles and issues for the implementation of specific applications of PANTHEON that were discussed during participatory research activities are listed in ***Table 11***. Those should be thought of as early as possible in PANTHEON's development and specific measures to minimize respective risks should be implemented.

Table 11: Potential risks, hurdles and issues for PANTHEON applications

Risk, hurdle or issue	Application
The use of IT-systems may be a liability during response operations, if it fails due to infrastructure damages or network overload. Proper security measures have to be in place, if emergency units rely on the system to work.	**C, D**
End users should receive in depth training regarding the use of the system in order to feel confident and familiar with its use when needed. Inadequate training could result in serious implications and delays when a disaster strikes.	**B, C, D**

The implementation of new systems in institutions (esp. national or state institutions) is a very long and hard path. Basic requirements (e.g., adequate data protection) from this target group have to be addressed in order to pass evaluation.	**A, B, C, D, E**
The system should focus on the most reasonable and feasible area of application, where many organisations internationally see gaps in DM. It should avoid trying to be a jack of all trades.	**A, B, C, D, E**
The possibility of legal aftermath should be considered, e.g., when crucial data was available to identify specific situational evolutions but was not identified by the operators due to a lack of training, lack of system usability or calculation failures.	**C, D**
The operative tasks on-site should not get mixed up with the coordinative tasks in the command centre. The incident commander on-site may add too many details for other organisations to comprehend.	**C, D**
For major events, a high level of monitoring, traffic measures and leadership support tools are already being used. Added value has to be provided by PANTHEON.	**C, D**
Already, there are existing procedures and plans in place for each organisation that regulate how/who/when is going to be deployed in most scenarios. When it comes to planning, added value has to be provided.	**A**
Data quality and uniformity is a regular problem in the cooperation of different emergency organisations. The meaning of provided or merged numbers may be misinterpreted and can lead to invalid calculations.	**D**
If PANTHEON collects vast amounts of data but fails in the simple presentation of it, the flood of data may lead to the distraction from actual challenges.	**C, D**
Newly built areas of cities often lack the accurate information, such as building plans, information on available infrastructure, etc.	**A, B, C, D, E**
Data security and sensible documents may pose barriers for the exchange of data across organisations, especially if this information is then stored on external servers.	**D**
In critical situations, emergency organisations tend to fall back to simplest methods of problem solving (e.g., pen and paper). The “hearts and minds” of emergency units have to be caught to ensure the use of new tools.	**C, D**
Data has to be updated regularly. Up to date data is key for SCDT.	**A, B, C, D, E**
Usability is the key to adoption. PANTHEON has to be visually well presented, easy to use, intuitive to navigate and clearly arranged to make it a successful tool.	**A, B, C, D, E**
Depending on national DM-structures and on the selected use case(s), the actual end users of the system might differ between countries.	**C, D**

4.3.3 DATA SOURCES

During the workshop discussions, the following data sources were mentioned by end-users and stakeholders. This list is neither mandatory nor a complete list of data sources to be utilized by PANTHEON but represents a collection of data sources that was assessed by end-users and stakeholders as potentially useful:

- Weather: Wind; Thunder; Rain; Weather forecast
- Urban microclimate (esp. for heatwaves): Air corridors; Vegetation; Shading conditions
- Historical data on emergencies and operations for the analysis and extraction of best practices and lessons learnt from past experience

- Data regarding critical infrastructures within or in the proximity of the affected area. Interconnections and interdependencies between critical infrastructures
- Traffic data
- Real-time satellite pictures
- Climate data
- Soil dryness
- Water levels and flood propagation
- Fire propagation models
- Social media
- Real-time videos from CCTV and Cameras of different organisations
- Public transport data
- Spatial plans
- Power lines
- Evacuation plans
- Maps with altitude contours (esp. for floods)
- Civil protection plans, that are implemented in specific disasters

In ***Table 12***2, data sources relevant for specific disaster scenarios and data that might be of importance in those scenarios are listed. These were presented in detail in chapter 2.2 and consist of data extracted from Deliverable 2.2.

Table 12: Relevant data and data sources for different disaster scenarios

Disaster scenario	Relevant data and data sources
Terrorist attacks	• Information on potential target areas for terrorist attacks (as identified though studies by authorities and institutes) • Information on neighbourhood vulnerability indicators such as population density, unemployment rates and social cohesion.
Floods	• Already existing flood risk maps • Possible sources of contamination when flooded • Critical infrastructure that might be damaged during floods • Location of drainage systems and flood walls • Interfaces with existing early warning systems
Wildfires	• Fuel load (amount of flammable material in the form of trees, houses, or other materials) and strength and direction of wind • Location of nearest fire station, nearest water points, and location and condition of roads • Interfaces with early warning systems (such as the The FireHub of BEYOND) • Information on nature reserves or other vulnerable ecosystems
Heatwaves	• Information on building measures such as insulation measures, green roofs and air conditioning • Existing heatwave early warning systems, such as the app EXTREMA
Earthquakes	• Information on earthquake-proof buildings and up-to-date building regulations.

	• Data on soil liquefaction and soil condition (e.g., 2020 European Seismic Risk Model) • Data on hazards that may occur in interaction with an earthquake, such as ground displacement, landslides, floods or tsunamis).
Technological accidents	• Data on chemical plants, nuclear power plants, or other relevant infrastructure which may leak hazardous material • Meteorological conditions such as wind strength and direction • Data on particularly vulnerable environments such as nature reserves • Information on vulnerable areas and areas with high density of chemical facilities
Droughts	• Information on baseline water stress

4.4 CATALOGUE OF DESIGN RECOMMENDATIONS FOR PANTHEON

Table 133 contains design recommendations derived from both the analysis of empirical data and preceding deliverables. The table first presents general design recommendations before addressing the specific application possibilities identified for the PANTHEON system. It must be mentioned here that these aspects will be further elaborated, concretised and prioritised in the next steps of the project and in exchange with respective stakeholders.

Table 13: Catalogue of design recommendations for PANTHEON

Title	Description
General Design Recommendations (to be considered for all application options)	
Community organisations	Locations of local NGOs, sports clubs and cultural institutions should be available and visible within the SCDT, as they might serve as useful contact points to the local community and could be able to provide a space that can be used for building emergency structures during disaster response operations.
Data of buildings	PANTHEON should contain data of buildings on: Number of flats, floors and residents. Businesses, their employees and working times. Building fabric and entries. Further building plans could be embedded within the system, if available.
Embedding documents	An option to embed documents within the SCDT. Therefore, building plans, emergency plans or other documents can be added to specific buildings and places, if available.

Filtering	Both automatic and manual filters are very important to enable usability and usefulness. The vast amounts of data should not overwhelm the operators, while leaving them the option to take all data into account.
Integrate all relevant emergency actors	The system to be developed by the PANTHEON consortium should identify and integrate all relevant emergency management actors present in the pilot region, considering both professionals and local communities.
Legislative specifics and flexibility	The system should be adapted to the emergency plans and legislation in force in the region. However, there should be some flexibility to allow for solutions that are not covered by emergency plans, as long as this does not lead to serious breaches of law and order.
Manual adaptability of incident data	The operator has to be able to add incidents, change times, change locations and other variable values.
Standard interfaces	The use of normed standard interfaces is very important. There are many systems already being used by emergency organisations and these have to be able to communicate or exchange data. Also, data import and export should be as easy as possible by using standard interfaces.
Uniform language	Clear and precise wordings and professional jargon have to be used, that are understood by all operators and emergency organisations. (Standardized vocabularies should be used, if available)
User-friendliness	The system should be easy to use and not require significant technical or scientific expertise from the operator's side.
Application A: Planning and early warning according to simulations	
Inclusion of local communities in emergency plan development	It is recommended to include the affected local communities when creating disaster response plans according to simulations within their area. This way, local knowledge can be integrated in the plans and community members can be sensitized and empowered in the process. It is also recommended to include vulnerable groups to address their individual needs during planning.
Informing citizens	Informing citizens about potential risks and emergencies is a fundamental right, and PANTHEON should thus integrate the necessary means of communication to reach as many people as possible. This communication should further include plans on how to address vulnerable groups.
Prioritisation of action	According to simulation and modelling, the system might suggest a prioritisation of actions to be taken according to calculations of probable consequences (e.g., in order to bypass cascades). While this should just be supportive information without any compulsion to act accordingly, it could point to measures that otherwise might get lost or undervalued.
Size detection of spaces	The system should be able to detect on-site spaces according to their size. This will lead to the quick identification of the right sites to designate and build structures (for example 25m x 25m for a helipad). There could be a set of predefined structures and their respective sizes, where suitable sites can be identified, while leaving the option to change dimension requirements.
Socio-demographic data	For operations, information on the quantity as well as the quality of affected people is of high relevance. For example, the evacuation efforts are very different for a student's home and an old people's home. Therefore, socio-demographic data on population in the area might be of high importance.

Warning notices for vulnerabilities	(Automatically) mark vulnerable buildings (schools, hospitals, old people homes, etc.) with according warning messages. For this, week days and day times should be factored in to draw an accurate picture of vulnerability.
Application B: Training and exercises	
Defining zones	The operators of the system should be able to mark and define zones with polygons. These should include danger zones (red, yellow, green) or also defined areas for specific purposes (e.g., patient collection, staging areas for ambulances or firefighter).
Embedding instructions	For specific hazards and locations, behavioural or safety instructions should be embedded in those areas.
Levels of permission	As soon as different command levels and different organisations are working with the system, there have to be different levels of permission that regulate the scope of competencies within the system. It may for example define the data and information that one can see, import, export, modify and adapt and also differences in their display. Since organizational structures may differ between countries, the definition of permission structures may be individually adaptable by organisation's admins.
Marking resources	Function to mark resources (units, vehicles, personnel etc.) within the SCDT.
No decision-making	The system should support operators by providing information but should not make the decisions for them.
Parallelism of operations	When adding/depicting emergency operations within PANTHEON, it has to be clear that those do not follow strict chronology. Operations are happening in parallel in different organisations and on different levels. This has to be reflected.
Prioritisation of action	According to simulation and modelling, the system might suggest a prioritisation of actions to be taken according to calculations of probable consequences (e.g., in order to bypass cascades). While this should just be supportive information without any compulsion to act accordingly, it could point to measures that otherwise might get lost or undervalued.
Size detection of spaces	The system should be able to detect on-site spaces according to their size. This will lead to the quick identification of the right sites to designate and build structures (for example 25m x 25m for a helipad). There could be a set of predefined structures and their respective sizes, where suitable sites can be identified, while leaving the option to change dimension requirements.
Socio-demographic data	For operations, information on the quantity as well as the quality of affected people is of high relevance. For example, the evacuation efforts are very different for a student's home and an old people's home. Therefore socio-demographic data on population in the area might be of high importance.
Time-stamps	When items (zones, resources etc.) or data is added to the SCDT, they should receive a time-stamp for better traceability.
Usable infrastructure on-site	Identify (ideally public) spaces and buildings in or next to the incident area, that can be used to build structures with low efforts.

Warning notices for vulnerabilities	(Automatically) mark vulnerable buildings (schools, hospitals, old people homes, etc.) with according warning messages. For this, week days and day times should be factored in to draw an accurate picture of vulnerability.
Zooming in and out	When zooming in and out using the SCDT, marked elements (like zones or resources) on the map should neither change their size nor their place.
Application C: Situational picture	
Access on site	PANTHEON could serve as an information interface for arriving units of all organisations, who then have the same level of situational overview.
Accurate and safe data and information exchange	In times of large disasters there is a need for cross-border and cross-sector response with a plethora of different first responders simultaneously operating at the scene. The system has to acquire information from various but reliable resources and disseminate accordingly to stakeholders. However, sensitive data should be protected not to fall in the wrong hands.
Community liaison officers	If installed, community liaison officers (see D2.5 (Bittner et al., 2023, p. 69)) should be embedded in their respective neighbourhoods within the SCDT. In case of an emergency or disaster, these can then be informed early on to disseminate behavioural instructions to the local community within their communication channels.
Defining zones	The operators of the system should be able to mark and define zones with polygons. These should include danger zones (red, yellow, green) or also defined areas for specific purposes (e.g. patient collection, staging areas for ambulances or firefighter).
Deliver information to on-site units	While the units on site might not have the time/resources to browse through the data in the system, the command centre should have ways of delivering specific information to those units. For example, streams of highly relevant CCTV or screenshots of drone pictures etc. There is a need for accurate exchange of information between the different levels of first response, from the operational level to the tactical and vice versa.
Embedding instructions	For specific hazards and locations, behavioural or safety instructions should be embedded in those areas.
Levels of permission	As soon as different command levels and different organisations are working with the system, there have to be different levels of permission that regulate the scope of competencies within the system. It may for example define the data and information that one can see, import, export, modify and adapt and also differences in their display. Since organizational structures may differ between countries, the definition of permission structures may be individually adaptable by organisation's admins.
Marking resources	Function to mark resources (units, vehicles, personnel etc.) within the SCDT.
No decision-making	The system should support operators by providing information but should not make the decisions for them.
Phone data (google maps)	An estimation of the number of people in specific areas could be very helpful. Primarily to generate quick expectations on the number of

	casualties or to estimate the need of evacuation volume. It may also help with the legal deployment of drones (depending on people in the area).
Picture comparison	Extent of damage might be estimated by comparing real time pictures (e.g., drones) with historical pictures or SCDT model.
Satellite data and remote sensing	The acquisition of data from sensors, UAVs, aircrafts and satellites is crucial in order to obtain a clear picture of the evolution of a crisis and to adopt a common operational picture among stakeholders. Moreover, remote data can provide an overview of the extent of the damage and, therefore, of the measures that need to be implemented for the recovery of the affected area after the disaster.
Size detection of spaces	The system should be able to detect on-site spaces according to their size. This will lead to the quick identification of the right sites to designate and build structures (for example 25m x 25m for a helipad). There could be a set of predefined structures and their respective sizes, where suitable sites can be identified, while leaving the option to change dimension requirements.
Social media sensing	The system could be capable of acquiring information from social media, since these are the primary source of information exchange for the general public. However, attention should be paid regarding the filtering of this information for the avoidance of fake news spreading.
Socio-demographic data	For operations, information on the quantity as well as the quality of affected people is of high relevance. For example, the evacuation efforts are very different for a student's home and an old people's home. Therefore socio-demographic data on population in the area might be of high importance.
System resilience in harsh environments	In many cases of disasters communications collapse. The PANTHEON system should be able to operate on such occasions and thus, to have the capacity to send and receive all relevant information independently of communications failure.
Time-stamps	When items (zones, resources etc.) or data is added to the SCDT, they should receive a time-stamp for better traceability.
Usable infrastructure on-site	Identify (ideally public) spaces and buildings in or next to the incident area, that can be used to build structures with low efforts.
Utilization in everyday emergencies	To ensure appropriate use in disaster situations, the system might also be used during everyday small-scale emergencies. This would keep the end users engaged with the system and facilitate regular training.
Warning notices for vulnerabilities	(Automatically) mark vulnerable buildings (schools, hospitals, old people homes, etc.) with according warning messages. For this, week days and day times should be factored in to draw an accurate picture of vulnerability.
Zooming in and out	When zooming in and out using the SCDT, marked elements (like zones or resources) on the map should neither change their size nor their place.
Application D: Cross-organisational communication	
Access on site	PANTHEON could serve as an information interface for arriving units of all organisations, who then have the same level of situational overview.
Accurate and safe data and information exchange	In times of large disasters there is a need for cross-border and cross-sector response with a plethora of different first responders simultaneously

	operating at the scene. The system has to acquire information from various but reliable resources and disseminate accordingly to stakeholders. However, sensitive data should be protected not to fall in the wrong hands.
Communication hub	All organisations have the possibility to access PANTHEON and both enter and receive information/numbers.
Community liaison officers	If installed, community liaison officers (see D2.5 (Bittner et al., 2023, p. 69)) should be embedded in their respective neighbourhoods within the SCDT. In case of an emergency or disaster, these can then be informed early on to disseminate behavioural instructions to the local community within their communication channels.
Defining zones	The operators of the system should be able to mark and define zones with polygons. These should include danger zones (red, yellow, green) or also defined areas for specific purposes (e.g. patient collection, staging areas for ambulances or firefighter).
Deliver information to on-site units	While the units on site might not have the time/resources to browse through the data in the system, the command centre should have ways of delivering specific information to those units. For example, streams of highly relevant CCTV screenshots of drone pictures etc. There is a need for accurate exchange of information between the different levels of first response, from the operational level to the tactical and vice versa.
Embedding instructions	For specific hazards and locations, behavioural or safety instructions should be embedded in those areas.
Levels of permission	As soon as different command levels and different organisations are working with the system, there have to be different levels of permission that regulate the scope of competencies within the system. It may for example define the data and information that one can see, import, export, modify and adapt and also differences in their display. Since organizational structures may differ between countries, the definition of permission structures may be individually adaptable by organisation's admins.
Marking resources	Function to mark resources (units, vehicles, personnel etc.) within the SCDT.
Media communication	System could provide media with information points, where they can safely receive information without entering the incident area.
Parallelism of operations	When adding/depicting emergency operations within PANTHEON, it has to be clear that those do not follow strict chronology. Operations are happening in parallel in different organisations and on different levels. This has to be reflected.
Phone data (google maps)	An estimation of the number of people in specific areas could be very helpful. Primarily to generate quick expectations on the number of casualties or to estimate the need of evacuation volume. It may also help with the legal deployment of drones (depending on people in the area).
Picture comparison	Extent of damage might be estimated by comparing real time pictures (e.g., drones) with historical pictures or SCDT model.
Satellite data and remote sensing	The acquisition of data from sensors, UAVs, aircrafts and satellites is crucial in order to obtain a clear picture of the evolution of a crisis and to adopt a common operational picture among stakeholders. Moreover,

	remote data can provide an overview of the extent of the damage and, therefore, of the measures that need to be implemented for the recovery of the affected area after the disaster.
Size detection of spaces	The system should be able to detect on-site spaces according to their size. This will lead to the quick identification of the right sites to designate and build structures (for example 25m x 25m for a helipad). There could be a set of predefined structures and their respective sizes, where suitable sites can be identified, while leaving the option to change dimension requirements.
Social media sensing	The system should be capable of acquiring information from social media, since these are the primary source of information exchange for the general public. However, attention should be paid regarding the filtering of this information for the avoidance of fake news spreading.
Socio-demographic data	For operations, information on the quantity as well as the quality of affected people is of high relevance. For example, the evacuation efforts are very different for a student's home and an old people's home. Therefore socio-demographic data on population in the area might be of high importance.
System resilience in harsh environments	In many cases of disasters communications collapse. The PANTHEON system should be able to operate on such occasions and thus, to have the capacity to send and receive all relevant information independently of communications failure.
Time-stamps	When items (zones, resources etc.) or data is added to the SCDT, they should receive a time-stamp for better traceability.
Utilization in everyday emergencies	To ensure appropriate use in disaster situations, the system might also be used during everyday small-scale emergencies. This would keep the end users engaged with the system and facilitate regular training.
Warning notices for vulnerabilities	(Automatically) mark vulnerable buildings (schools, hospitals, old people homes, etc.) with according warning messages. For this, week days and day times should be factored in to draw an accurate picture of vulnerability.
Zooming in and out	When zooming in and out using the SCDT, marked elements (like zones or resources) on the map should neither change their size nor their place.
Application E: Documentation and evaluation	
Defining zones	The operators of the system should be able to mark and define zones with polygons. These should include danger zones (red, yellow, green) or also defined areas for specific purposes (e.g. patient collection, staging areas for ambulances or firefighter).
Parallelism of operations	When adding/depicting emergency operations within PANTHEON, it has to be clear that those do not follow strict chronology. Operations are happening in parallel in different organisations and on different levels. This has to be reflected.
Satellite data and remote sensing	The acquisition of data from sensors, UAVs, aircrafts and satellites is crucial in order to obtain a clear picture of the evolution of a crisis and to adopt a common operational picture among stakeholders. Moreover, remote data can provide an overview of the extent of the damage and,

	therefore, of the measures that need to be implemented for the recovery of the affected area after the disaster.
Time-stamps	When items (zones, resources etc.) or data is added to the SCDT, they should receive a time-stamp for better traceability.
Zooming in and out	When zooming in and out using the SCDT, marked elements (like zones or resources) on the map should neither change their size nor their place.

5. CONCLUSIONS

The aim of the present deliverable was to elaborate concrete design criteria to be used by the technicians within the PANTHEON consortium for the development of a tool whose goal is to enhance community disaster resilience by improving existing disaster management mechanisms. To achieve this, SSH experts conducted a participatory design process that included a requirements analysis to identify current gaps and problems in disaster management, as well as requests for improvements that the PANTHEON system under development could address and resolve.

As a first step, previous results from WP2 were consulted and analysed with regard to design implications for the PANTHEON system. Decisive determining factors such as disaster management regulatory frameworks that are in place in the focus areas of PANTHEON, most frequent hazards and risks in the focus areas as well as the role of vulnerable groups, and the participatory governance model elaborated in T2.5 were taken into consideration to provide the context necessary for better understanding potential end-users' and stakeholders' behaviour, needs, desires and fears.

The next step was to gain a deeper understanding of the different stakeholders and end-users in the focus regions, as well as their roles, tasks, and responsibilities in the event of a disaster. This was done by identifying relevant stakeholders/end-users in disaster management and categorizing them according to their level of responsibility as 1) administration, 2) first responders, and 3) community. Following this distinction, the relevant stakeholders and end-users for the respective focus regions were identified and an activity profile was created to show *who* does *what* and *when* in the event of a disaster.

In an attempt to operationalize PANTHEON, the central terms were identified and defined, and an easy-to-understand explanation of the project, including a pictogram, was developed to ensure a common basis for all actors involved in the participatory design process. This is followed by a presentation of central methods that can be applied in participatory design processes, before the methods used in the specific case and the data collection process by means of workshops as well as the analysis of these data by SSH experts are explained in greater detail.

The subsequent presentation of the results of the participatory design process first examines gaps and issues in disaster management that the PANTHEON system could address, before presenting five potential applications of the system under development and potential hurdles in the implementation of such a system. In addition, the presentation section also lists different data sources that a digital twin technology should take into account according to the statements of the experts consulted. The results of Task 2.2 are also reviewed, and different data sources that need to be considered are assigned to different disaster scenarios such as forest fires, terrorism, terrorist attacks, etc.

The core of this report is the design criteria derived from the participatory design process with designated experts in the field of disaster management in Vienna and Athens, which is systematically presented in a Design Criteria Catalogue (see Table 13) and assigned to the respective identified applications. This systematic overview is intended to help the technical developers of the SCDT technology to best consider the needs and requirements from a practitioner and end-user perspective in the implementation and development of the PANTHEON tool.

It is our hope that the requirements and design criteria for an effective disaster management tool presented in this report that were elaborated by SSH experts in a participatory design process together with

experienced end-users and stakeholders, can help improve disaster management in the focus regions of the PANTHEON project and contribute to increasing the disaster resilience of communities in the near future.

6. REFERENCES

Aldrich, D. P. (2019). Challenges to coordination: Understanding intergovernmental friction during disasters. *International Journal of Disaster Risk Science*, *10*, 306–316.

Apostolopoulou, V., Bagiyan, V., Bakunts, S., Geyer, C., Grabmaier, I., Kainz, S., Kazantzidou, D., Kirilova, S., Tatarchuck, K. S., Triantafyllou, I., Tsaloukidis, J., & Valles, L. (2023). *D2.3 COMMUNITY VULNERABILITY AND CAPACITY ASSESSMENTS* (PANTHEON - Community-Based Smart City Digital Twin Platform for Optimised DRM Operations and Enhanced Community Disaster Resilience). Horizon Europe PANTHEON, Grant Agreement N°101074008.

Arnstein, S. R. (1969). A Ladder Of Citizen Participation. *Journal of the American Institute of Planners*, *35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Aufgaben des Krisenmanagements der Stadt Wien. (n.d.). *Aufgaben des Krisenmanagements der Stadt Wien*. Stadt Wien. https://www.wien.gv.at/menschen/sicherheit/krisenmanagement/krima-aufgaben.html

Bahadori, M., Khankeh, H. R., Zaboli, R., & Malmir, I. (2015). Coordination in disaster: A narrative review. *International Journal of Medical Reviews*, *2*(2), 273–281.

Bittner, S., Grabmaier, I., Kainz, S., Barrado, C., Bagiyan, V., Bakunts, S., & Zamora, D. (2023). *D2.5 PARTICIPATORY GOVERNANCE MODEL AND RECOMMENDATIONS* (PANTHEON - Community-Based Smart City Digital Twin Platform for Optimised DRM Operations and Enhanced Community Disaster Resilience). Horizon Europe PANTHEON, Grant Agreement N°101074008.

Boin, A., & Bynander, F. (2015). Explaining success and failure in crisis coordination. *Geografiska Annaler: Series A, Physical Geography*, *97*(1), 123–135.

Bundesministerium für Finanzen. (n.d.). *Bundesrecht konsolidiert: Gesamte Rechtsvorschrift für Wehrgesetz 2001, Fassung vom 19.10.2023*. Rechtsinformationssystem Des Budnes: RIS. https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=bundesnormen&Gesetzesnummer=20001612

BUNDESMINISTERIUM FÜR INNERES. (n.d.a). *Geschäftseinteilung Bundesministerium für Inneres*. Bundesministerium Für Inneres. https://www.bmi.gv.at/113/

BUNDESMINISTERIUM FÜR INNERES. (n.d.b). *Krisen- und Katastrophenmanagement Zivilschutz in Österreich*. Bundesministerium Inneres. https://www.bmi.gv.at/204/skkm/start.aspx

Bundesministerium für Inneres. (n.d.). *Organigramm*. Landespolizeidirektion Wien. https://www.polizei.gv.at/wien/lpd/organigramm/organigramm.aspx

Bundesministerium für Landesverteidigung. (n.d.). *KATASTROPHENHILFEEINHEIT AFDRU (AUSTRIAN FORCES DISASTER RELIEF UNIT)*. BUNDESHEER.AT. https://www.bundesheer.at/afdru

Davis, M., Altevogt, B., & Reeve, M. (2015). *Regional disaster response coordination to support health outcomes: Summary of a workshop series*. National Academies Press.

Décret n°2005-1156 du 13 septembre 2005 relatif au plan communal de sauvegarde et pris pour application de l'article 13 de la loi n° 2004-811 du 13 août 2004 de modernisation de la sécurité civile, Pub. L. No. 2005–1156 (2005). https://www.legifrance.gouv.fr/loda/id/LEGITEXT000006052410

DeWalt, K. M., & DeWalt, B. R. (2011). *Participant observation: A guide for fieldworkers* (2nd ed). Rowman & Littlefield, Md.

Die Johanniter. (2022). *JOHANNITER Wien*. JOHANNITER Wien. https://www.johanniter.at/wien/ueber-uns

EFEHR. (2021). *Earthquake RISK across Europe*. http://www.efehr.org/Earthquake-risk/What-is-earthquake-risk/

Efthimiou, N., Psomiadis, E., & Panagos, P. (2020). Fire severity and soil erosion susceptibility mapping using multi-temporal Earth Observation data: The case of Mati fatal wildfire in Eastern Attica, Greece. *CATENA*, *187*, 104320. https://doi.org/10.1016/j.catena.2019.104320

Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology. (n.d.). *Organisation*. Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology. https://www.bmk.gv.at/en/ministry/organisation.html

Feloni, E., Mousadis, I., & Baltas, E. (2020). Flood vulnerability assessment using a GIS-based multi-criteria approach—The case of Attica region. *Journal of Flood Risk Management*, *13*(S1), e12563. https://doi.org/10.1111/jfr3.12563

Feuerwehr Wien. (2020). *FEUERWEHR WIEN; Vorbeugender Brandschutz*. Berufsfeuerwehr Wien. https://berufsfeuerwehr-wien.at/

Food and Agriculture Organization of the United Nations & Caribbean Natural Resources Institute. (2022). *Toolkit for vulnerability and capacity assessments in Caribbean coastal and fishing communities*. https://books.google.at/books?id=ElhqEAAAQBAJ&pg=PA44&lpg=PA44&dq=timelines+tools+VCAs&source=bl&ots=1jbp7-Ado0&sig=ACfU3U1btjjNCkCOczoZRfGTe9GidgWd-w&hl=en&sa=X&ved=2ahUKEwj42aCtifCAAxUIgf0HHShECWwQ6AF6BAg1EAM#v=onepage&q=timelines%20tools%20VCAs&f=false

Grünes Kreuz. (2023). *Grünes Kreuz*. Grünes Kreuz. https://grueneskreuz.org/de/Home.html

Hashemipour, M., Stuban, S. M., & Dever, J. R. (2017). A community-based disaster coordination framework for effective disaster preparedness and response. *Australian Journal of Emergency Management, The*, *32*(2), 41–46.

Organisation of Civil Protection and other provisions, Pub. L. No. 2344/1995 (1995).

Upgrade of civil protection and other provisions, Pub. L. No. 3013/2002 (2002).

'Xenokratis' general civil protection plan, Pub. L. No. 1299/2003 (2003).

National Crisis and Hazard Management Mechanism, restructuring of the General Secretariat of Civil Protection, upgrade of civil protection volunteering system, reformation of the Fire Brigade and other provisions, Pub. L. No. 4662/2020 (2020).

Kammer der Steuerberater und Wirtschaftsprüfer. (2021a). *Arbeiter-Samariter-Bund Österreichs*. Österreichisches Spendengütesiegel. https://www.osgs.at/organisationen/arbeiter-samariter-bund-oesterreichs/?gclid=Cj0KCQjwpc-oBhCGARIsAH6ote-beHlOIxIs8ZWbvYLCarhM_tnJ6MEFbrYWEMPPt1f3XnMlVQIt-O0aAjPOEALw_wcB

Kammer der Steuerberater und Wirtschaftsprüfer. (2021b). *Sozial Medizinischer Dienst Österreich*. Spendengütesiegel Österreich. https://www.osgs.at/organisationen/sozial-medizinischer-dienst-oesterreich/?gclid=Cj0KCQjwjt-oBhDKARIsABVRB0w6Usk3129CXANTfaGPb-mNVlua66lgDZ2J46SwruERBJz3Qkko9-QaAhrMEALw_wcB

Karali, A., Varotsos, K. V., Giannakopoulos, C., Nastos, P. P., & Hatzaki, M. (2023). Seasonal fire danger forecasts for supporting fire prevention management in an eastern Mediterranean environment: The case of Attica, Greece. *Natural Hazards and Earth System Sciences*, *23*(2), 429–445. https://doi.org/10.5194/nhess-23-429-2023

Kotsiou, O., Srivastava, D., Kotsios, P., Exadaktylos, A., & Gourgoulianis, K. (2018). The Emergency Medical System in Greece: Opening Aeolus' Bag of Winds. *International Journal of Environmental Research and Public Health*, *15*(4), 745. https://doi.org/10.3390/ijerph15040745

Loi n° 2003-699 du 30 juillet 2003 relative à la prévention des risques technologiques et naturels et à la réparation des dommages (1), Pub. L. No. 2003–699 (2003). https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000604335

Loi n° 2004-811 du 13 août 2004 de modernisation de la sécurité civile (1), Pub. L. No. 2004–811 (2004). https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000804612

Loi n°87-565 du 22 juillet 1987 relative à l'organisation de la sécurité civile, à la protection de la forêt contre l'incendie et à la prévention des risques majeurs, Pub. L. No. 87–565 (1987). https://www.legifrance.gouv.fr/loda/id/LEGITEXT000006069012

Mairie de Paris. (2018). *Paris Resilience Strategy*. https://resilientcitiesnetwork.org/downloadable_resources/Network/Paris-Resilience-Strategy-English.pdf

MALTESER Austria. (n.d.). *Wer wir sind*. MALTESER HOSPITALDIENST AUSTRIA. https://www.malteser.at/wer-wir-sind/

Mayring, P. (2002). Einführung in die qualitative Sozialforschung [Introduction to qualitative social research]. *Beltz: Weinheim, Basel*.

MindTools. (n.d.). *The Disney Creative Project*. https://www.mindtools.com/abyeaeb/the-disney-creative-strategy

Ministry for Climate Crisis and Civil Protection. (2023). *Civil protection emergency plans*. Civilprotection. https://civilprotection.gov.gr/sxedia-politikis-prostasias

Nguyen, T. T. X., Bonetti, J., Rogers, K., & Woodroffe, C. D. (2016). Indicator-based assessment of climate-change impacts on coasts: A review of concepts, methodological approaches and vulnerability indices. *Ocean & Coastal Management*, *123*, 18–43. https://doi.org/10.1016/j.ocecoaman.2015.11.022

ÖRHB. (2023). *LANDESGRUPPE Niederösterreich & Wien*. Österreichische Rettungshundebrigade. https://www.oerhb.at/oerhb-noe-wien/

Österreichische Wasserrettung Bundesleitung. (2023). *GEMEINSAM IM EINSATZ Sei auch du dabei*. ÖSTERREICHISCHE WASSERRETTUNG Landesverband Wien. https://w.owr.at/

Österreichischer Bergrettungsdienst. (n.d.). *Bergrettung Niederüsterreich/Wien*. Bergrettung Niederösterreich/Wien. https://bergrettung-nw.at/

ÖSTERREICHISCHES ROTES KREUZ. (n.d.). Wiener Rotes Kreuz. https://www.roteskreuz.at/wien/home

Parlamentsdirektion. (2019). *GESCHÄFTSEINTEILUNG der Zentralstelle des Bundesministeriums für Landesverteidigung (BMLV)*. Parlament. https://www.parlament.gv.at/dokument/XXVII/AB/9777/imfname_1442406.pdf

Prizzia, R. (2008). *The role of coordination in disaster management*.

Sanoff, H. (2011). Multiple Views of Participatory Design. *Focus*, *8*(1). https://doi.org/10.15368/focus.2011v8n1.1

Schröter, B., Hauck, J., Hackenberg, I., & Matzdorf, B. (2018). Bringing transparency into the process: Social network analysis as a tool to support the participatory design and implementation process of

Payments for Ecosystem Services. *Ecosystem Services*, *34, part B*, 206–217. https://doi.org/10.1016/j.ecoser.2018.03.007

Stadt Wien. (n.d.). *Der 'K-Kreis'*. Die Helfer Wiens. https://diehelferwiens.wien.gv.at/k-kreis

Stadt Wien - Wiener Wohnen. (n.d.). *Über Wiener Wohnen*. Stadt Wien | Wiener Wohnen. https://www.wienerwohnen.at/ueber-uns/ueber.html

Stadt Wien, Berufsrettung Wien. (n.d.). *Berufsrettung Wien*. Stadt Wien. https://www.wien.gv.at/gesundheit/einrichtungen/rettung/index.html

Stadt Wien, Feuerwehr und Katastrophenschutz. (n.d.). *Freiwillige Feuerwehren in Wien*. Stadt Wien. https://www.wien.gv.at/menschen/sicherheit/feuerwehr/organisation/feuerwachen/freiwillige-feuerwehren.html

Stadt Wien, Magistratsdirektion - Geschäftsbereich Organisation und Sicherheit - Gruppe Sofortmaßnahmen. (n.d.). *Gruppe Sofortmaßnahmen*. Stadt Wien. https://www.wien.gv.at/menschen/sicherheit/sofortmassnahmen/

Stadt Wien, Magistratsdirektion - Krisenmanagement und Sicherheit. (n.d.). *AkutBetreuungWien—Psychosoziale Betreuung in Notfallsituationen*. Stadt Wien. https://www.wien.gv.at/menschen/sicherheit/krisenmanagement/akutbetreuung/index.html

Stadt Wien, Stadtservice Wien. (n.d.). *Stadtservice Wien*. Stadt Wien. https://www.wien.gv.at/kontakte/stadtservice/

Stadt Wien, Veterinäramt und Tierschutz. (n.d.). *Stadt Wien—Veterinäramt und Tierschutz (MA 60)*. Stadt Wien. https://www.wien.gv.at/kontakte/ma60/index.html

Tamarck Institute. (n.d.). *Index of Community Engagement Techniques*. https://www.tamarackcommunity.ca/library/index-of-community-engagement-techniques?gclid=Cj0KCQjw_5unBhCMARIsACZyzS335QQZjmN3yTsT0Cto0QEOq5468nnJKZr5iss9EhvuYAnQhJEolmUaAomcEALw_wcB

Triantafyllou, I., & Apostolopoulou, V. (2023). *D2.2 REGIONAL MULTI-HAZARDS/RISK DATA AND ASSESSMENT REPORT* (PANTHEON - Community-Based Smart City Digital Twin Platform for Optimised DRM Operations and Enhanced Community Disaster Resilience). Horizon Europe PANTHEON, Grant Agreement N°101074008.

Tsaloukidis, J., Condomines, J.-P., Mykoniatis, G., Barrado, C., Apostolopoulou, V., Nakos, S., Grabmaier, I., Shtefchyk Tatarchuck, K., Chronopoulos, P., & Bagiyan, V. (2023). *D2.1 COMMUNITY BASED DRM ANALYSIS AND REGIONAL ECOSYSTEM* (PANTHEON - Community-Based Smart City Digital Twin Platform for Optimised DRM Operations and Enhanced Community Disaster Resilience). Horizon Europe PANTHEON, Grant Agreement N°101074008.

Tsaloukidis, J., Petsioti, P., Gatsogianni, C., Georgiou, E., Stergiopoulos, G., Karamousadakis, M., Apostolopoulou, V., Nakos, S., Bularca, O., Barrado, C., & Sharples, J. (2023). *D3.1 TECHNOLOGY ROADMAP FOR DISASTER RESILIENT COMMUNITIES* (PANTHEON - Community-Based Smart City Digital Twin Platform for Optimised DRM Operations and Enhanced Community Disaster Resilience). Horizon Europe PANTHEON, Grant Agreement N°101074008.

UN Habitat. (2012). *Visioning: As participatory planning tool, learning from Kosovo practices*. http://unhabitat-kosovo.org/old/repository/docs/visioning-ENG_580382.pdf

V001-295—Statut für die Unternehmung „Wien Kanal“. (n.d.). https://www.ris.bka.gv.at/Dokumente/Gemeinderecht/GEMRE_WI_90101_V001_295_2014/GEMRE_WI_90101_V001_295_2014.pdf

Voinov, A., Jenni, K., Gray, S., Kolagani, N., Glynn, P. D., Bommel, P., Prell, C., Zellner, M., Paolisso, M., Jordan, R., Sterling, E., Schmitt Olabisi, L., Giabbanelli, P. J., Sun, Z., Le Page, C., Elsawah, S., BenDor, T. K., Hubacek, K., Laursen, B. K., … Smajgl, A. (2018). Tools and methods in participatory modeling: Selecting the right tool for the job. *Environmental Modelling & Software*, *109*, 232–255. https://doi.org/10.1016/j.envsoft.2018.08.028

Wethington, E., & McDarby, M. L. (2015). Interview Methods (Structured, Semistructured, Unstructured). In S. K. Whitbourne (Ed.), *The Encyclopedia of Adulthood and Aging* (pp. 1–5). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118521373.wbeaa318

Wien Energie GmbH, Wien Energie Vertrieb GmbH & Co KG. (2023). *Die Energie von Wien*. WIEN ENERGIE. https://www.wienenergie.at/

Wiener Gesundheitsverbund. (2023). *Startseite*. Wiener Gesundheitsverbund. https://gesundheitsverbund.at/

Wiener Linien. (2023). *Top News*. WIENER LINIEN. https://www.wienerlinien.at/

Wiener Netze GmbH. (2023). WIENER NETZE. https://www.wienernetze.at/

YOUSE GmbH. (2013). *AAL Toolbox*. AAL Association. http://www.aal-europe.eu/wp-content/uploads/2015/02/AALA_ToolboxA5_online.pdf

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AAL	Ambient Assisted Living
ABW	Akut Betreuung Wien (Acute Care Vienna)
AFDRU	Austrian Forces Disaster Relief Unit
ASA	Aid and Support Action
ASB	Arbeiter Samariter Bund
BKA	Bundes Kriminalamt (Federal Criminal Office)
BMEIA	Federal Ministry for European and International Affairs
CBDRM	Community Based Disaster Risk Management
CBRNe hazards	Chemical, biological, radiological, nuclear and explosive hazards
CCIP	The Chamber of Commerce and Industry of Paris
CCTV	Closed Circuit Television
CP	Civil Protection
CPCU	Compagnie Parisienne de chauffage urbain
CSA	Com Support Action
DGPR	General Directorate for Risk Prevention
DGSCGC	General Directorate of Civil Security and Crisis Management
DM	Disaster Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ECHO	European Community Humanitarian Office
EKAB	National Centre for Emergency Aid
ENFSI	European Network of Forensic Science Institutes
ERDF	Electricite reseau distribution France
ERPUS	L'etablissement de preparation et de response aux urgences sanitaires

ESA	European Space Agency
E.S.K.E.D.I.K.	Joint Coordination Center for Operations and Crisis Management
EU	European Union
FAA	First Aid Action
FFA	Forest Firefighting Action
FPA	Forest Prevention Action
F.S.D.	Hellenic Police Forensic Science Division
GEMAPI	Gestion des milieux aquatiques et prevention des inondations
G.S.C.P.	General Secretariat of Civil Protection
GSOD	Großer Sicherheits- und Ordnungsdienst (large security police order service)
HF	High frequency
H.R.T.	Hellenic Rescue Team
ICPE	Installation Classee pour la Protection de l'Environment
INERIS	Institut National de l'Environment Industriel et des Risques
NGOs	Non-governmental organisations
PAA	Public Awareness Action
PAPI	Programme d'action de prevention des inondations
PCA	Plan de continuite d'activite
PDUIF	Plan de deplacements urbains d'Ile de France
PGRI	Risk Management Flood Plans
PID	Presse und Informationsdienst (Press and Information Service)
PLU	Plan local d'urbanisme
POI	Plan d'operation interne
PPR	Prevention Plans Risk
PSA	Psychological Support Action

ReSA	Relief and Support Action
REX	Disaster Analysis Missions
SAMU	Service d'aide medicale urgente
SaR	Search and Rescue
SCDT-Technology	Smart City Digital Twin-Technology
SGDSN	Secrétariat général de la défense et de la sécurité nationale
SHOM	Service hydrographique et océanographique de la Marine
SKKM	Staatliches Krisen- und Katastrophenschutzmanagement (State crisis and disaster protection management)
SMA	Shelter Monitoring Action
SMD	Sozial Medizinischer Dienst
SSH	Social Sciences and Humanities
SWOT Analysis	Strength, Weaknesses, Opportunities and Threats Analysis
T	Task
TRAct	Transportation Action
UAV	Drone/Unmanned Aerial Vehicle
UFA	Urban Firefighting Action
UHF	Ultra high frequency
USaR	Urban Search and Rescue
UTE analysis	User Task Environment Analysis
VHF	Very high frequency
WEGA	Vienna Special Operations Unit
WP	Work package

APPENDIX A – LIST OF KEY TERMS

1. ***Adaptation:*** Actions and measures taken to adjust and respond to the impacts of climate change, aiming to reduce vulnerability and enhance resilience to climate-related hazards.
2. ***Cascading effect:*** Effects that result from a primary incident or event and propagate through interconnected systems or processes, potentially leading to further consequences.
3. ***CBRN attack:*** Chemical, Biological, Radiological and Nuclear attack, it can include the letter "E" referred to Explosives.
4. ***Community-Based Disaster Risk Management (CBDRM):*** It refers to the approach of involving communities in managing and reducing disaster risks, utilizing local knowledge, resources, and participation.
5. ***Community:*** Group of individuals who share common characteristics, interests, or geographical proximity and interact with one another within a particular social, cultural, or physical context.
6. ***Civil protection:*** The organization responsible for ensuring the safety and well-being of citizens in the face of disasters and emergencies. In Paris, civil protection is organized by the Department for Prevention and Protection (DPP), which works in cooperation with officials, first responders, and the municipal civil security reserve.
7. ***Civil protection plan and strategies:*** Measures and actions developed by member states to manage and respond to emergencies and disasters, ensuring the protection and safety of the population.
8. ***Climate Change:*** Long-term shifts in global or regional climate patterns, primarily caused by human activities, leading to various environmental impacts, including increased frequency and intensity of extreme weather events.
9. ***Climate-related disaster:*** Disasters or events influenced or exacerbated by climate change, such as extreme weather events, sea-level rise, and heat waves.
10. ***Community Disaster Resilience:*** The ability of a community to prepare for, respond to, and recover from natural or man-made disasters, which involves the collective efforts of individuals, organizations, and government agencies to minimize the impact of disasters on the community and its residents.
11. ***Copernicus System (European Union Earth Observation Programme):*** a comprehensive and ambitious initiative aimed at providing accurate and timely Earth observation data and information for environmental monitoring, climate change analysis, and civil security purposes. It is managed by the European Commission in partnership with the European Space Agency (ESA) and other European and international organizations.
12. ***Council of Europe:*** An international organization composed of member states from across Europe, promoting cooperation and dialogue on various issues, including disaster risk reduction and risk governance.
13. ***COVID-19 pandemic:*** The global outbreak of the coronavirus disease in 2019, caused by the SARS-CoV-2 virus, resulted in a significant number of deaths, strain on healthcare systems, disruptions to public life, and economic damage.
14. ***Crisis Management:*** The process of preparing for, responding to, and recovering from crises.
15. ***Critical entities:*** Key organizations or infrastructure systems that play a crucial role in the functioning of member states, such as those in the energy and transport sectors.

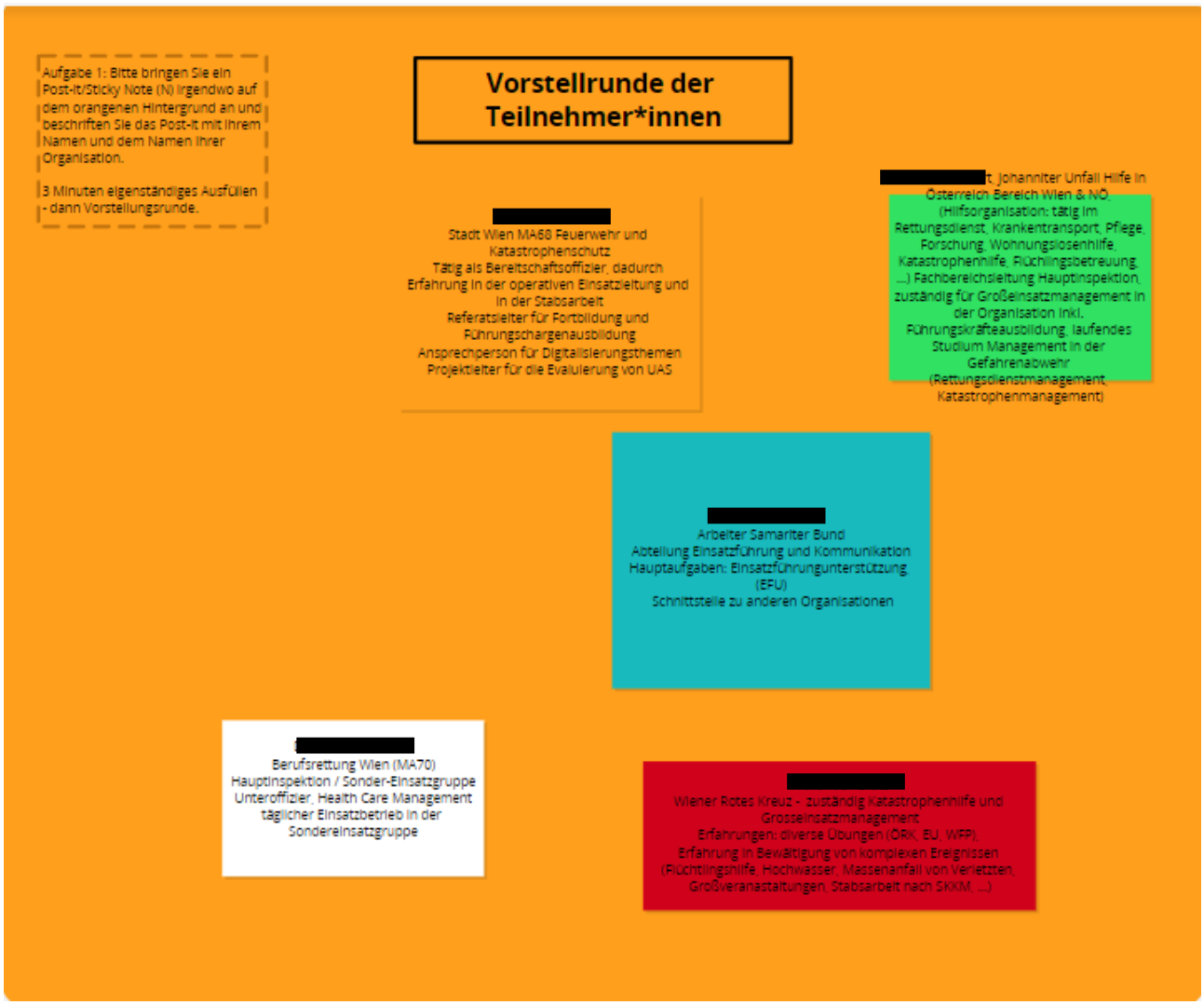
16. ***Critical infrastructure:*** Physical and virtual systems, facilities, and networks essential for the operation of societies and economies, including energy grids, transportation networks, and communication systems.
17. ***Cybersecurity:*** Measures and practices designed to protect computer systems, networks, and data from unauthorized access, cyber threats, and attacks.
18. ***Decentralised and/or Participatory Governance:*** a system of governance that involves the distribution of power, decision-making authority, and responsibility to lower levels of government or directly to the people. It emphasizes active citizen participation, inclusivity, and transparency in decision-making processes.
19. ***Disaster:*** Catastrophic event that causes significant damage and disruption to an extent that overwhelms local capacities, often resulting from natural hazards such as storms, floods, earthquakes, or man-made incidents.
20. ***Disaster Management (DM):*** The actions, policies, and procedures undertaken to prepare for, respond to, recover from, and mitigate the impacts of disasters. It includes activities such as risk assessment, emergency response, and post-disaster recovery.
21. ***Disaster management cycle:*** The continuous process of planning, preparedness, response, and recovery for managing disasters.
22. ***Disaster Risk Management (DRM):*** The systematic approach, strategies, and measures put in place to analyse, reduce, and manage the risks and vulnerabilities associated with disasters. It encompasses the actions taken to prevent, mitigate, prepare for, respond to, and recover from disasters.
23. ***Disaster Risk Reduction (DRR):*** The systematic efforts and strategies aimed at minimizing the impacts of disasters by reducing the underlying risk factors and vulnerabilities. It involves proactive measures taken to prevent or mitigate the effects of hazards, enhance resilience, and promote sustainable development.
24. ***Drone/Unmanned Aerial Vehicle (UAV):*** an aircraft that is operated without a human pilot on board. Drones are typically controlled remotely by a pilot on the ground or can be programmed to operate autonomously using pre-defined flight plans and onboard sensors.
25. ***Early warning:*** Systems and mechanisms that provide advance notice and alerts about potential hazards or impending disasters, allowing individuals and communities to take necessary actions.
26. ***Earthquake:*** Natural disasters caused by the sudden release of energy in the Earth's crust, resulting in ground shaking and potential damage to buildings and infrastructure.
27. ***European Commission (EC):*** The executive body of the European Union responsible for proposing and implementing EU policies, including those related to climate change adaptation and risk reduction.
28. ***Exposure:*** The degree to which a system, region, or population is subjected to potentially harmful effects of a hazard, considering physical, social, and economic factors.
29. ***Extreme rainfall:*** Intense and prolonged periods of heavy rainfall can lead to flooding and damage to infrastructure.
30. ***Flooding:*** The overflow of water onto normally dry land, often caused by heavy rain, river overflow, or storm surges, resulting in property damage, infrastructure disruptions, and risks to human life.

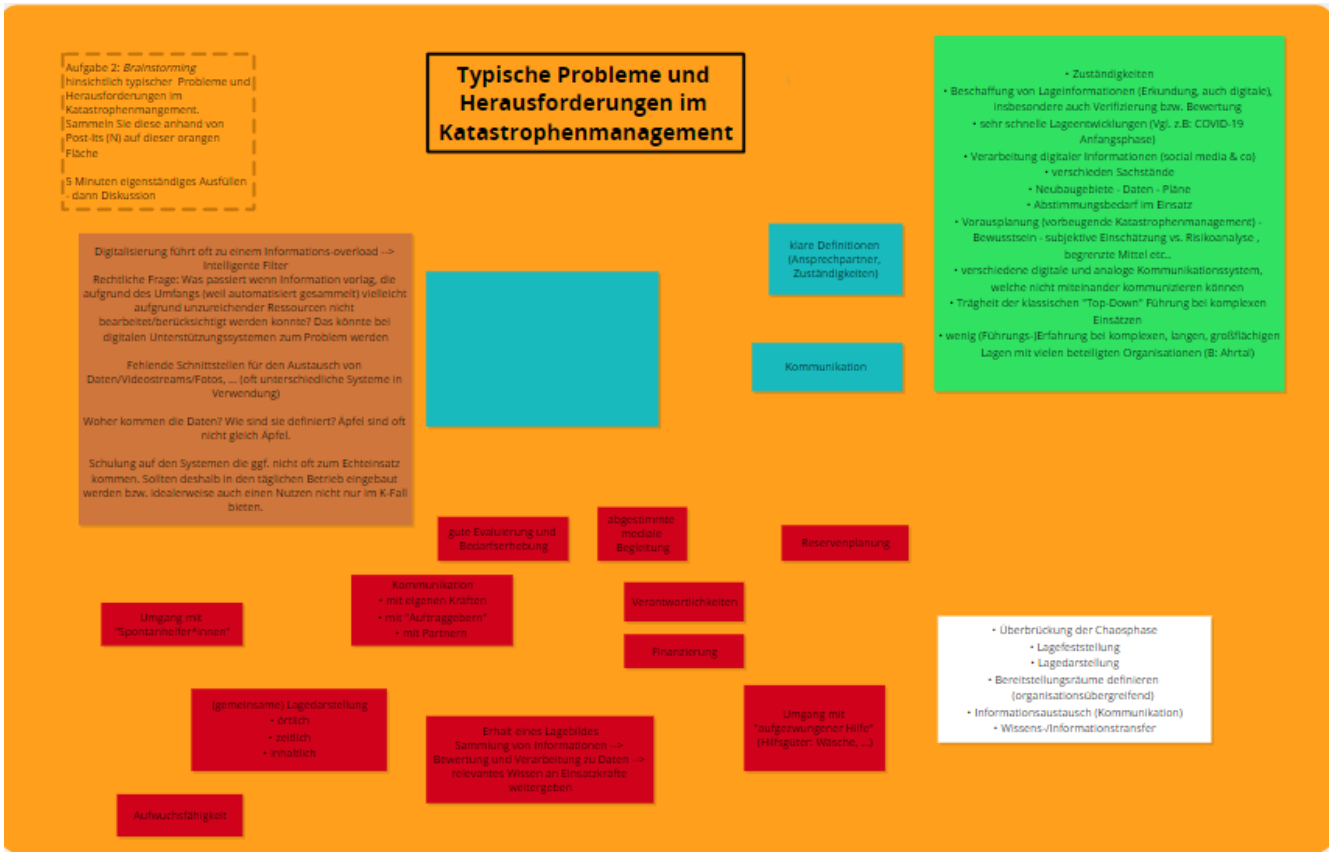
31. ***Flood risk:*** Potential dangers and hazards associated with flooding, including the impacts of increased water levels and overflow of rivers or other water bodies.
32. ***Forest fire:*** Uncontrolled fires that occur in forested areas, causing loss of life, damage to ecosystems, and overwhelming emergency services.
33. ***Geophysical hazard:*** Natural hazards related to Earth's geological processes, including earthquakes, landslides, and volcanic eruptions.
34. ***Governance:*** The system of decision-making, policies, and processes implemented by national and local authorities to manage risks and address challenges related to disasters and climate change.
35. ***Hazard map:*** Maps that identify areas with high risk of natural hazards such as floods, droughts, landslides, and extreme temperatures.
36. ***Hurricane:*** Large, rotating storms characterized by strong winds and heavy rain, typically forming over warm ocean waters. Hurricanes can cause widespread destruction, including damage to buildings, infrastructure, and coastal areas.
37. ***Hydro-meteorological hazard:*** Natural hazards related to weather and climate, such as storms, floods, and droughts.
38. ***Industrial accident:*** Accidents or incidents that occur within industrial facilities or processes, resulting in significant harm, damage, or environmental impact.
39. ***Integration:*** The process of combining or coordinating different elements or levels to create a comprehensive and connected approach to addressing climate change adaptation and disaster risk reduction.
40. ***Landslide:*** The downward movement of a mass of soil, rock, or debris on a slope.
41. ***Malicious act:*** Intentional actions with harmful intent, such as sabotage or terrorism.
42. ***Mitigation:*** Actions taken to reduce or prevent greenhouse gas emissions and alleviate climate change impacts.
43. ***Man-made disaster:*** Disasters caused by human activities. In France, man-made disasters can include incidents at industrial installations and establishments, such as dams and nuclear plants, as well as terrorist attacks.
44. ***Major-accident hazard:*** Hazards associated with the storage, handling, and use of dangerous substances that can lead to significant accidents with severe consequences.
45. ***Natural hazard:*** A natural process or phenomenon that may cause loss of life, injury, property damage, disruption of services, or environmental damage.
46. ***Open-source software platform for emergency management and humanitarian aid:*** software solution that is freely available for use, modification, and distribution, specifically created to support organizations and agencies involved in emergency response and humanitarian efforts.
47. ***Prefect:*** The representative of the state at the departmental level in France, responsible for coordinating operational processes, mobilizing personnel and resources, and managing local disaster response efforts.
48. ***Preparedness:*** Measures taken in advance to improve awareness, readiness, and response capacity of individuals and communities to potential hazards and disasters.
49. ***Prevention phase:*** The phase of the disaster management cycle focused on measures taken to prevent or mitigate the impact of snowfalls and frost, such as road maintenance and snow removal.

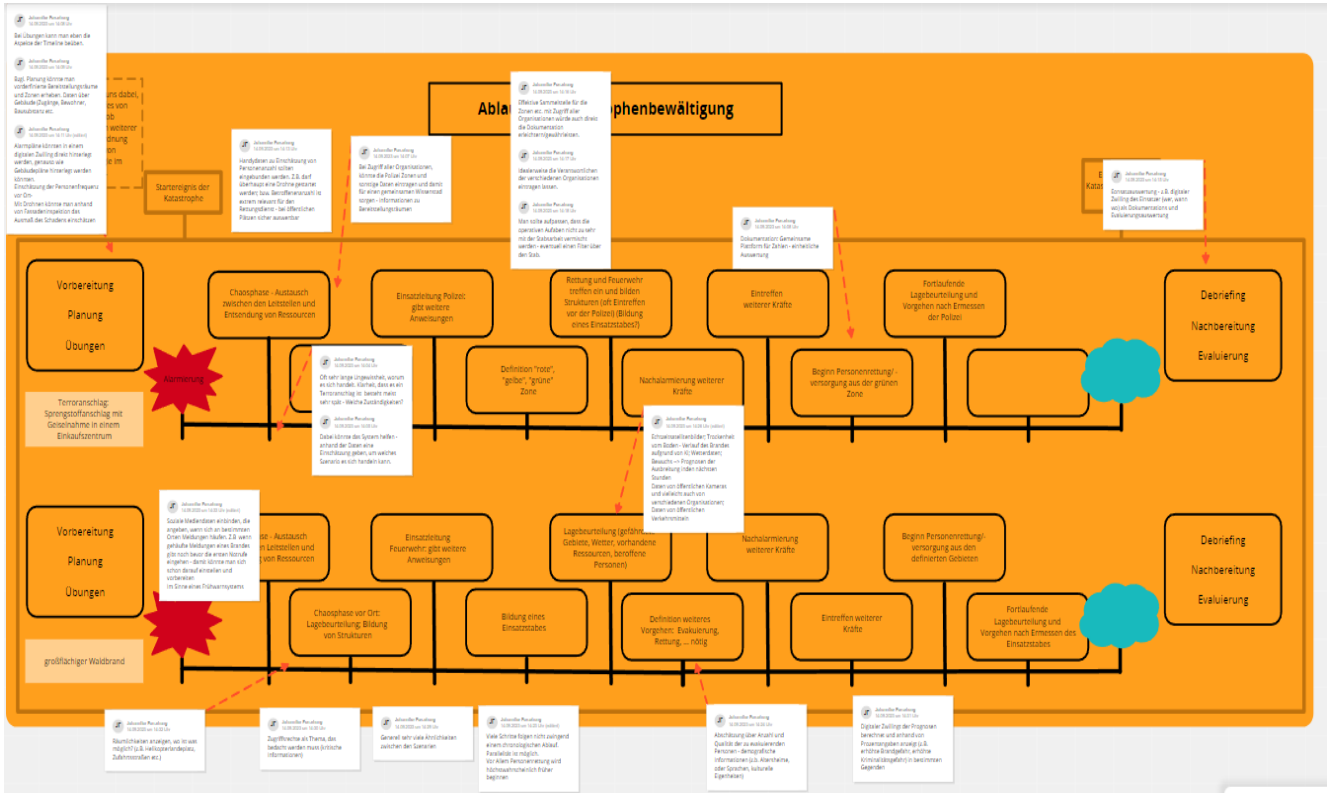
50. ***Policymaker:*** Individuals or authorities responsible for formulating and implementing policies at national and local levels, guiding actions and interventions related to disaster risk reduction and climate change adaptation.
51. ***Public awareness:*** Level of knowledge, understanding, and consciousness that the general public has about various issues, topics, or events. It reflects the extent to which people are informed, educated, and conscious of matters that affect them, their communities.
52. ***Recovery:*** The phase of disaster management that focuses on long-term rebuilding and reconstruction efforts after a disaster.
53. ***Recovery phase:*** The phase of the disaster management cycle focused on restoring damaged infrastructure, providing support to affected areas and residents, and documenting damages to the primary production sector.
54. ***Regulation:*** Legislative acts or rules issued by the European Parliament and the Council of Europe to establish specific measures or provisions for a particular purpose, such as amending the 1313/2013 Decision to address challenges related to the COVID-19 pandemic and enhance response capacity.
55. ***Remote sensing:*** the process of acquiring information about the Earth's surface or other objects from a distance, typically using satellite, aerial, or other airborne sensors. It involves the collection and interpretation of data without direct physical contact with the objects or areas of interest.
56. ***Response capacity:*** The ability of a system or region to effectively respond and recover from the impacts of natural hazards or disasters, including the availability of resources, infrastructure, and institutional capacity.
57. ***Response phase:*** The phase of the disaster management cycle involving immediate actions and interventions in response to snowfall and frost emergencies, including search and rescue operations, provision of medical help, and restoration of essential services.
58. ***Risk:*** Possibility of something bad happening or a situation involving exposure to danger.
59. ***Risk Assessment:*** The process of identifying, evaluating, and analysing potential risks, including those associated with disasters, to develop strategies for risk reduction and management.
60. ***Risk Governance:*** The application of policies, regulations, and practices to manage and reduce risks associated with disasters and climate-related hazards.
61. ***Sensitivity:*** The degree to which a system or region is responsive or sensitive to changes in environmental conditions, including natural hazards.
62. ***Seismic risk:*** The potential for earthquakes to occur in a specific area, leading to the potential for damage and loss of life.
63. ***Smart City Digital Twin:*** A virtual replica or simulation of a city that integrates real-time data from various sources to provide insights and facilitate decision-making for urban planning and management. It combines advanced technologies, data analytics, artificial intelligence, and geospatial mapping to create a digital representation of a city`s physical and social infrastructure.
64. ***Stakeholder:*** Individuals, organizations, or groups with an interest or involvement in a particular issue or sector. In the context of disaster management, stakeholders can include government agencies, NGOs, community members, researchers, and first responders.
65. ***Storm:*** Severe weather events characterized by strong winds, heavy rain, and sometimes accompanied by lightning, thunder, or hail. Storms can cause damage to infrastructure and pose risks to human safety.

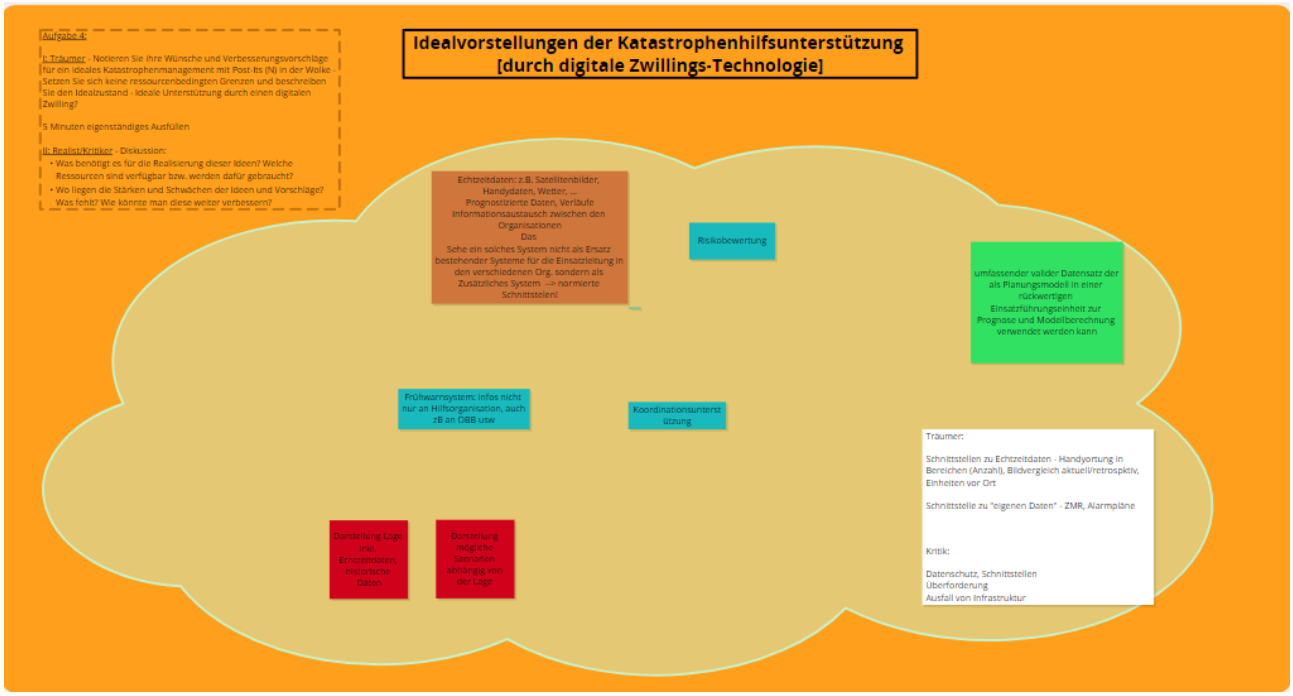
66. ***Synthetic Environment:*** Computer-generated or virtual representation of a real-world environment or scenario.
67. ***Technological hazard:*** Hazards arising from human-made processes or activities, such as industrial accidents or technological failures.
68. ***Technology roadmap:*** A strategic plan that outlines the development and deployment of technologies within an organization or industry. It provides a visual representation of the path and timeline for the implementation of various technologies to achieve specific goals and objectives.
69. ***Terrorism:*** Use of violence, intimidation, or coercion to achieve political, religious, or ideological objectives.
70. ***Tsunami wave:*** large ocean waves caused by underwater earthquakes or volcanic eruptions.
71. ***Vulnerability:*** The susceptibility or sensitivity of a region or population to the impacts of natural hazards or disasters, considering exposure, sensitivity, and adaptive capacity.
72. ***Vulnerable area:*** Areas that are at a higher risk of experiencing the negative impacts of disasters due to factors such as geographical location, exposure to hazards, socioeconomic conditions, and inadequate infrastructure.
73. ***Vulnerable group***: Segments of the population that are more susceptible to experiencing harm, discrimination, or disadvantage due to various factors such as their social, economic, geographic location, or physical circumstances with a higher impact when a disaster occurs.

APPENDIX B – 'CONCEPTBOARD' USED IN THE VIENNESE PARTICIPATORY DESIGN WORKSHOPS




Aufgabe 2: Brainstorming
hinsichtlich typischer Probleme und Herausforderungen im Katastrophenmanagement.
Sammeln Sie diese anhand von Post-Its (N) auf dieser orangen Fläche
5 Minuten eigenständiges Ausfüllen - dann Diskussion
Typische Probleme und Herausforderungen im Katastrophenmanagement
• Zuständigkeiten
• Beschaffung von Lageinformationen (Erkundung, auch digitale), insbesondere auch Verifizierung bzw. Bewertung
• sehr schnelle Lageentwicklungen (Vgl. z.B: COVID-19 Anfangsphase)
• Verarbeitung digitaler Informationen (social media & co)
• verschieden Sachstände
• Neubaugebiete - Daten - Pläne
• Abstimmungsbedarf im Einsatz
• Vorausplanung (vorbeugende Katastrophenmanagement) - Bewusstsein - subjektive Einschätzung vs. Risikoanalyse , begrenzte Mittel etc..
• verschiedene digitale und analoge Kommunikationssystem, welche nicht miteinander kommunizieren können
• Trägheit der klassischen "Top-Down" Führung bei komplexen Einsätzen
• wenig (Führungs-)Erfahrung bei komplexen, langen, großflächigen Lagen mit vielen beteiligten Organisationen (B: Ahrtal)
Digitalisierung führt oft zu einem Informations-overload --> Intelligente Filter
Rechtliche Frage: Was passiert wenn Information vorlag, die aufgrund des Umfangs (weil automatisiert gesammelt) vielleicht aufgrund unzureichender Ressourcen nicht bearbeitet/berücksichtigt werden konnte? Das könnte bei digitalen Unterstützungssystemen zum Problem werden
Fehlende Schnittstellen für den Austausch von Daten/Videostreams/Fotos, ... (oft unterschiedliche Systeme in Verwendung)
Woher kommen die Daten? Wie sind sie definiert? Apfel sind oft nicht gleich Apfel.
Schulung auf den Systemen die ggf. nicht oft zum Echteinsatz kommen. Sollten deshalb in den täglichen Betrieb eingebaut werden bzw. idealerweise auch einen Nutzen nicht nur im K-Fall bieten.
klare Definitionen (Ansprechpartner, Zuständigkeiten)
Kommunikation
gute Evaluierung und Bedarfserhebung
abgestimmte mediale Begleitung
Reservenplanung
Kommunikation
• mit eigenen Kräften
• mit "Auftraggebern"
• mit Partnern
Verantwortlichkeiten
Finanzierung
Umgang mit "Spontanhelfer*innen"
(gemeinsame) Lagedarstellung
• örtlich
• zeitlich
• inhaltlich
Erhalt eines Lagebildes
Sammlung von Informationen -->
Bewertung und Verarbeitung zu Daten -->
relevantes Wissen an Einsatzkräfte weitergeben
Umgang mit "aufgezwungener Hilfe" (Hilfsgüter: Wäsche, ...)
Aufwuchsfähigkeit
• Überbrückung der Chaosphase
• Lagefeststellung
• Lagedarstellung
• Bereitstellungsräume definieren (organisationsübergreifend)
• Informationsaustausch (Kommunikation)
• Wissens-/Informationstransfer


Ablauf Katastrophenbewältigung
Startereignis der Katastrophe
Vorbereitung
Planung
Übungen
Alarmierung
Terroranschlag: Sprengstoffanschlag mit Geiselnahme in einem Einkaufszentrum
Chaosphase - Austausch zwischen den Leitstellen und Entsendung von Ressourcen
Einsatzleitung Polizei: gibt weitere Anweisungen
Rettung und Feuerwehr treffen ein und bilden Strukturen (oft Eintreffen vor der Polizei) (Bildung eines Einsatzstabes?)
Eintreffen weiterer Kräfte
Fortlaufende Lagebeurteilung und Vorgehen nach Ermessen der Polizei
Debriefing
Nachbereitung
Evaluierung
Definition "rote", "gelbe", "grüne" Zone
Nachalarmierung weiterer Kräfte
Beginn Personenrettung/-versorgung aus der grünen Zone
Vorbereitung
Planung
Übungen
großflächiger Waldbrand
Einsatzleitung Feuerwehr: gibt weitere Anweisungen
Lagebeurteilung (gefährdete Gebiete, Wetter, vorhandene Ressourcen, betroffene Personen)
Nachalarmierung weiterer Kräfte
Beginn Personenrettung/-versorgung aus den definierten Gebieten
Debriefing
Nachbereitung
Evaluierung
Chaosphase vor Ort: Lagebeurteilung: Bildung von Strukturen
Bildung eines Einsatzstabes
Definition weiteres Vorgehen: Evakuierung, Rettung, ... nötig
Eintreffen weiterer Kräfte
Fortlaufende Lagebeurteilung und Vorgehen nach Ermessen des Einsatzstabes


Aufgabe 4:
I: Träumer - Notieren Sie ihre Wünsche und Verbesserungsvorschläge für ein ideales Katastrophenmanagement mit Post-Its (Ni) in der Wolke. Setzen Sie sich keine ressourcenbedingten Grenzen und beschreiben Sie den Idealzustand - Ideale Unterstützung durch einen digitalen Zwilling?
5 Minuten eigenständiges Ausfüllen
II: Realist/Kritiker - Diskussion:
• Was benötigt es für die Realisierung dieser Ideen? Welche Ressourcen sind verfügbar bzw. werden dafür gebraucht?
• Wo liegen die Stärken und Schwächen der Ideen und Vorschläge? Was fehlt? Wie könnte man diese weiter verbessern?
Idealvorstellungen der Katastrophenhilfsunterstützung [durch digitale Zwillings-Technologie]
Echtzeitdaten: z.B. Satellitenbilder, Handydaten, Wetter, ...
Prognostizierte Daten, Verläufe
Informationsaustausch zwischen den Organisationen
Das
Sehe ein solches System nicht als Ersatz bestehender Systeme für die Einsatzleitung in den verschiedenen Org. sondern als Zusätzliches System --> normierte Schnittstelen!
Risikobewertung
umfassender valider Datensatz der als Planungsmodell in einer rückwertigen Einsatzführungseinheit zur Prognose und Modellberechnung verwendet werden kann
Frühwarnsystem: Infos nicht nur an Hilfsorganisation, auch zB an ÖBB usw
Koordinationsunterstützung
Darstellung Lage inkl. Echtzeitdaten, historische Daten
Darstellung mögliche Szenarien abhängig von der Lage
Träumer:
Schnittstellen zu Echtzeitdaten - Handyortung in Bereichen (Anzahl), Bildvergleich aktuell/retrospktiv, Einheiten vor Ort
Schnittstelle zu "eigenen Daten" - ZMR, Alarmpläne
Kritik:
Datenschutz, Schnittstellen
Überforderung
Ausfall von Infrastruktur