CRISPRO: Security and Protection through Knowledge Synergies

Title: D3.2 Sharing Good Practices and Lessons Learned Case Studies Benchmarking

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Introduction

The risks that threaten modern societies have become increasingly complex and generally require cross-sectoral cooperation due to reduced security as a whole. The global trends concerning climate changes, mobilisation, conflicts, forced migration, and transferrable forms of violation are also linked to social media and citizens' mobilisation/awareness. The widespread communicable airborne diseases heavily impact European societies' protection efforts. The increased number of multi-facet disasters, incidents and forms of disorder and interruption threatened the sustainable and stable delivery of the citizens' services, supply of goods, medicines, health and social care services, and utilities.

CRISPRO partners collected and analyses 22 case studies about disasters: extreme natural events, climate change, technological failure combined with the stationary chemical hazards and sociogenic behavioural stress, CBRN-communicable deceases related events, and violation events triggered by industrialisation and smartening of the systems and communities.

Analysed cases study demonstrates a multiple-threats approach is needy. Therefore, learning from practical experience and investing in prevention and learning from others shall be critical knowledge-based issues for gaining greater resilience of the societies.

Interoperability of early warning mechanisms is required to develop a new integrated safety and security culture, which is the centre of the societal resilience concept.

The best practices are outlined as the CRISPRO benchmarking approach to support decision-makers to create safety for societies and citizens.

Project Context

The project outlines experiences from past events that are important for the management, organisation, and investment in mitigation of the risk in the future. Our ultimate goal is to bridge the gap between LEAs, municipalities, public service providers and first responders and to foster collaboration through the development of more integrated and coordinated approaches to improve the safety and security of soft targets, to prevent or mitigate the impact of natural, biological and technological threats/hazards, and to learn from past events effectively.

The ability to measure emergency preparedness to predict the likely performance of the emergency response systems in possible large-scale crises is critical for the prevention and development of vulnerability reduction measures. It is, however, difficult to know how to foster the emergency management system to deal with extraordinary large-scale events, whether it be a natural disaster, chemical and biological hazard, terrorist attack, or industrial or transportation accident.

The best practices benchmarking study papers look from vulnerability, situational awareness, early warning and prediction technologies and response provisions. However, the risks that threaten modern societies have become increasingly complex and generally require cross-sectoral cooperation. In response to this, the proposed risk assessment processes, in terms of technology, administration and policy, and the levels of risk awareness, have to be regularly evolved. There is, however, a constant need to enhance the processes of assessing impacts on the community ecosystem and its functionalities to gain a better understanding and learn from the past how to strengthen preparedness in the organisation, sources, and protection/reduction measures and capital investments. To do so, we have to gather knowledge and lessons learned from historical disaster-related evidence and analyse behavioural response approaches and cascading effects on related societal relations and infrastructure.

Risk assessment provisions

Why is it important to valorise and capitalise on practical experience?

An important aspect of risk assessment on the European Union at international, national, and regional levels is handling the various administrative stakeholders and managing parallel communications in crises. The nature- and climate change-related hazards currently affecting Europe have a widespread impact on the critical infrastructure due to the growing interdependency of societies. Furthermore, extreme wind, temperature, snow, rain, landslides, floods, storms and tornado events, especially those with cross-border impacts, can be subject to political repercussions. In general, the personnel is not adequately equipped or prepared to effectively respond in such crises, which require an abrupt response and multi-sectoral control measures. In such situations, ad-hoc arrangements are commonly adopted, resulting in operational problems.

It refers to the management of permanent crisis response organisations is often a challenge for politicians and civil servants. However, the convening of ad-hoc coordination groups presents its challenges since the special resources and services required in such disaster situations are not provided.

An ad-hoc leadership can create confusion at the operational level since it duplicates the existing national system, resulting in a chaotic situation and uncertainty regarding responsibilities. In contrast, the enhancement of the provision of a robust and permanent disaster response system is preferable. In particular, it has four essential characteristics: 1) juridical power, 2) operational capacity, 3) technological advantage, and 4) a political mandate. In addition, this structure has the benefit of good communication across different sectors.

The case studies of CRISPRO demonstrate that the critical or strategic infrastructure, supply chains, cities services are at any time endangered and vulnerable to any extraordinary event. Even a chemical, transport or fire incident could easily spread and contract any part of the civilian infrastructure. Urban areas are mostly affected. Smartening the civil services systems increases the interdependency and needs for introducing cost-effectiveness measures. The latter shall be based on using one infrastructure/utility network as a provision or firmware for multiple services that bring more troubles in unsecured by an extraordinary natural, social or cyber event. Nowadays, the EU security strategy emphasises the need for critical infrastructure protection (CIP). The aim is to strengthen the resilience of key functions, i.e. vital infrastructures such as border and transport security, by reducing their vulnerability. The evolving CIP policy is based on a multi-hazard approach that considers natural and manufactured disasters. However, several initiatives remain to be implemented by the European Commission to systematise and institutionalise this process.

To date, the Member States have adopted a rather passive approach towards protecting critical infrastructure, which has resulted in an increased demand on policy planning to pave the way for this CIP initiative. The CIP aims to provide a common framework for dealing with security and safety issues but where the powers and capabilities remain the authority of the Member State. Unfortunately, the Member States often strive to preserve their sovereignty in civil security matters. After all, each Member State is responsible for protecting its citizens. However, vulnerability issues assigned with disruption of the functionalities of the infrastructure and supply chains need to preclude multi-faceted sectoral cooperation and support and mechanisms.

CRISPRO took advantage of the multi-hazards assessment approach mainstreamed by the newest directives of the EU on CIP and followed the model of assessing cascading effects triggering disruption of societal systems and related functionalities of the communities.

In support, this document describes a benchmarking method for assessing previous emergencies at home and abroad. As a result, we can evaluate each step of the emergency cycle and evaluate how our system would behave in a similar situation and draw conclusions and make recommendations on what should be changed or developed/enhanced.

The basic philosophy of resilience leads to CRISPRO case study benchmarking: The ability of an individual, a household, a community, a country or a region to prepare for, to withstand, to adapt, and to quickly recover from stresses and shocks without compromising long-term development prospects. We would like to contribute to developing a new approach for building resilience. Notwithstanding, CRISPRO benchmarking weight up the resilience-centred concept as an opportunity to bring together political dialogue, humanitarian and land use or urban development work and priorities in a comprehensive, coherent and effective approach to achieve better results on the ground.

Building resilience not only reduces suffering and loss of life but is also more cost-effective. The EU Approach to Resilience recognises the need to address the root causes of crises, especially recurrent crises, chronic poverty and vulnerability, and take a long-term perspective firmly embedded in local and national policies and linked to complementary action at the regional level. The approach incorporates several key components, including the following: the need to anticipate crises by assessing risks; a greater focus on risk reduction, prevention, mitigation and preparedness; and further efforts to enhance swift response to and recovery from crises. The resilience aims to address natural and man-made disasters, including slow- or rapid-onset disasters, large-scale emergencies and localised but frequent stresses and shocks, and crises in fragile or conflict-affected states.

Crisis types/categories disaster circumstances

Emergencies are extreme events that put lives and properties at risk. They can strike suddenly, or they will develop for a longer time. They require immediate response and coordinated application of resources. Effective emergency response management places extraordinary demands upon personnel for accurate, timely information to optimise limited resources under urgent constraints of time and skills.

Instead of just looking at some documents, we try to create a structural way of assessing 22 cases studies and developing CRISPRO risk mitigation assessment and procedures for better performance in any future and improved decision-makers repository.

For clarity, the CRISPRO project has identified four key categories – or types – of crisis that a civil security system may encounter:

- Natural disasters
- Infectious diseases
- Industrial failure and stationary chemical hazard
- Disruption of basic services of the critical infrastructure or supply services
- Cyber and social-media societal triggered violation emerging into cyber or physical attacks

Benchmarking

CRISPRO Benchmarking method

Following, we make an effort to use the benchmarking in the CRISPRO multi-hazards risk assessment context. Finally, we aim to establish a model to benchmark disasters risk reduction (DRR) and disaster risk management (DRM) against historical earmarking of extraordinary events.

When planning the benchmarking sessions/tasks, we needed to establish what we were trying to accomplish. For example, what areas do we want to develop or check against others? Also, we might classify some of the most valuable data.

Over the years, benchmarking practices have continually evolved in diverse ways. There have been marked changes in how organisations approach benchmarking. Krishnamoorthy and D'Lima have in their study summarised the various definitions into four major elements that make up a universal definition of benchmarking (Krishnamoorthy& D'Lima 2014)

- What is it? An ongoing procedure, tool or controlled approach.
- What does it do? Measures assess, advance, searches for and learn about products, services, performance, and practice.
- To whom was it evaluated? Comparisons with the best-in-class world leaders, similar organisations, etc.
- The anticipated results: To attain better performance, content, and apply knowledge.

Definition of benchmarking

Benchmarking is "the process of identifying, understanding, and adapting outstanding practises from organisations anywhere in the world to help an organisation improve its performance" (Kumar et al., 2006).

Benchmarking is a process of learning from others. It is using the knowledge and expertise of others to develop the organisation. It examines performance, noting the organisation's strengths and flaws, and assessing what needs to be made to move forward.

Benchmarking was first introduced to compare business organisations with or against current standards. Further on, it has been widely used in different circumstances and lately in the public sector, especially in health care.

Benchmarking approach

The case study benchmarking process under the CRISPRO project focuses on assessing the vulnerabilities, impacted functionalities of the societal systems, strategic infrastructure, and changes triggered in communities and emergency response systems due to the event. The CRISPRO benchmarking approach is based on six stages/steps for the setting of benchmarking of the DRM /DRR cycle as follows:

- Define the purpose of the benchmarking tool (step 1)
- Identification of disaster management aspects(step 2)
- Design the assessment framework: Design of risk management assessment questions (Step 3)
- Define indicators labels scoring framework (Step 4)
- Collect case studies and evaluate based on the benchmarking scoring and labelling indicators(Step 5)
- Definition of the CRISPRO benchmarking thresholds (Step 6)

The results of the benchmarking approach are defined as one of the CRISPRO tools supporting the decision-making and sharing knowledge processes on how to get prepared, prevent, react, recover, learn from the practices and redress them in to upgrade of the DRM cycle. The benchmarking procedure is based on the 22 case studies comparing processes and performances related to the DRM and risk assessment. There is no benchmarking methodology that we could adopt. But there are common features of benchmarking that allows speaking about the benchmarking method and necessary steps within the benchmarking. Build up models of those processes to understand any functional relations and their crucial points and define critical factors for success.

Step 1 Define the purpose of the benchmarking tool.

The benchmarking tool for risk management is developed to improve the ability of governments, civil society organisations, and the private sector to proactively plan and implement effective and efficient actions that would reduce their vulnerability to natural, technical and human-triggered disasters and create greater economic resilience when they do occur. The tool has the following utilities:

- A tool for evaluating the adequacy of current disaster risk management
- A tool for evaluating the readiness and capability of local, national institutions to deal with disaster risk.
- A list of best practice recommendations for disaster risk management.
- A tool for regional benchmarking of nations and programmes.

- The benchmarking is designed to be comprehensive given the following multi-dimensions of disaster risk management: risk exposure, geographic extent, and vulnerable elements. In terms of risk exposure, it was designed for multi-hazards. It could be redesigned for use at national, community, or enterprise levels to a geographic extent. It is, however, customisable to meet specific dimensions. Its present form covers all the vulnerable elements in general but may be redesigned to focus on any of the following vulnerable elements: affected population, infrastructure, economy, and environment.

What are the benefits of the benchmarking

- Administrative arrangements
- Assignment of responsibilities
- Stakeholders participation
- Information management
- Monitoring and evaluation of programmes
- Effective use of disaster risk management products

The benchmarking tool provides the following benefits as a whole:

- It provides a snapshot of exposure to combined disasters
- we can use to build support for the allocation of resources to reduce risk in areas defined.
- We can use it to prioritise national and regional programmes of activities.
- It can be used as an incentive at the political level.
- Consistently, it provides information on the state of readiness. This information can be used by regional, national and international civil protection agencies to define or redefine assistance programmes.

Step 2: Identification of the relevant disaster risk management aspect

We note major differences to determine what aspects of the cases are relevant for and what parts are not applicable.

Within stage two, we define the resources required to effectively and efficiently manage the components of disaster risk management activities. The following are the tools selected for review:

- Policies and plans
- Standards and regulations
- Legislation
- Human capacity
- Financial resources
- Technical tasks and contents.
- Public education and awareness
- Infrastructure development

We use a reverse engineering approach from disaster through reaction, recovery, lessons learnt and follow up mitigation measures following the risk governance cycle and focusing

on five aspects of the cases studies related to disaster risk reduction (DRR)and disaster risk management (DRM).

Within the benchmarking method, we consider the quality of performance of the following DRM/DRR cycle: response, recovery and resilience levels against the level of risks, including circumstance and vulnerability.

For the benchmarking as follows based on examined literature and intrenational methdoologies. These general and ultimate elements are considered for the CRISPRO case study framework drafting.

Labelling of aspects subject to DRM/DRM benchmarking method	What does the checklist of provisions include
Circumstances	• Combination of threats and hazards more than 1, or profiling potential cascading and amplifying effects • What combination of threats (na-tech) – please describe • Identified potential threats based on cascading effect • Multi-hazards induced disaster • Domino effect • Combination of incidents
Vulnerability	• Define the impact and areas of impact and hazards inducing the disaster. It helps us define the vulnerability attributes, including damages and affected areas of societal challenges. • Area • Population • Damages • Critical and soft infrastructure • Injured and human tolls • Affected area • Affected population • Affected critical or strategic infrastructure • Affected vulnerable groups • Identified critical assets to be protected • Damage level: Loss of life/ injury, Major damage (not only structural damage but also non-structural)
• Response capacity level Response efforts immediately after the hazard.	• Access to sources/knowledge, experience, tools amidst disaster • Used technologies/sources • capacities describe all types of operational, organisational, now how and technological capacities • Intervention teams • Know-how • Leadership crisis communication – organistaion • Technologies • Specific tools and equipment • Involved networks of emergency responders

	• Involved representatives of local communities, private sectors, NGOs (non-governmental organisations) and CBOs(civic-based organisations for volunteers) • Adequately equipped networks of responders (professional and public/volunteering actors) to respond to emergencies. • Adequately built communication systems and communication protocols • Identified leading agencies for each key emergency management sector, proper and clear distribution of responsibilities • Standard Operating Procedures (SOPs) for all aspects of disaster response are in place • Centralised/designated National (regional)Emergency Operations Centre equipped to handle the heavy flow and recording of data and information. • Ground rules established for media contact and advocacy activities • Arrangements for the involvement of additional expertise personnel from the other public agencies, the private sector is in place
Recovery level	• Recovery efforts after the hazard (what recovery plan) • Capacity relays to the mobilisation of staff, technologies and local actors • Clean-up, repair, and restoration teams are identified and trained • The existence of a clear strategy for deployment of these teams are developed • tools and transportation required for clean-up are assembled • established site-specific database on past damages • the databases used to prioritise new projects, upgrading and clean-up activities • common damage assessment methodology has been adopted for the country • identified and employed damage assessment teams been identified • A recovery policy is defined and approved • Community recovery resources are identified and inventoried. • Strategic positioning of resources for the quick response • Community-level training to support disaster response • Arrangements for monitoring and evaluating the effectiveness of the emergency response plan • Established early warning monitoring systems for all technological hazards and natural hazards in your communities, suited to local conditions and circumstances • A national disaster rehabilitation/recovery policy and plan exists • Infrastructural prioritisation for reconstruction /rehabilitation is in place, as well as strategies for impact assessment, rehabilitation and reconstruction, essential skills and personnel needed, essential equipment, service providers, construction contractors, and telecommunications providers, strategies for road clearance and reconstruction, electricity restoration, telecommunications restoration, water supply restoration, restoration of services at the airports and seaports, logistics storage, national aid fund is prepared to distribute material aid and equipment needed in the period of post-disaster recovery based on the spatial prioritisation in rehabilitation/reconstruction of infrastructure, a current inventory of sources of supply for rehabilitation and reconstruction materials exists, a purchasing agreement been made with the relevant suppliers. • Employed existing/designated post-event damage assessment teams to determine causes of failures and reasons for success. • Widely spread results of this assessment. • Ensured customs procedures for incoming relief workers or in-kind contributions • Allocated national budgetary for rehabilitation/reconstruction based on objectively defined criteria

Resilience level	• Major preparedness/ DRR measures before the hazard • Lessons learned from the event • Major changes/improvement in disaster risk management • capacities relay to future planned follow-up prevention/preparedness provisions based on lessons learned. • Regulation measures • Organisational measures • Technological measures • Awareness measures • Established joint disaster preparedness training and simulation activities for network members being conducted regularly • Planned development and update of the technologies and sources needed for the performance of the early monitoring systems • Periodically reviewed, tested and rehearsed the disaster recovery plan • Delivered policy guidance for budget management concerning rehabilitation/reconstruction • Developed plans for the revitalisation of affected sectors, priorities are objectively determined and reviewed • Developed community-level plans for sectoral revitalisation, including also NGOs and CBOs, also incorporating the risk reduction activities performed by the business continuity plans for educational institutions, health facilities and all types of social and public services providers(facilities) secured by the public and state institutions or delegated to private entities. • Introduced a method of budgetary allocation for rehabilitation and reconstruction informed by past damages • Introduced a system of public accountability about expenditures for rehabilitation/reconstruction • Consider a plan to develop monitoring systems agreed to by experts and relevant authorities, including personnel trained to use and maintain the equipment. • Introduced specific requirements for the public and private agencies that store and use hazardous chemicals • Introduced data receiving and processing in real-time or adequate near-time, obtaining, reviewing, and disseminating data on vulnerability-to-hazards factors, routinely archived, and accessible for verification and research purposes. • Data analysis, prediction, and warning based on acceptable scientific and technical methodologies and information issued following international standards and protocols • Centres are equipped with tools and personnel to handle data management and run prediction models, including fail-safe systems, e.g. power back-up, equipment redundancy, and on-call personnel systems. • Established a network and linkages with scientific research communities • Agreements established to ensure consistency of warning messages and communication channels where different agencies handle different hazards, • Established common protocols that define communication responsibilities and channels for technical warning services • Established working communication agreements with regional and international agencies • Introduced robust system-wide tests and exercises, including full exercises of response in recovery teams

	• Diversity the mechanisms in place for mobilisation fo all types of resources and facilities including and where applicable, e.g. amateur radios, safety shelters, mechanisms in place for informing the community, inter-agency contingency plans for natural and technological disasters, adequate emergency contingency plans for local communities, companies and all type fo social, education and health facility networks including transportation and logistics services related to supply of basic and emergency needs • Established emergency funding • Explored alternative financial measures • All the SOPs are reviewed and updated regularly • Introduced policies governing the storage, disposal and transportation of hazardous chemicals • Communicate and establish measures to promote awareness of past non-structural failures in the revision of emergency response activities • Developed Standard Operating Procedures (SOPs) for all aspects of disaster response • Proper investment and mitigation planning aimed to the revision and post-impact assessment of the technological, chemical and other related to intact human failures • Proposed update of the reconstruction/rehabilitation activities • Proposed measures to promote awareness • Introduced arrangements for monitoring and evaluating the effectiveness of rehabilitation and reconstruction plans • Introduced robust and cross-sectoral research and joint methodologies to facilitate research on disaster risk management • Established mitigation policies, plans, and programs with legislative support • Established policies, plans, and programs based on hazard mapping, vulnerability assessment, and risk assessment? • Established policies, plans, and specific programs for the community and all vulnerable groups, respecting the multi-hazard in nature of disasters • The goals and objectives of mitigation plans are clearly stated, measurable and prioritised. • These policies, plans, and programs are revised regularly • Identified all corrective structural measures that would mitigate disasters • Potential environmental and social, and cultural impacts associated with proposed structural measures • Regulations and awareness in place • Budgeting for the cost of mitigation planning regularly • Does the budgeting plan encourage density bonuses, transfer of development rights, tax credits to encourage land developers, and alternative public spending allocations? • Trained local capacity to conduct mitigation planning • Hazard and vulnerability reduction information is incorporated into school curricula • Local communities are actively involved in mitigation planning

Stage 3: Design of risk management assessment questions

The third stage involves formulating a series of the case study's assessment framework questions that aim to explore the adequacy and content of current disaster risk

management tools and resources of the country in each of the six disaster management phases and the design of a scoring system. The questions were phrased to highlight recommendations for best practices in disaster risk management. It contains a list of easily understood questions that we chose through an extensive review of risk management literature and broad-based consultation.

- Distribute the extraordinary events as per the nature of the disaster or emergency,
- Take a look at the circumstances of the assessed emergency,
- Define impacted group of persons,
- Outline major damages and human life/health costs,
- Identify most vulnerable groups affected by the events,
- List the main characteristics of the overall emergency management approach and assess what you need to notify compared with the system available,
- List the main characteristics of the operational environment and assess what you need to notify compared with your operational environment(s) that you want to be prepared to cover.
- List the important actions and resilient measures,
- All performance measurement requires data collection.

The framework of questionnaires for benchmarking based on case studies

What type of disaster/extraordinary event
Caused by
Affected area
Affected population
Affected critical or strategic infrastructure
Affected vulnerable groups
What combination of threats (na-tech) – please describe
Identified critical assets to be protected
Identified potential threats based on cascading effect
Response efforts immediately after the hazard
Access to sources/knowledge, experience, tools amidst disaster
Used technologies/sources
Loss of life/ injury
Major damage (not only structural damage but also non-structural)
Recovery efforts after the hazard (what recovery plan)
Major preparedness/ DRR measures prior to the hazard
Lessons learned from the event
Major changes/improvement in disaster risk management

Step 4: Define indicators labelling and scoring system

In stage five, we define, label and assign a scoring approach to the benchmark of the disaster risk management cycle.

Then, we define scoring for each label based on the three levels of **Adequate**, **Basic** and **Critical** – assign an easy scoring system from 3 to 1 respectively and define how these three scores are interpreted within each label.

Performance level	Description	scoring
An adequate	timely and appropriate resources, preventive and preparedness measures, investments and planning in place, etc.	3
B basic	Normal conduct, typical difficulties	2
C critical	Poorly accomplished or slow	1

Table 1: Benchmarking scoring system

Then we go through the emergency cycle step by step, list the necessary actions, and rate them, e.g. in three categories (you may very well use more categories, but it doesn't normally bring about any extra information).

For each rating, the state also why you gave that rating for the level of performance. Then look carefully at the actions profiling the rating of the assessed case, especially when the actions are rated critical. Finally, note the essential things you need to improve to be prepared for similar emergencies. Later, we will combine/create an improvement plan of all the essential aspects.

Label/measuring	Adequate (3 points)	Basic (2 points)	1 Critical (1 point)
Response capacity level	Adequate use of intervention teams in place; Use of technology; use of specific equipment; Adequate crisis communication and situational awareness; Applied consistently across; well established; applied and regularly updated; well established across sectors;	Limited initial capacity, processes performed, some metrics have been developed but are still fragmented.	Non-existent or, to a large extent, insufficient capacity, processes are not performed or only partially so. No extra assets available for the first line organisation but adequate assets within reach from other organisations (e.g. Regional Rescue Department)

	constantly improving; a higher proportion Processes are well developed and consistently measured or assessed. Baselines are established and measured; problems are identified and fixed. Adequate use of protection measures in places reducing or mitigating the impact on the affected area, population, assets and natural environment Rescued people and lives, No injures Secured and protected critical, strategic and soft targets infrastructures		Emergency plans are prepared but not usable for good prevention and preparedness on outside threats.
Recovery level	Reduced risk of potential damages in the course of the disaster Mostly or completely present; comprehensive; complete; fully integrated; full compliance; full validation; applied consistently across sectoral recovery processes; well established, applied and regularly updated information about the recovery efforts share information amongst all types of modular/clustered recovery (build-back-better teams); Provided humanitarian and state aid support to affected parts of the population and economic actors	Limited facilities, coordination, SOPs, networks, organisation, recovery plans, strategic approach, material aid	Poor or lack of any facilities, coordination, SOPs, networks, organisation, recovery plans, strategic approach, material aid

Resilience level	Developed consistent strategies, and good practices are applied Sound prevention and preparedness on outside threats, emergency plans prepared but not usable Activities have been measured and assessed regularly. A process of continual improvement has been established and is ongoing. The organisation demonstrated innovation and flexibility.	Developed random and non-consistent measures Measures are not sufficient Insufficient legal support established Insufficient funding identified Insufficient coordination, training and facilitating of the preparation and resilient level activities.	Very weak management structure and poorly organised

Table 2: Benchmarking scoring system per the three-level DRM/DRR approach

The scoring results of the performance level give us a good opportunity to test the feasibility of benchmarking.

Step 5: Collect and evaluate the case studies based on the benchmarking labelling and scoring approach

The task of gathering lessons learned data is accomplished through the following steps.

- *What happened*? The fact-gathering phase. It aims to establish the details of a given incident and establish what happened before (preparedness), during (response), and after (recovery) the incident in a detailed chronological order. The emphasis is on collecting as much factual information as possible to establish an overview of actions.
- *Why does it happen*? Why does the event happen? Why do emergency response and recovery efforts go the way they do? This phase aims to establish the main (immediate cause) and the contextual reasons (contributing factors) why emergency response and recovery operations went as they did. In addition, best practices seek to explain the root causes of system success, failure or omissions.
- *What can we learn*? What worked, what didn't? This section describes the different successes and failures and their relative impact on events. Lessons tend to be specifically related to the incident under review but may include more generic emergency preparedness capacities and capabilities, such as information sharing.

- *What does this mean for our community*? What needs to be developed? What policies or working methods need to change to avoid the identified problems.

We have compared the evidences per disaster type break down per benchmarking categories and propose the knowledge in common aggregated in the form of a benchmarking toolbox to support the risk mitigation assessment challenged by policy-makers and crisis managers. The list of all twenty-two case studies is annexed to this document. Below we presented a summary of the categories of multi-hazards events and aggregated information for each framework questionnaire based on the most frequent answers. The table below presents aggregated and extracted data and information from the collected case studies from Italy, Spain, the Czech Republic, Slovakia and France. All collected twenty-two case studies are included in this document in Annex 1.

Table 3: Summary of the case studies based on the benchmarking framework of questions and categories

criteria/extraordinary multi-hazard event/disaster	disruption conclusions natural disasters	disruption conclusions chemical incidents	disruption conclusions technical failure	conclusion cyber attack	conclusions security physical terrorism act/attack
What type of disaster/extraordinary event	contamination and storm	industry facility fire, car accident transportation of dangerous substances, hazardous material leak, oil spill	fire in the residential area	cyber attack	sociogenic human factor behavioural threat driver
Caused by	Natural conditions	human failure, criminal acts, driving under the influence of drugs, technical failure, the storm caused obsolescence of the ship, the fire destroyed electricity	poor quality infrastructure or industrial infrastructure	cyber-driven violating of the public system	sociogenic human factor behavioural threat driver
Affected area	up to 12.000 persons affected, border regions affected	road, water and city infrastructure, natural heritage		soft infrastructure hospital threatened health services	soft, protected infrastructure
Affected population	water supply, electricity supply	company employees, employed and working in particular business sectors and suppliers, tourism, small and medium enterprises, confined people, evacuation	evacuation	over 1300 persons affected	students
Affected critical or strategic infrastructure	elderly persons affected	road, water and city infrastructure, natural heritage	bridge destruction, pipeline destruction, civic supply infrastructure	health services and infrastructure	school educational infrastructure
Affected vulnerable groups	waste and water and fires + supply disruption	employees, people with low income, people dependent on the tourism		patients	vulnerable groups

What combination of threats (na-tech) – please describe	drinking water	the toxic gas, liquids, ammonia, flammable products, products and damage area, costs for recultivation, decontamination, recovery	leak, exposition	missing information about patients (inpatient part), missing personal data of patients (examination by device)	radicalism and social vulnerability
Identified critical assets to be protected	drinking waters, access to communication limited, cut off of regions, affected tourism season, affected more persons visitors and inhabitants in the impacted regions	soundness + physical assists stations, infrastructure, coastline objects		hospital internal information network	educational facilities
Identified potential threats based on cascading effect	hygienic measures strengthened	pollution, health, threat of exposition, traffic interruption natural disaster, increasing of vulnerable groups, affected population	population at risk	interruption of electricity supply, reduction of health care	life in danger
Response efforts immediately after the hazard	early detection of contamination	integrated rescue system, useful and relevant information on time, prevention measures in the course of disaster development, proper mapping of all area and potential endangered objects and population		disconnection from the backbone network (medical devices), reinstallation of the operating system	N/a
Access to sources/knowledge, experience, tools amidst disaster	rescue and health services coordination, situational awareness, use telecommunication systems	available knowledge and resources from private entities companies	all first responders, coordinated reaction and technological equipment	access to information limited, partial media coverage to citizens, patients	cyber- supported attack
Used technologies/sources	affected up to 8000 persons	control of chemicals use of technologies	specific sampling detection equipment	network reinstallation	Ten death persons
Loss of life/ injury	affected drinkable water, affected area of 30.000km2 of the forest, 32.000.000 euro loss, 240.000 ha of agriculture land	reduced effects on human life, just one loss	first responders	N/a	Ten death persons, disrupted community, lost trust and community security
Major damage (not only structural damage but also non-structural)	municipal level and army	facility destruction, natural disasters, environmental damage, damages over billions, environmental damage can be valued in financial means	infrastructure in surrounding areas, affected national	Loss due to attack CZK 40 million, Confidentiality violated - NO, Impaired integrity – YES, Impaired	post-traumatic services

		hence in their nature-based role in producing clean are and balancing the nature	supply networks, jobless people	availability – YES, Impaired authenticity – NO, System compromise - YES	
Recovery efforts after the hazard (what recovery plan)	situational awareness, coordination and interoperability	emergency planning, economic measures, strengthening the preparedness at private company facilities, measures concerning the actual distance of industrial areas/zone(water/land), proximity to the inhabited catchment area, including hospitals, residential areas, etc.	compliance analyses by the regional and national authorities, policy and decision-making improved	malware removal and traffic recovery	better protection of the school system
Major preparedness/ DRR measures concerning the hazard	centralised monitoring and situational awareness in case of disasters with cascading effect spreading fast and enhancing greater areas, the contingency plan for effective crisis management in case of events with less probability	preparedness and technical revision of the industrial technical objects, infrastructure, introduce land-use regulation changes concerning the distance between industrial and residential zones		antivirus security and its control	better protection of the school system
Lessons learned from the event	include drinkable water supply in critical infrastructure, strengthened regional crisis centres, and synchronisation of response on the centralised level to face needs of resources and equipment		social discomfort, restrictions, action plans strengthened concerning the control and monitoring, better monitoring of the areas	more frequent inspection	better monitoring of the violation activities spread via social media
Major changes/improvement in disaster risk management	change of risk assessment methodology, multi-hazards approach to risk assessment and preparedness, prevention, introduced robust monitoring systems, increased local community planning on fostering settlements' prevention systems	fostered prevention and monitoring measures		contingency planning for soft strategic infrastructure improved	better monitoring of the violation activities spread via social media

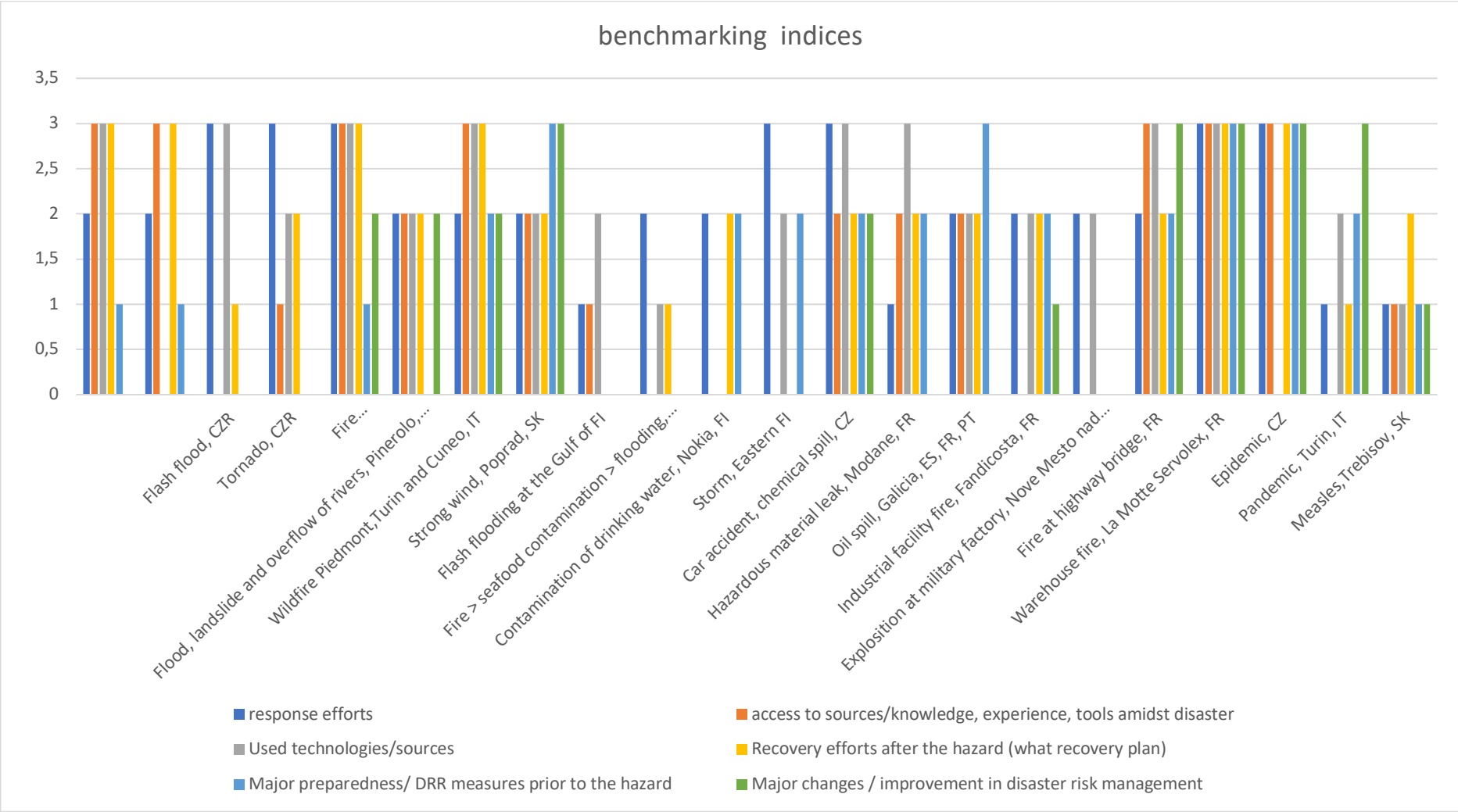
Below, we present the benchmarking categories against five different types of multi-hard extraordinary events considered to be widely spread in European societies to determine future trends in the following 25-30 years. As a result, European societies and, in particular, decision-makers can learn how to use the benchmarking toolbox to assess the risk mitigation measures. In other words, benchmarking categorisations helps the design of investment and mitigation programmes and improve planning and societal systems.

Scoring and setting the benchmarking thresholds. This process involves scoring six critical responses, preparedness and recovery and learning/building back better phases.

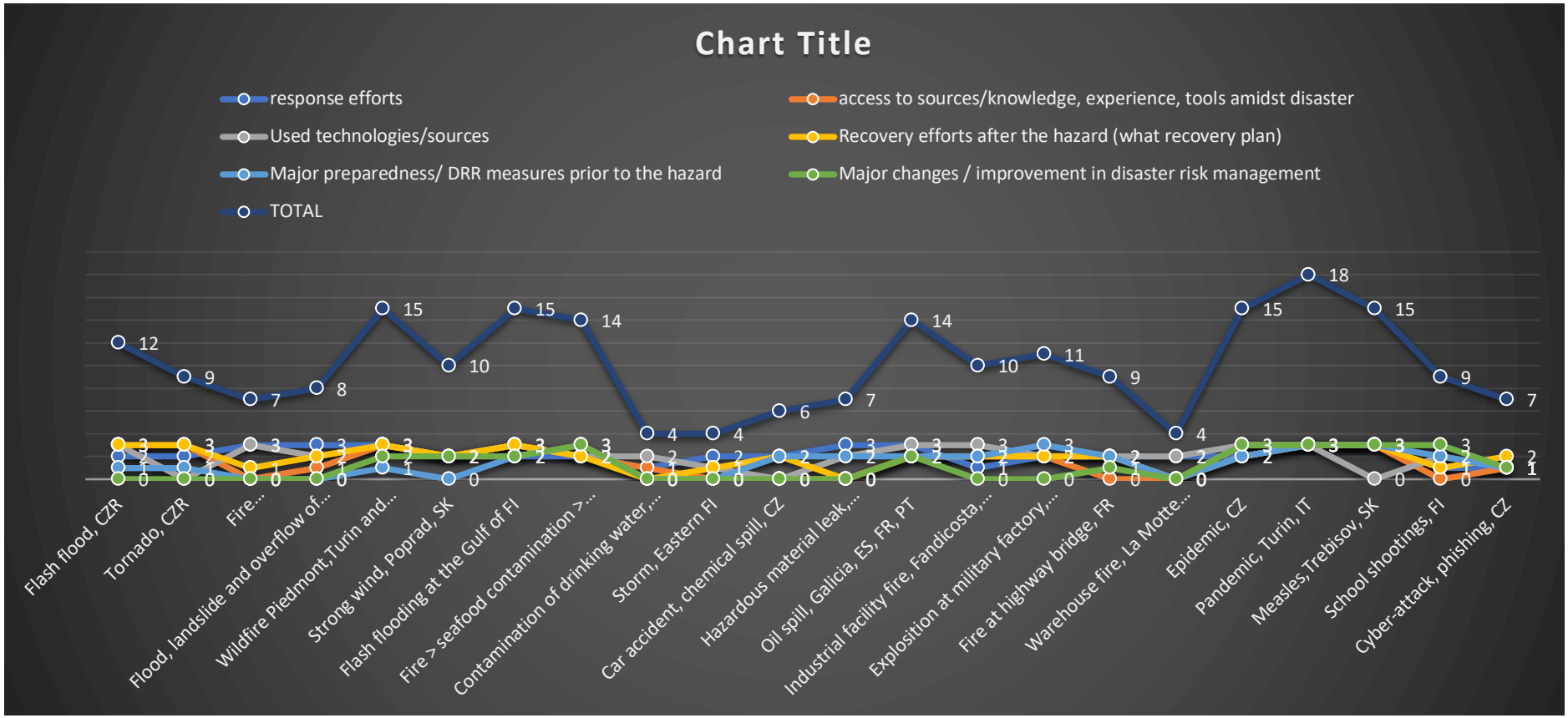
Table 4: Scoring results from the assessment of cases collected

	response efforts	access to sources/knowledge, experience, tools amidst disaster	Used technologies/sources	Recovery efforts (what recovery plan)	Major preparedness/ DRR measures before the hazard	Major changes/improvement in disaster risk management	TOTAL
Flash flood, CZR	2	3	3	3	1	0	12
Tornado, CZR	2	3	0	3	1	0	9
Fire. La Léchère, Savoie, Auvergne-Rhône-Alpes, South-eastern FR	3	0	3	1	0	0	7
Flood, landslide and overflow of rivers, Pinerolo, Piedmont, IT	3	1	2	2	0	0	8
Wildfire Piedmont, Turin and Cuneo, IT	3	3	3	3	1	2	15
Strong wind, Poprad, SK	2	2	2	2	0	2	10
Flash flooding at the Gulf of FI	2	3	3	3	2	2	15
Fire > seafood contamination > flooding, Finisterre, West of Galicia, ES	2	2	2	2	3	3	14
Contamination of drinking water, Nokia, FI	1	1	2	0	0	0	4
Storm, Eastern FI	2	0	1	1	0	0	4
Car accident, chemical spill, CZ	2	0	0	2	2	0	6

Hazardous material leak, Modane, FR	3	0	2	0	2	0	7
The oil spill, Galicia, ES, FR, PT	3	2	3	2	2	2	14
Industrial facility fire, Fandicosta, FR	1	2	3	2	2	0	10
Exposition at the military factory, Nove Mesto nad Vahom, SK	2	2	2	2	3	0	11
Fire at highway bridge, FR	2	0	2	2	2	1	9
Warehouse fire, La Motte Servolex, FR	2	0	2	0	0	0	4
Epidemic, CZ	2	3	3	2	2	3	15
Pandemic, Turin, IT	3	3	3	3	3	3	18
Measles, Trebisov, SK	3	3	0	3	3	3	15
School shootings, FI	1	0	2	1	2	3	9
Cyber-attack, phishing, CZ	1	1	1	2	1	1	7



Graph 1: Graphical presentation of the results from the scoring of the cases studies



Graph 2: Linear presentation of the results from the scoring of the cases studies, Demonstration of max scoring attained per each case study

Stage 6: CRISPRO benchmarking thresholds

After reviewing and scoring the collected case studies, we list the major CRISPRO benchmarking thresholds, including moderate and above minimum level requirements that need to be incorporated and inúroved by any organisation and first responders, policy-makers with DRM and DRS. The results will be adopted by the online risk mitigation assessment tool and used to develop the framework of the table-top exercise. The exercises shall check the benchmarking levels and online CRISPRO assessment tool. By the end of the exercises and tests of the online CRISPRO assessment tool, the benchmarking levels will be corrected/improved and respectively increased.

The CRISPRO benchmarking thresholds are based on the experience of the partners and networked organisations involved in the project; however, we intend to extend the number of actors using these tools to upgrade the thresholds. Benchmarking thresholds demonstrate a kind of a vision for investments in legal provisions, planning, investments, resources, capacity building, technologies and equipment. It is also important for the users of the CRISPRO project results to learn from the other and learn from practical experience. Below, we present the CRISPRO benchmarking thresholds attained and scored based on the twenty-two cases (Annex 1) and the scoring system introduced in Steps 3, 4 and 5 of the performance approach.

Once each of the six selected elements for defining the benchmarking thresholds, we summarise the best performed by 3 points actions as summarised below per the benchmarked procedures/method/approach and intervention-based technologies and support situational awareness knowledge.

Response efforts immediately after the hazard.
• Professional rescue services: • Use of intervention units on-site, specialised equipment, detection and analysis. • Storage of unimpaired waste is evacuated using gear to prevent spread. • Aminditsrtion and organisation • Organisational and functional management procedure. • Delivery information bulletins in advance • Use the EWS of the hydrographical forecast data. • Inform the different stakeholders (Prefettura, Civil Protection, Fire brigade, Police, Mayors, Mountain Unions). • Early warning of the Volunteers Area, TV and radio information bulletins to alert people, activation of communication, forecast alerts, shut-down or damages of roads, border crossing and bridges; closure of schools, human and technological resources, evacuation orders, rescue orders, recommendations for preparedness actions on official social media (FB and Twitter) (one-way communication process) Involved all type of intervention units

- Involved volunteers
- Involved intervention rescue vehicles similar to Helicopters, Canadair airborne fleet
- Involved specific technologies for monitoring of the affected environment, decontamination and support resue and services.
- Ensured protection of the surrounding areas, tank removal, and leak sealing.
- Efforts oriented to correct the damage
- Debris cleaning activities
- Efforts placed on early detection of potential further development of the hazards and cascading effect induced/caused further damages
- Launched citizens initiatives to support most vulnerable persons (provide food, staff, material aid, post-trauma support, primary goods, etc.)
- Implement a broader civil protection framework of actions implemented by the local authorities, city and the third sector organisations and private actors. (e.g. psychological support helpline for single people, help service for the elderly and disabled).
- Increased attention to health, chemical, industrial, natural or any other threat can lead to public disorder, epidemiological situation, mass destruction of a designated area, deteriorated water, food, air quality.
- Introduced anti-epidemic measures to prevent the spread of this infectious disease.

access to sources/knowledge, experience, tools amidst disaster

- The proper legal system in support of the civil protection interventions on the national and territorial level
- Operational and informational centre in place
- Activated the contingency plan of the region
- Provided adequate orders of the chief commander
- Employed necessary units.
- Used prevision system based on the Fire Weather Index (FWI), EWS
- Delivered a daily bulletin providing information and data to the local authorities and stakeholders involved in the fire risk management chain.
- Using the public monitoring network (air pollution, water, temperature, etc.) contributed to having information on cascading effects.
- Made use of the early warning signal.
- Developed situational awareness among the key operational actors, for example, Rescue Department, Police Department, Energy and water supply services providers, other strategic logistic and supply chains, public transport and intercity/ international transport carrier, etc.
- Used a contingency and type plan or a crisis plan for the region
- Used a traumatological plan of the emergency health unit, hospitals, etc.
- Launched a local campaign through volunteers
- Activated additional public resources, association's funds, and private donations (through fundraising campaigns).
- Activated local/regional operations centre to manage and coordinate the activities.
- Activated local municipal hubs (third sector organisations whose venues have been used to supply and deliver the food packages to people)
- Awareness for the local community.
- Monitoring the physical environment

Used technologies/sources

- Used the information systems for monitoring of the affected area and for receiving u-to-date information about the weather and other condition in the development
- Used local radio, media, other media systems for communication with citizens
- Used GIS system to the location of every unit.
- Used other software for communication with every unit.
- Used VPI (first response vehicle), FPTTU (special fire engines for the tunnel), CTRCH4 (Chemical risk technical advisor level 4), CECH (chemical intervention unit), VRAC (air reserve breathable), PCM (mobile command post), other detection, identification and sampling technologies.
- Employed standards operational procedures in the form of a chain of commands: group head, command leader, PCM (mobile command post), operational medical support
- Activation of Copernicus EMS
- Made use of delineation maps (showing the extent of fire, flood, affected area)
- Made use of high-resolution optical satellite images
- Water level monitoring system
- Made use of numerical models run automatically
- Employed water level observations measured
- Made use of forecasts and observations stored in the same database
- Made use of international comparative forecasts
- Made use of techniques and resources for correction of the damage
- Made use of standard operating procedures for coordination of the rescue and recovery efforts
- Made use of digitalised data about population, health, environment and supply of goods and medicines conditions
- Made use of various mobile apps for mapping supplies and affected areas and persons
- Made use of so-called “help requests” collected through a free-phone number managed by Civil Protection or by directly contacting the Municipal Social Services or the hubs

Recovery efforts after the hazard (what recovery plan)

- The local government and the government have provided prepared money from a budget for a crisis like this. During the early days, a wave of solidarity also began, and many NGOs and many volunteers rushed to the rescue.
- The local government and the government have provided prepared money from a budget for a crisis like this. Also, a wave of solidarity began, and many NGOs and many volunteers rushed to the rescue.
- Activated Copernicus EMS to assess the grade level of the damages caused but the wildfire events, as well as to understand the risk of soil erosion and landslide over the burnt areas where the loss of vegetation has possibly led to substantial chemical and physical properties changes—introduced regular control at critical infrastructure sites concerning any potential technological failures or interruption (municipal technology with heating ducts, electric cables, water pipes and sewers, pumping of water from private houses, sewer networks, etc.
- Introduced some urgent measures allocating some funding for payments for the self-employed, food vouchers
- Introduced mass prevention programmes and preparedness (evacuation training, vaccination, etc.)

Major preparedness/ DRR measures concerning the hazard Benchmark scoring:
• Recovery involved physical reconstruction/fostering of the damaged area: • Forest recovery: soil, forest, cattle. Town recovery: cleaning, infrastructure repairs. Coast recovery: cleaning, mud collection • Regular control of air and water quality. • Provide post-traumatic consultancy for victims and relatives of the victims' affected population. • Establish immediate precautions measures for securing the supply of drinking water and avoid contamination of the main supply of food and water. • Ensure distribution of free medicines against any risk of intoxication. • Ensure that organisations involved have consolidated working relationships • Identified different axes of intervention, such as community networks for social inclusion, solidarity networks for people in conditions of housing distress, territorial networks for the inclusion of citizens in conditions of serious marginalisation. • Monitoring of the situation regularly, community visits, online platforms. • The system collects and evaluates information from all localities on a 3-day basis for more than ten epidemiological indicators (visits from abroad, tests, quarantines, hospitalisations, deaths, etc.). The interactive report from the given monitoring system is available online via access.

Major changes/improvement in disaster risk management
• Riska mitigation analyses of the area and assets, valuing potential external impacts: • Major changes concerning fires: proper assessment of the interconnection between hazards and vicinity area. It is needed to interconnect hazards to the risk assessment techniques used for civil protection by analysing possible activation of the hazards based on the effect of various circumstances on the impacted area, avoid general assessment, and adopt risk assessment to a specific analysed area. In addition, the working model for hazards activation prediction needs to be adopted during fire seasons to external situational analyses and prognoses. • The working model is adapted to hazard prediction and prevention during fire season. It is important to work on nature-based and other solutions to decrease the negative impact of any hazards. For instance, to set actions to prevent soil degradation immediately after the fire is implemented. • New strategic plan, the new conception of sustainable development of the impacted area. Avoid reaction-driven planning and focus on prevention and mitigation measures. I • improved adaptability of the system for crisis response and preparedness: Hubs for rapid response • Activated different levels of organisational support for collecting different types of resources (human, funds, food), but we should manage the action at the neighbourhood level. • The community network helped integrate other requests such as school supplies and psychological support. • Specified the prevention and control measures • Delivered prevention scenarios in case of mass spread of the disasters and affected greater area. • Developed scenarios for the public health, the social and economic impact on wellbeing • Employed and evaluated data and scenarios using statistical methods • Delivered methodologies and scenarios based on several criteria: economic versus social / health criterion, the prognosis of the epidemiological situation using deterministic and stochastic models, and to evaluate the social impact on the individual and society.

- Activation of regional or national crisis management tools and coordination
- Analysed received alerts
- Changes in regulations concerning guns ownership
- Adoption of the European directive
- Update of emergency planning for companies storing explosives and other dangerous CBRNe agencies. Enable regular checks and control of quantities stored in designated and licensed facilities.
- Prove in practice evacuation and increase interoperability of various strategic managers and crisis units involved in preparedness exercises.
- Modular exercises support improving the response time and adequate manner of emergency planning.
- Provide intervening units with a list of stored ammunition and explosives.
- Improve prevention measures, and disaster assessment of the risk of explosion provide information about amounts and type of hazardous materials.
- Develop a register about the storage areas in danger of exploding estimate the number of injured based on emergency and contingency planning
-

Lessons learnt

When the risk landscape is constantly changing and emergencies become more complex, adapting to change, and constant development is necessary to ensure adequate prevention, preparedness, reaction and recovery related processes, capacities, and sources. Organisations that keep up with and practice innovative techniques and approaches in any kind of activity can increase their decision-making and planning in risk mitigation and capital investments and the organisation of community life and fostering vulnerability issues.

CRISPRO collected examples demonstrate that the performance of emergency services is subject to comprehensive prevention and preparedness based on perceived expectations and incomplete evidence. The project has challenged finding a structured way of collecting lessons learned from any disaster and emergency. Often lessons learned are just statements or even lists of commonly known "does and donts". If we want to benefit from the results of previous cases, we need to look at the cases from the perspective of decision-making and planning.

Lessons learned about mitigation of vulnerability can ideally be achieved by assessing any emergency responses, regardless of how successful the response is perceived, because they can contribute in several ways to the quality improvement in emergency preparedness planning and response. Unfortunately, there is also a temptation to only review incidents where the response was deemed inadequate, but this misses crucial opportunities to understand and repeat effective responses.

Implementing lessons learned into organisational procedures comes down to leadership and organisational culture. The success or failure of learning from historical events will

depend on the strong commitment at all levels of the úrevention, preparedness, mobilisation of staff and sources and adequate provision of emergency services.

After the series of reviews, the next stage is the adoption of the tool by national and regional stakeholders and the adoption of the case study benchmarking framework, and we do list some lessons learnt as follows:

- Provide sufficient financial and technical resources by national governments to fulfil the objectives of the DRM/DRR; that is, reducing the region's risk exposure to natural hazard events.
- Establish a national and regional mechanism in each country responsible for continuously working on the prevention, response and recovery and the country's readiness to withstand natural hazards.
- Building the knowledge-base of political decision-makers and strategic and crisis managers of major public and private agencies on the utility of the benchmarking thresholds.
- Propose the use of the CRISPRO benchmarking tool as a self-assessment evaluation tool.
- Formulate policy directives and legislative support towards the mainstreaming of the DRR and DRR by using the CRISPRO benchmarking tool as an annual audit tool that all key agencies can implement.
- Build effective public awareness programmes that promote participation in adaptation and preparedness measures.

Identified Current Trends

Assuming the likelihood of events, cases studies and best practices from lessons learned, some current trends are important in the future.

The COVID-19 pandemic response stretched the concept of modern emergency management in ways we had never stretched it before. It has also shown the importance of the all-hazards approach when governments and communities prepare for emergencies.

Modern societies are becoming more and more complex and are full of interdependencies. In addition, the ongoing climate change will bring about weather-related problems and cascading effects. Therefore, it calls for risk-based planning for all eventualities, not just the traditional accident and everyday emergencies.

One of the components of effective risk mitigation disaster management is the development of solid, trusted public and private partnerships. Creating partnerships among first responders, businesses and community stakeholders can ensure that the right people

respond to a crisis. Collaboration between the public and private sectors also helps supply these responders with the tools to manage a disaster.

Public-private partnership (PPP) is becoming more and more important since the private sector owns and runs much of the vital functions of society.

In addition, the civil society sectors organised voluntary organisations can have an important role to play in supporting the emergency services in the planning, response and recovery phases of most emergencies.

Furthermore, the fourth sector comprises self-organised actors or actor groups who are not affiliated with any formal organisations and engage in emergent short-term activities. The fourth sector can become active in all phases of a crisis or disaster by taking on diverse tasks and roles. Resilient and agile fourth-sector actors adapt to the actions of formal actors according to circumstances. Part of them is the widely spread social media. These are today available and widely used by everybody. Social media outlets provide a quick way to distribute information to many people, which is why authorities have relied on them during recent disasters.

Through social media, members of the public who witness incidents can provide public safety and protection organisations with timely, geographic-based information. This information can be used by decision-makers in planning response strategies, deploying resources in the field, and, in turn, providing updated and accurate information to the public.

Artificial intelligence technology has penetrated all walks of life, bringing great changes to industry development and new experiences to human work and life. Artificial Intelligence can greatly help emergency and disaster management efforts. Today, Drones, robots and sensors can provide intelligent and accurate information concerning landscapes and damaged buildings. It allows rescue workers to understand the topography of a landscape and the extent of damage to a building. In addition, drones can find victims trapped in debris allowing rescue workers to get to them quickly.

It is worth noting that as all these new ways are helping to manage the risk in the form of planning, mitigation measures, incentives and capital investments, they also bring potential risks of malfunctioning, misinformation or deliberate misuse. So, they need to be implemented prudently.

Conclusion

Risk reduction management and risk mitigation assessment systems (i.e. preparedness for disasters and crises threatening the state, society or citizens) have often been developed based on experience and applied according to the characters of each country's political system, changes in threat perceptions and as a reaction to the latest experiences in dramatic crises. They are not so many results of theoretical consideration and scientific studies or concluded from the experience of other countries. That is why these systems in European countries have previously differed remarkably, and it is still difficult to shape standard structures, procedures and communication rules for crisis management duties. Therefore, the decisions concerning the development of the risk mitigation assessment approach are usually made as a compromise derived from practical experience and political processes.

All major incidents will bring about several "analysis", "critiques", and "lessons learned" reports. While some reports are comprehensive, they are, on the whole, ad hoc in nature. This fact hinders their utility for widespread use outside of the organisation they were created. If we don't implement disaster response knowledge in developing our capacity for major operations, the lessons learned will be little more than a slogan.

It would be useful to have a European Union level standard of collecting essential information of emergencies and the conduct of the participating organisations and actors. For example, there is risk mitigation in emergency management, and reduction risk management standards are designed as a tool for continuous improvements. However, it cannot as we implement such in gathering lessons learned of actual emergencies. It might, anyway, set an example of how the EU level "lessons learned gathering standard" could be constructed.

Political-Strategic Level Recommendations

Political-strategic level conclusions derived from the case studies in this report are as follows:

1. DRR and risk mitigation assessment requires national civil security officials to run effective inter-operable communications both internally and externally.
2. Internally, the situational picture should be built among shareholders and shared. Both chief rescue officials interviewed for this study paper mentioned shared situational awareness as the main goal of future developments.
3. Externally, active communication is required to boost civil preparedness and performance during hazard scenarios. This report has indicated how urban people are more dependent on electricity and telecommunications than those living in the countryside.

4. It is important to develop a response strategy to consider the whole spectrum of crises and emergency management measures. There are general, functional and regional aspects that should be observed and concerned.
5. Preparedness: What would be the added value from a response point of view, discussing, among other things, such issues as the possibilities of member states pooling resources (the question of organisation in sub-areas and their linkages).
6. Response: It could be considered by the EU whether there are any issues that we could address in regional settings within the issue area' response'. While mostly those activities are more naturally in the 'preparedness' phase, this might also include joint operations of some kind, acknowledging that response organisations are often following the neighbouring areas.
7. Recovery: Recovery-related assistance and cooperation are needed when insufficient resources and capabilities. It can be on both a planned and ad hoc basis. The project could evaluate issues where automatic and planned cooperation in recovery and restoration should occur. The main question remains: is it likely to obtain information about any obstacles/problems?
8. Training and exercises: Training and exercises should be organised in a cross-sectoral and regional context; what would be the most important issues to be addressed in training, what

could the other side teach the other that would be beneficial in practice, who would train whom?

9. Joint Operational capacities: A follow-up Crispro project could consider more practical ways of operating together, including such issues as standard operational protocols, and then doing this as practice over borders.
10. Injury prevention: A follow-up Crispro project could discuss injury prevention challenges in cooperation with safe communes and secure city networks.
11. There are administrative, organisational and strategic challenges related to decreasing civil protection budgets within the Member States. Future policy should protect civil protection budgets within the Member States.
12. The wide range of national and multinational actors are not fully involved nor sufficiently interlinked into EU disaster risk management (preparedness, response, consequence management) and critical infrastructure protection (CIP).
13. Better interoperability and deeper organisational synergies are needed across the sectors and borders.
14. Stronger EU partnerships and hybrid networks (academia, industry, small and medium-sized enterprises, agencies) allow better civil protection response and shared civil security capacities (compare military cooperation). Such relationships should be nurtured and encouraged.
15. Bringing all the systems together in a common or mutual system at a common policy level will be important for the citizens of the EU countries. It will also provide opportunities for more efficient and cost-effective emergency services.

16. It is challenging to provide emergency response services in all EU languages. One solution to this problem that we outline is that all callers be connected to their home country Emergency Response Centre (ERC) to get assistance in their native language.
17. All countries should have the same emergency number and SOP. With easier access and regular updates, more information should be put on the Internet, possibly via a joint EU 112-website.
18. Look at the examples of cross-border cooperation that worked rather well. However, it is recommended that higher-level basic agreements on cooperation are developed and implemented.
19. There should be direct technical connections between ERC's in different countries to easily transfer calls from other countries. It is recommended that a system is put in place that when one travels, works or studies in another country, one should understand given signals, signs etc. If in danger (earthquake, a flood, avalanche etc.), one should understand warnings/notifications. We can achieve this by developing a common emergency signalling system for the entire EU.
21. There is no shared understanding in Europe on the limits of cooperation or integration in civil protection. Still, most actors agree upon the desirability of further integration and closer regional cooperation.
22. Results and recommendations from risk assessment and mapping may create conflicts due to political and economic interests. Thus it requires a well-coordinated and established cross-border and cross-sectoral cooperation, exchange of information (including intelligence) and expertise, and the development of a cohesive regional safety culture through education, training and communication between all interested parties at regional, national and local levels.
23. Civil protection as a concept has not been specifically defined in all Member States.
24. Civil protection (CP) is a national competence, but it does not prevent states from requesting assistance through the EU's CP mechanism in an emergency that overwhelms national capacities. Member States need to develop adequate Host Nation Support structures and procedures to receive such assistance.
25. Assessments of preparedness and simulations of crisis events are valuable exercises. However, these exercises are often designed, conducted, and even evaluated by those practising them. As a result, there is little space for a real challenge and "external expertise", which would put the system on its limits and, by doing this, highlight shortcomings and gaps. A system of cross-checking safety and crisis management between related stakeholders could be a feasible way of improving the effectiveness of these assessments.

It is important to note that several political-strategic levels recommendations have already been implemented in the civil security framework of the EU and its CP Mechanism.

Operational-Tactical Level Recommendations

The operational-tactical level conclusions and the subsequent recommendations derived from the case studies of this report are as follows:

1. we should secure electricity supplies in emergencies. For instance, the Finnish Ministry of Employment and the Economy took measures after the storms of 2010 and 2011 that resulted in updating the Energy Market Act.
2. Emergency Response Service should not get jammed. There should be more communication capacity and an emphasis on public awareness. For example, we should educate people to have patience, and the number 112 is not the right place to call in a case of a regular electricity cut. Another national helpline should be developed for lower priority events.
3. we should enhance civilian preparedness. Those in need should take action and purchase generators (for example, farms and other entrepreneurs). Civilians should have the resources to survive a couple of days without electricity, especially in remote areas.
4. The officials' networks (TETRA) need to be developed. Furthermore, emergency maintenance should be improved and spread across European Union Member States with a common action policy.
5. Responsibilities of different officials should be set out clearly in future policy. For instance, in Finland, the regional rescue departments are not responsible for helping to fix electricity lines. Instead, the responsibility lies with the service provider.
6. Preparedness should be better coordinated and become a national requirement. Municipalities have various approaches to emergencies. The approaches should be made similar. In addition, the role of state administrative agencies should be clarified and formalised in future policy.
7. The ways to produce situational pictures should be standardised, improving communication between administration levels. Such policy would allow for better cooperation in cross border events.
8. The end-users and first responders often desire a joint command and control body with four essential characteristics: juridical power, operational capacity, technological advantage, and a political mandate. In addition, they are needed to avoid a too rigid sectoral structure, which obstructs horizontal information flow and slows the definition of the character of the actual crisis.
9. Enhanced role of citizens and volunteers supports first responders' work – particularly in rural and long-distance areas. The bottom line is a better response with more coordinated action.

The recent discussion has shown that a reasonably comprehensive policy and procedure structure exists within the EU. However, examining the national case studies has highlighted weaknesses and limitations to current policies and procedures. Therefore, several recommendations are outlined in this report to inform and improve future policy decisions.

It is by no means a definitive list of required policies. Instead, it is intended to guide and facilitate the detailed discussion of the intricate societal and political issues surrounding the development of future policies. By learning from past case studies and attempting to foresee future requirements, it may be possible to reduce the negative consequences of extreme weather events through definitive and effective policy decisions.

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One example of different philosophies and thereby even available emergency assets is the growing need to incorporate the private and volunteers sectors into the preparedness plans and actual response. However, the level of involvement varies between countries or even regions and municipalities.

Annex I Multi-hazards natural driven disasters case studies

Example 1: Natural phenomenon/extreme climate changes (8 cases)	1	2	3	4
type of /extraordinary event	Flash flood, **Czech Republic Šumvald,Břevenec, Oskava**	Tornado, **Czech Republic Moravská Nová Ves, Mikulčice, Hrušky, Lužice, Bažantice, Pánov, Hodonín**	La Léchère is a commune in the Savoie department in the **Auvergne-Rhône-Alpes region in south-eastern France**	Flood, landslide and overflow of rivers **Homogeneous Zone of Pinerolo (HZP), Piedmont, Italy**
caused by	Heavy rain	Extreme weather, condition, heavy storm, windy situation	6,000 m3 of shredded wood and laths, deconstruction waste Fire (09/05/2017)	Rainfall
affected area	5 municipalities	7 municipalities , 26 kilometres long waistline wide over 500 metres	LA LECHERE (and la vallée de la talentwise)	Homogeneous Zone of Pinerolo (HZP), 45 municipalities, 12 municipalities, 10 hilly belt municipalities, mountain area, 23 municipalities with three valleys
affected population	4200	10 000 citizens	Yes (air pollution over several kilometres)	132,561 in (Istat, 2011)
affected critical or strategic infrastructure	Source of water, Bridges, Electricity, gas line, Waste pipeline	source of water, bridges in municipality, electricity	Waste disposal	buildings, roads, bridges, power lines, methane pipelines, sewage systems, sport facilities
affected vulnerable groups	elderly people, elementary school, kindergarten	elderly people, elementary school, kindergarten	100 pensioners in the social centre, 354 persons at a school	elderly population over 75 years old
what combination of threats (na-tech) – please describe	Heavy rainfall, flash flood, landslide, blackout, insufficient of gas, electricity and water	Heavy rainfall, flash flood, landslide, blackout, insufficient of gas, electricity and water	Economic: national crisis in the wood processing sector, Establishment Non-Compliance: Wood Burning in Waste Disposal	Hydrogeological and hydraulic instability, due to climate change: variation in seasonality and magnitude of phenomena associated with snow dynamics,

				instability of rock complexes, debris flows and surface landslides.
Identified critical assets to be protected	Line of water, Gas, electricity, Traffic infrastructure, local government, local voluntary	Line of water, Gas, electricity, Traffic infrastructure, local government, local voluntary	Retirement Homem school	county roads, buildings, bridges, rivers protections, Ski resorts
identified potential threats based on cascading effect	Lack of information in the first hours, insufficient forces and resources	Fire and explosion, fall of loose shards, the leak of chemical substances	Pollution: A river - water of extinction, air pollution due to non-toxic, acrid and unpleasant fumes, slight presence of formaldehyde and benzene	debris flows, surface landslides in Villar Pellice, flood along the Chisone stream, overflow of Agrevo and Albona streams, Debris flow of Agrevo stream in Perosa Argentina municipality, 5 bridges collapsed, interrupted traffic network, Isolated residential areas, damages to the communication network, critical infrastructure, building.
Response efforts immediately after the hazard	Integrated rescue system (firefighters, Police and paramedics), Army and volunteers	Integrated rescue system (firefighters, Police and paramedics), Army and volunteers	50 firefighters on site, specialised equipment, detection and analysis, Storage of unimpaired waste is evacuated using gear to prevent spread.	Organisational and functional management procedure, the information bulletins give hydrographical forecast data to the different stakeholders (Prefettura, Civil Protection, Fire brigade, Police, Mayors, Mountain Unions). Activation of the 24h situation room of the Civil Protection Early warning of the Volunteers Area, TV and radio information bulletins to alert people, activation of communication, forecast alerts, shut-down or damages of roads,

				border crossing and bridges; closure of schools, human and technological resources, evacuation orders, rescue orders, Information about the weather forecast, recommendations for preparedness actions on official social media (Fb and Twitter) (one-way communication process)
access to sources/knowledge, experience, tools amidst disaster	Legal system, establishing the territory, operational, informational centre, activated the Alarm plan of the region, order of the chief commander, employed necessary units	Legal system, establishing the territory, operational, informational centre, activated the Alarm plan of the region, order of the chief commander, employed necessary units	N/a	organisational and functional management procedure for the regional warning system for civil protection
Used technologies/sources	used the information system called “Crisis Records”, established a Staff of chief commander in the affected area, used local radio tune, GIS system to the location of every unit, GINA software for communication with every unit.		VPI (first response vehicle), FPTTU (special fire engines for the tunnel), CTRCH4 (Chemical risk technical advisor level 4) CECH (chemical intervention unit), VRAC (air reserve breathable), PCM (mobile command post) Chain of command : CDG (group head) - CDC (column leader), SSO (operational medical support) CEMUL + MPR (towable motor pump emulsion cell), VDIP 69 (Detection, Identification and Sampling Vehicle of the Rhône)	regional daily hydrographical forecast warning system, activation of Copernicus Emergency Management Service
loss of life/ injury	2 life was lost, and 70 people were injured	6 life lost, 300 injured	A firefighter was injured during the reconnaissance	2008: 4 dead, 3 injured, 300 displaced people

				2016: 1 dead
Major damage (not only structural damage but also non-structural)	demolished the pipe of water, gas, broken pylons of electricity wires, 4 of the houses must be demolished, 37 others must be reconstructed on behalf of the decision of the Static. 14 bridges w ere down, and the other 9 had to be repaired, The flash flood hit over 200 properties, the reconstruction of the land around the houses is not yet finished,	1 200 houses damaged, 200 demolished	N/a	Damage to property and infrastructure, destruction of crops, interruption to communication networks and critical infrastructure Erosion of soil, destruction of harvest Evacuation and rescue measures Business interruption inside the flooded area
Recovery efforts after the hazard (what recovery plan)	The local government and the government have provided prepared money from a budget for a crisis like this. During the early days, a wave of solidarity also began, and many NGOs and many volunteers rushed to the rescue.	The local government and the government have provided prepared money from a budget for a crisis like this. A wave of solidarity also began, and many NGOs and volunteers rushed to the rescue.	The operator disposes of the burned waste and implements site monitoring. The activity is maintained. Inputs of wood waste are carried over to other facilities.	The recovery efforts concern mostly the recovery of river protection and debris removal.
Major preparedness/ DRR measures prior to the hazard	Integrated rescue system of the region.	We have an integrated rescue system in the region.	N/a	Lessons learned from the event.
Major changes/improvement in disaster risk management	-	-	N/a	The risk methodology developed in the ARTACLIM project will allow identifying in which areas hydrogeological risks are supposed to increase due to climate change; this will allow identifying where it is prior to investing in preventing risks for settlements, infrastructures, communities, ecosystems and so on.

SECOND PART

Example 1: Climate change-induces extreme natural phenomenons (8 cases)	5	6	7	8
type of /extraordinary event	Wildfire Piedmont, Metropolitan City of **Turin and the Province of Cuneo. In the Metropolitan City of Turin, Susa Valley and Homogeneous Zone of Pinerolo**	Strong wind, **Slovakia, High Tatras Mountain**	Flash flooding at the Gulf of Finland	Cascade event: fire > seafood contamination > flooding, **Finisterre, west of Galicia**
caused by	severe droughts, warm weather conditions, soil dryness, vegetation stress, absence of rainfall, strong gusts of Föhn wind, absence of snow at high altitudes favouring the vertical distribution of fires (some fires started over 2000 m high); plentiful dry biomass, abandon slopes, denaturation of cultured lands);	a cold wind of the boron type frontal system advanced Lomnický štít cap(166 km / h)	A storm with winds of 25 m/s, waves reached heights of up to 8 meters	Intense fire wave. 8.000 fire origins, 1.636 fires
affected area	Piedmont region, Turin, Province of Cuneo.	12 600 ha forests, 6 million cubic meters, 3 million trees 2,5 million cubic meters of wood	Seawater flooding, coastal areas in Finland, Estonia and Russia.	Finisterre, west of Galicia (north-west of Spain) 100.000 ha forest burned Affected area: 13.000 km2
affected population	Population: 4,356, 000	district of High Tataras, tourists, no figures.	critical moments were in Helsinki and nearby, Loviisa nuclear power plant,	21.700 population in Finisterre region

			Russian coast, The city of St Petersburg, Estonian coastline from Pärnu to Viimsi valid.	
affected critical or strategic infrastructure	60 municipalities hit by the fires	Sidewalks, markings, bridges, tourist infrastructure	Loviisa NPP	the fishing industry directly impacted main sources of employment in the area
affected vulnerable groups	All inhabitants of the area	water resources supplying 100,000 inhabitants with drinking water	Elderly people's homes - Estonian coastline.	Poor and socially excluded groups, single mothers, families highly dependent on fishing and seafood collection
what combination of threats (na-tech) – please describe		Affected economic activities, tourism	Radiation and Nuclear Safety Authority emergency, sea-level rise, Energy Company Fortum preparing to close down	Fire, Burnt remains clog water streams, untreated burnt soil, Heavy rain drags mud, burnt remains downstream, towards the coast, flooded coastal towns, causing damages
Identified critical assets to be protected	Residential areas, slopes, animals, ecosystem	Natural protected areas, wild forest	Loviisa NPP, public and private real estate, government buildings. Loviisa, safety and security measures emerged, unrapidly rising sea waters	Drinking water supply infrastructure Power supply infrastructure Gas supply infrastructure Roads and streets Poor and socially excluded groups affected
identified potential threats based on cascading effect	Intense smoke and fumigation led, un-breathable air, visual precipitations, changed quality of the Western Po valley and the City of Turin (45km leeward from the largest fire), one of the most air-polluted European territories.	Economic, endemic, affected flora and fauna, affected natural sources	Emergency status for the electricity grids	Unemployment Drinking water affected

Response efforts immediately after the hazard	270 department staff, 600 volunteers, Helicopters, Canadair airborne fleet, Canadair aircraft from France, Switzerland and Croatia supporting efforts to extinguish the fires.	Activation of the public and NGOs, public collection, volunteering activities for planting new trees and cleaning the debris from the storm.	The nuclear power plant increased its preparedness, information received from the Russian authorities	Coordination assessment: coordination improvement First response: burnt soil and burnt remains
access to sources/knowledge, experience, tools amidst disaster	prevision system based on the Fire Weather Index (FWI), A daily bulletin gives data and information to the authorities and stakeholders involved in the fire risk management chain, The public air pollution monitoring network contributed to having information on cascading effect	Financial and human resources	early warning signal, situational awareness also began to develop among the key operational actors in the Helsinki metropolitan area, Rescue Department, Police Department, Helsingin Energy, the Port of Helsinki, Helsingin Vesi, the Finnish Transport Agency, the Helsinki City Environment Center, the Helsinki Military County, the Gulf of Finland Coast Guard.	Access to sources was affected. Access to knowledge, experience, tools: good and available
Used technologies/sources	Activation of Copernicus EMS, delineation maps (showing the extent of fire) over 6 areas of interest, high-resolution optical satellite imagery	125 tractors, 8 harvesters with forwarders, 26 horses. costs for the immediate elimination of the consequences SKK 31 million	the sea-level monitoring system, numerical models run automatically four times a day, water level observations measured every hour, Forecasts and observations are stored in the same database, foreign comparative forecasts as part of the Joint Baltic Sea Operational Research System (BOOS).	Local, regional, national and international resources were necessary
loss of life/ injury	1 dead 8 firefighters suffered smoke intoxication Hundreds of people have been evacuated, including 185 elderly people of a rest home	one loss of life	One person died in Estonia, 15 injured. In Finland, no one was seriously injured or killed.	No loss of lives Economy affected Nature affected
Major damage (not only structural	9,700 hectares of which 7,200 of forest have been destroyed including areas in the Site of	The total volume of wood in damaged stands,	Private sector damage and measures,	Natural disasters affecting economic activity

damage but also non-structural)	Community, woodlands and pasture areas between 700 and 2800 m of altitude, Serious damages to biodiversity, soil quality, degradation of ecology functions in burned areas	75.5% fell to spruce, 8.2% to pine, 6.9% to spruce, 1.6% to fir (especially alder, birch, willow, rowan, aspen, mountain maple), local natural potential and, of course	Finnair: storm would not cause any disruptions to its operations. Fortum: faced problems with the distribution of electricity, Public sector: The damage caused by the 2005 floods rose to EUR 20 million for one insurance company alone. In Finland, damaged not only private property but also public sewer systems and ports and road structures.	
Recovery efforts after the hazard (what recovery plan)	The activation of Copernicus EMS was activated to assess the grade level of the damages caused but the wildfire events, as well as to understand the risk of soil erosion and landslide over the burnt areas where the loss of vegetation has possibly led to substantial chemical and physical properties changes.	Forest management planning	control at critical infrastructure sites. Municipal technology with heating ducts, electric cables, water pipes and sewers. The pumping of water from private houses, Sewer networks blocked by floodwater, r resulting in 63,000 cubic meters of untreated wastewater, About a hundred households in the metropolitan area needed the help of the rescue service.	Recovery involved: Forest recovery: soil, forest, cattle, harvest Town recovery: cleaning, infrastructure repairs Coast recovery: cleaning, mud collection
Major preparedness/ DRR measures prior to the hazard	Lack of law that can surveillance the forestry and water management. Many of the damages originate because of bad forestry and bad shape water troughs.	-	Check the conformity of the storage places more (DREAL mission). Do not exceed authorised volumes Respect remoteness distances between piles of wood and property boundaries (accessibility to relief and propagation)No trees or branches nearby (risk of fire spread)The area must be watertight to prevent infiltration of extinction water into the soil	Climate change is going to increase the frequency and magnitude of hydrogeological hazards

Major changes/improvement in disaster risk management	The Piedmont Region in 2019 has approved a Recovery Plan for the Wildfire 2017.	The monitoring system, planting different types of trees	Critical communication (TETRA v. Broadband), cross border interaction, Security and safety standards of the Loviisa Nuclear Power Plant, it established the situational data system.	

Interruption of supply

	9	10
What type of disaster/extraordinary event	In the **Finnish city of Nokia**, on November 28–30, 2007, contaminated sewage water flowed into the drinking water network for three days, causing severe symptoms for thousands of people.	The **summer storms** of 2010 affected particularly **Eastern Finland**.
Caused by	it revealed the cause of the contamination to be a combination of different events. A maintenance man in the Nokia waterworks had opened a valve between tap water and sewage water pipes to let some tap water flush out the sewage pipe. **It had previously installed the valve against regulations.** Because of pressure differences, the water flowed in the opposite direction contaminating the tap water. There was carried out maintenance work at another site. The access of the technical water to the domestic water network due to improperly constructed connection between the technical water network and the domestic water network. The measure developed into a complex, long-lasting and far-reaching crisis.	The first storm called Asta arrived in Finland on July 30th at 02.00 am. Asta storm (30.7.) was followed by Veera storm (4.8), Lahja storm (7.8.) and Sylvi storm (8.8.) These severe storms had an impact on 11 days. Asta was a typical thunderstorm with downward flows, but its strength and amount of flashes of lightning (24 415) made it exceptional. Especially during night hours with downward flows makes it rare – but fortunate as it prevented human losses.
Affected area	City of Nokia 34.500	Asta proceeded with a 100 km wide storm front, and it affected the Finnish territory for 4.5 h. Approx speed was 102 km/h, and the highest measured wind was 29 m/s.

		It affected five regions: South-Savo, Southern Karelia, Northern Karelia, North-Savo and Central Finland.
Affected population	The contamination affected an area with some 12,000 inhabitants and caused an epidemic of thousands of cases of diarrhoea and vomiting, primarily due to Norovirus and Campylobacter infections. Hundreds of inhabitants were hospitalised, and the town was forced to forbid all use of tap water temporarily.	The summer storms of 2010 affected particularly Eastern Finland. Several weeks lasted in mitigating the consequences. But, unfortunately, the situation occurred at the same time when neighbouring Russia was struggling with the all-time high forest fires. This created more stress.
Affected critical or strategic infrastructure	Water supply network of the city of Nokia	The strong winds destroyed critical infrastructures, electricity lines, road networks and telecommunication towers. The electricity network was badly damaged, affecting 1/3 of electricity providers. It destroyed electric power networks (including distribution networks) in the storm impact areas. The electric grid and distribution networks were largely affected in Eastern and Central Finland. A total of 35 000 kilometres of electric power network were destroyed or damaged. As a result, some 9 000 distribution sub-networks were left without electricity. Power cuts and their consequences were more widespread than immediate storm areas. They affected one-third of the service providers and about 480 000 electricity customers. Almost 100 000 of them were longer than 12 hours without electricity.
Affected vulnerable groups	Particularly elderly people	
What combination of threats (na-tech) – please describe	The range of pathogens that entered the water supply network was wide because treated municipal waste entered domestic water.	The situation occurred at the same time when neighbouring Russia was struggling with the all-time high forest fires.
Identified critical assets to be protected	The domestic drinking water network should properly safeguard against contamination and warning systems effective for alarming disasters.	
Identified potential threats based on cascading effect	There was a poorly designed installation in Nokia's Kullaanvuori water treatment facility. A drinking water pipe was connected to a wastewater pipe to flush the wastewater pipe. Such an installation is illegal, and for a good reason, backflow occurs if the water pressure in the drinking water pipe is too low. Unfortunately, a maintenance worker accidentally opened the valve, and wastewater flowed into the drinking water supply for two days, seriously affecting the health of thousands of people.	The July-August time frame is the most active holiday season and results from multiplying the population in Eastern Finland. Most of the holidaymakers were used to the rapid reaction by emergency authorities due to living in metropolitan areas. In remote areas of Eastern Finland, the first responders might arrive after one hour or so. However, difficulties emerged as the electricity was down, which resulted in poor communications between citizens and the rescue authorities.

Response efforts immediately after the hazard.	It took two days until it gave an official warning that the water was contaminated and distributed drinking waters in bottles.	Several weeks lasted in mitigating the consequences.
Access to sources/knowledge, experience, tools amidst disaster	It detected the contamination rather soon, but the company decided to ignore it, assuming it was a transient pulse caused by the repairs.	
Used technologies/sources	Permanent technology of rescue and health services.	The Ministry of the Interior soon announced no need for national rescue measures. Therefore, the Ministry does not see it necessary to take a national coordination role due to the storm. The Ministry noted that the regional rescue services had been informed about the developments, and they had performed well. Most critical comments came from municipal level authorities. Their point was focusing on weak preparedness, incoherent situational awareness and poor reactivity, which were laid on the shoulders of few persons and authorities. Improvisation was essential for success; instead, it would have conducted the consequence management based on the system approach.
Loss of life/ injury	The treated wastewater caused more than 8,000 people in the Nokia City area. As a result, more than 5,000 people (54%) of the city's residents fell ill with stomach diseases from November 28th 2007 to January 20th 2008, and 16% of those living in the "clean area" at the same time.	
Major damage (not only structural damage but also non-structural)	More than 400,000 litters of coarse-treated wastewater had entered the Nokia city domestic water network. Yet immediate retaliation remained limited.	The economic losses of this storm surge was the biggest for the forestry (30 000 km2) and in financial terms 50,4 million euro (refunded by insurers). The total costs have been estimated to be over 32 million euros (standard compensations 10 million, operational costs 18 million and investments 4 million). The biggest economic losses occurred in forestry during the summer of 2010. According to the Finnish Forest Research Institute Metla, 8.1 million m3 of standing timber fell or was destroyed. This is the same amount as 15 per cent of the annual cutting amount. The direct losses to forestry resulting from the July-August storm season have been estimated to 240 000 hectares of land.

Recovery efforts after the hazard (what recovery plan)		The local and municipal level authorities faced difficulties to obtain timely and coherent data. Challenges emerged of sharing capacities and data across the borders of the regional rescue services. There was no request to mobilise the Finnish Rescue Force (highly equipped Finnish rescue commando battalion) or the first assistance units of rescue services to assist worst-hit regions.

Chemical induced multi-hazards events.

Example 3: Chemical incident	11	12	13
what type of disaster/extraordinary event	Car accident with dangerous chemical substances, **highway D 46 Prostějov, The Czech Republic**	Hazardous material leak on the town of **Modane, France**	Oil spill (26-year-old oil tanker "Prestige") **Spain, Galicia,** November 13th, 2002
caused by	driving under the influence of drugs	The leak of hydrochloric acid at a weld on a railway highway tanker (08/12/2020)	Obsolescence of the ship, structurally deficient. Deficiencies had been reported in previous ports, but there had taken no action to correct them. During a storm, carrying 77.000 tonnes of heavy fuel oil, the tanker burst a tank while being at about 210km from the coast of Galicia, in the Atlantic ocean. Spanish, Portuguese and French governments refused to allow the ship to dock. The ship was towed from one place to the other while governments discussed. 6 days later, the tanker split in two and sank. It is estimated that it spilt 60.000 tons of oil.

affected area	Highway and part of a city with a population of 40,000 citizens		Thousands of kilometres of coastline. Most in Galicia (Spain), but also in Portugal and France. It is the largest environmental disaster in the history of both Spain and Portugal
affected population	700 citizens	65 people confined, the station's administrative buildings evacuated, and 4 people taken in charge at the Victims Gathering Point	Fishing industry dependant population Tourism dependant population
affected critical or strategic infrastructure	Highway	International and road railway line interruption	Fishing infrastructure Tourism infrastructure
affected vulnerable groups	Several retirement homes and kindergarten	Population	Fishing dependant population: mainly elderly people, low qualified
what combination of threats (na-tech) – please describe	Car accident, leak of dangerous chemical substances into the environment,	Cloud of toxic gas moving towards homes new leak and new intervention following the mishandling of the service provider in charge of the unloading operations of the tanker truck. new toxic release from storage of this non-deposit tanker truck entirely on the dangerous goods area of a multimodal transport platform (rail highway)	Before the storm: structural deficiencies: refusal to take action to repair the deficiencies After the storm: refusal to allow the ship to dock and reduce the damaged area from three governments: Spanish, Portuguese and French
Identified critical assets to be protected	The health of people and the environment	Train station	All critical assets are sufficiently away from the coastline
identified potential threats based on cascading effect	Because of the closed highway, there was a higher risk of a car accident on the detour route, High risk of pollution caused by the leak of dangerous chemical substance	Affected population	Oil spill > natural disaster > wildlife destruction > economy destruction > increase of vulnerable groups or vulnerability within already existing vulnerable groups.
Response efforts immediately after the hazard.	Integrated rescue system (Firefighters, Police, Paramedics)	Protection of the perimeter, removal of the tank, sealing of the leak.	Efforts were oriented to correct the damage once it was produced. Oil cleaning activity and there were also placed efforts on early detection of deficiencies in the structure of tankers and improvement of their design and construction.

access to sources/knowledge, experience, tools amidst disaster	-		Plenty. All knowledge was available.
Used technologies/sources	-	Control of chemical hazards.	Techniques and resources were used to correct the damage.
loss of life/ injury	1 life loss		No loss of lives
Major damage (not only structural damage but also non-structural)	There was a polluted highway a near environment, so there have to be done some special restoration work		Environmental damage was immense. Loss of wildlife, destruction of the coastline Damages amounted to over 1.5 billion euros.
Recovery efforts after the hazard (what recovery plan)	Emergency plan of the region, permanent type activity of integrated rescue system		Plan Galicia: economic measures to mitigate the consequences Clean-up of the coast
Major preparedness/ DRR measures prior to the hazard	Integrated rescue system of the region		Preparedness typically involved: Revision of the tankers Keeping tankers routes at a sufficient distance from the coast
Lessons learned from the event	More patrol for DUI	Control of tanker trucks before boarding on the railway motorway.	Efforts were concentrated on the structure of ships, inspections prior to sailing.
Major changes/improvement in disaster risk management	-		Efforts were concentrated on the structure of ships, inspections prior to sailing, and distance from the coast (sailing routes).

Second part chemical

Example 3: Chemical incident	14	15
what type of disaster/extraordinary event	**Fandicosta, France** Fire in an industrial facility. Fishing industry. May 2016 The industrial facility is located close to the coastline and the fire affected: - The facility itself - Part of coastline, sea contamination - Service station (petrol station) - Highway connecting Galicia North-South	Exposition of VOP Novaky, **Nove Mesto nad Vahom Slovakia** Explosives for disposal exploded in the decommissioning depot of the Military Repair Company
caused by	The fire originated due to electrical failure in a piece of equipment close to a tank containing ammonia.	breach of safety regulations, a human factor, unprofessional handling of the lighter initiation of the detonator.
affected area	Facility itself Coastline, sea contamination Town (partially) Service station Highway	smashed the windows of buildings in the nearby city of Prievidza at a distance of 12 km from the site of the explosion
affected population	Fandicosta employees Neighbours	n/a
affected critical or strategic infrastructure	Service station Highway, AP-9, traffic had to be diverted for several hours Potential threat: ammonia tanks, liquid nitrogen tanks. Fire extinguishing services managed to prevent fire from reaching these tanks.	Nováky and the surrounding villages were left without electricity. The fixed and mobile network not working the ingenious system of the city television, which is connected to the city radio, also failed broadcasts via amplifiers
affected vulnerable groups	Fandiscosta employees. Mostly	Yes, families of the workers

what combination of threats (na-tech) – please describe	Electrical failure – flammable material (harmonisation material, 20-year-old) – the proximity of toxic products – the proximity of coastline – the proximity of citizenship	accompanied by a huge mushroom, damage to health containers of hazardous substances in this company were not disturbed the local thermal power plant was also not endangered, aside gate was damaged several hot water pipes were bent strengthened preventive reasons It had released no dangerous chemicals into the air.
Identified critical assets to be protected	Petrol station Highway	N/a
identified potential threats based on cascading effect	Fire – the threat of explosion (flammable products) - the threat of toxic cloud – the threat of traffic interruption	a thirty-fold exceedance of the value of dangerous hexavalent chromium measured chemical consumption of oxygen, nitrite and nitrate nitrogen, as well as heavy metals - mercury, cadmium, copper and lead, were also exceeded
Response efforts immediately after the hazard	Fire control. Prevention of fire extension	injured transported to the nearest hospital – lack of capacity used folded beds in front of the hospital all doctors and nurses called to service there was created a crater of approximately 20 meters Search for missing people the help of dog handlers six missing workers from the affected delaboration room wounded transferred to the towns of Prievidza, Trenčín, Topoľčany and Partizánské rescue service from Bratislava helped eleven people trapped in more remote buildings for several hours fire eliminated remotely using a special technique pouring and cooling the unexploded ordnance until morning

access to sources/knowledge, experience, tools amidst disaster	The company owner was available at all times, providing useful and relevant information to emergency services Civil forces are available and collaborative at all times	20 ambulances a helicopter 84 members of the Firefighters Forces Presidium, 27 members of municipal fire brigades, 19 employees of company fire brigades, 3 employees of the fire brigade of the Military Unit 5782 Nováky, 4 firefighters of the Military Unit 1056 Zemianske Kostoľany municipality, 34 doctors, 5 emergency call conductors, the unidentified number of nurses and paramedics. • pyrotechnicians, • investigators, • chemical labs of the MoI
Used technologies/sources	Coordination, fire extinguishing services, etc.	Fire tanks a crane an excavator rescue equipment thermal imagers to search for living people
loss of life/ injury	No loss of lives, no person injured	8 dead 14 heavily injured_ 34 injured
Major damage (not only structural damage but also non-structural)	Facility destruction Non-structural damage: services affected for several hours	Broken windows destroyed delaboration room Health impact

Recovery efforts after the hazard (what recovery plan)	The facility was insured, and the company and the company owner. The company recovered after the fire.	urges the construction of a four-lane expressway R2 towards Trenčín establishment of an ambulance station in Nováky (the nearest one is thirteen kilometres away), wireless radio in the city
Major preparedness/ DRR measures prior to the hazard	Preparedness typically involved: Production facilities revision and maintenance	construction of a warning system
Lessons learned from the event.	Efforts were concentrated on the structure of ships, inspections prior to sailing	the company need to develop an emergency plan following the law at the time of the explosion – the existing one was outdated and unproven in practice need preparedness exercises improve time response and adequate manner the emergency plan was outdated and unproven in practice. provide intervening Firefighters Forces units with a list of stored ammunition and explosives improve prevention measures for assessment of the risk of explosion provide information about amounts and types of hazardous materials – develop a register about the storage areas in danger of exploding estimate the number of injured based on emergency and contingency planning
Major changes/improvement in disaster risk management	No major changes were implemented	Another explosion happened later; safety and security issues related to the environment, very old technologies, need a change of equipment and smartening of the systems.

Technical failure

	16	17
what type of disaster/extraordinary event	Fire of a local squatted in a highway bridge pile of the commune of Albertville, Savoi, France	warehouse fire on the town of La Motte Servolex (02/28/2018), France
caused by	Squat (05/13/2018)	Burning of a hangar
affected area	Fire of a squat located inside the pile of a bridge	Whole building
affected population	Five people are confined, and 35 others evacuated. Gas cut for 125 homes in the commune of Grignon. 15,000 private telecommunications subscribers (internet and mobile phone)	10 habitations evacuated
affected critical or strategic infrastructure	Destruction of the bridge deck following a gas explosion due to damage to the pipe crossing the bridge.	
affected vulnerable groups	population	population
what combination of threats (na-tech) – please describe	Fire of a squat located inside the pile of a bridge Installation of a 100 m security perimeter Presence of 20kV power lines An ignition gas leak followed the explosion.	
Identified critical assets to be protected	Population	
identified potential threats based on cascading effect	Fire generating a gas leak, then creating a gas cloud in a deck sheath than a gas explosion... Power outage, water, telephony and internet (the bridge allowed the circulation of these fluids) for several days could endanger the population. Destruction of the bridge deck, closure for months before repair.	The hangar of one of the companies set the whole building on fire, which affected two other companies and caused unemployment. In addition, there could have been a risk of pollution.
Response efforts immediately after the hazard	50 firefighters on scene, police, gas department intervene to stop the natural gas leak	26/10/2016, 2FPTR-FPT-2 EPAN-VRAC-VEMUL-VSAVSSO-CDS-GARDE DIR-PCM-3 CDG-VSM VEV FSLOG

access to sources/knowledge, experience, tools amidst disaster		
Used technologies/sources	FPT-FPTL-CCR-MCH-VIRT-CYNOCTRCH3- PCM- 3 CDG-CDC-CDS-MADSSO-- PSY MAIRE-SOUS-PREFET-DIR-GRDF - ENEDIS- POLICE 9 / 17 / 8 Installation of a generator for public lighting.	An Identification and Sampling Detection Vehicle (VDIP) has been hired from Lyon to conduct various analyses, atmospheric measurements and water quality measurements. Surveys and analyses did not report pollution in sampling areas.
loss of life/ injury	4 firefighters are supported for hearing problems following the explosion.	1 firefighter on the ankle
Major damage (not only structural damage but also non-structural)	Power outage (20000 V), water, gas (MP), telephony and internet (the bridge allowed the circulation of these fluids) for several days. Gutted bridge: Road traffic prohibited on the severely damaged bridge (estimated repair cost: 4 million euros, reopening expected end of 2019). Detour of more than 15 minutes for users. Public lighting out of service	6 persons jobless
Recovery efforts after the hazard (what recovery plan)	the community in charge of managing the bridge secured the space by closing it to prevent access. There was an administrative and judicial investigation and a compliance analysis by DREAL. For the duration of the works, care had to be taken to preserve biodiversity and build a temporary dam deviating part of the Isère.	
Major preparedness/ DRR measures prior to the hazard	The Albertin Bridge event shows the attention that it must pay to secure utility networks (telecommunications, gas, electricity, drinking water, etc.). The slightest accident on the latter usually leads to significant social discomfort (15,000 personal mobile phone and Internet subscribers in this case and interruption of the road for months).	

Lessons learned from the event.	Beyond this, several lessons concerning natural gas networks specifically call for questions on: The singular strategic points are already identified by distributors or transporters (watercourse crossings, railways, etc.) of configurations similar to that of the accident: Areas or premises where abnormal heat load accumulation occurs; Confined passages not open to the outside and not visitable.	
Major changes/improvement in disaster risk management	• The relevance of an action plan to strengthen controls at the level of previously identified areas or to study their removal.	

Human airborne induced multi-hazards deceases.

Example 4: Contagious human/animal diseases	**18**	**19**	**20**
what type of disaster/extraordinary event	Epidemic, **the Czech Republic**	**Pandemic, Turin, Italy**	Measles, **Trebisov, Slovakia**
caused by	SARS – CoV2 – new type of coronavirus called COVID-19	Covid-19 virus	From January this year to February 14th 2019, the Public Health Office of the Slovak Republic (ÚVZ SR) registers 67 cases of measles in Slovakia. In the district of Trebišov (Košice Region), 57 cases of diseases were reported within the mentioned time limits. The measles epidemic has persisted in the Trebišov district since September 2018, with cases where it is starting to increase, related to the natural migration of the population. A total of 149 people became ill with measles from September 2018 to February 14th 2019. Epidemiologists have recorded the most diseases in the towns of Trebišov and Sečovce towns.

			Many diseases occur in children who are still related to their age could not be vaccinated. In the district of Michalovce (Košice Region), where the measles epidemic lasted for about 4 months last year, epidemiology has caused 4 cases of this disease since the beginning of this year. Anti-epidemic measures in Michalovce - reported 428 cases (420 confirmed and 8 unconfirmed) in the Michalovce district and 19 cases in the Sobrance district. Anti-epidemic measures have been secured. The Regional Office of Public Health, based in Bratislava, does not record any new cases.
affected area	Whole country	Turin, Italy 900.000 inhabitants	Trebisov town, 25549
affected population	1 700 000 citizens	886,837 inhabitants (Istat, 2017)	Roma population, 6000, 25% of the local population
affected critical or strategic infrastructure	Every critical and strategic infrastructure had to take regime and personnel measures.	To contain the spread of the virus, the Italian national government imposed during spring 2020 a total lockdown of the population in the whole country for more than 2 months. The social and economic crisis associated with the pandemic has increased the pressures on food access, revealing an increasing number of individuals that lost their daily income, cannot afford their basic needs, cannot purchase food or are homeless.	
affected vulnerable groups	Senior citizens, chronically ill, compulsory school	low-income and new unemployed due to lockdown restrictions (9,000 families)	Bridging measures aimed at improving the availability of routine health services for the population of the ethnic Roma minority
what combination of threats (na-tech) – please describe	In an epidemic, every identified danger has a higher risk rate because the preparedness is reduced by taking regime and personnel measures	The restrictions introduced to reduce and contain the virus's spread have had serious socio-economic consequences, such as the increasing number of people who struggle with food access.	N/a
Identified critical assets to be protected	Senior citizens, chronically ill, emergency units,	Population, in particular people at higher risk of severe covid19 (people over 60+yrs or with	N/a

	hospital employees, necessarily services (funeral, waste management)	health conditions like lung or heart disease, diabetes or conditions that affect their immune system)	
identified potential threats based on cascading effect	Limitation in hospital care – every department was reduced due to reassignment personnel to the new COVID department.	Social-economic implications of coronavirus on vulnerable people	Our attention is to two main indicators of vaccination: vaccination rates and timeliness of vaccination. A module for monitoring the heterogeneous population was produced, characterising the individual groups with the degree of vaccination.
Response efforts immediately after the hazard .	The first response was for the emergency units in case of protective equipment and starting the RT-PCR laboratory tests for finding the Coronavirus cells.	The city of Turin implemented a new initiative in April 2020 called Torino Solidale to provide free food and primary goods to the most disadvantaged people. The free food delivery service is part of a broader framework of actions implemented by the city (e.g. psychological support helpline for single people, help service for the elderly and disabled) which saw the interaction between different departments of the City of Turin (Civil Protection, Environment and Green Division, Social Services Division), third sector organisations and private actors.	The Public Health Office of the Slovak Republic and the regional public health offices of the Slovak Republic pay increased attention to measles surveillance. We monitor the epidemiological situation in the occurrence of measles in Slovakia; in the event of a change in the epidemiological situation, we immediately take all necessary anti-epidemic measures to prevent the spread of this infectious disease.
access to sources/knowledge, experience, tools amidst disaster	Pandemic plan, Type plan - Epidemic plan, Crisis plan of the region, Traumatological plan of the emergency health unit, Traumatological plan of hospital,	350 volunteers recruited partly by the city through a local campaign, partly by the third sector organisations thanks to their contacts. Public resources (National Government, Piedmont Region and the City of Turin), association's funds, and private donations (through fundraising campaigns). Food donations collected by the "Piedmont Food Bank", the "Bank of Charity Works", 1 Operations Centre to manage and coordinate the activities	Awareness for the local community, monitoring the physical environment

		12 municipal hubs (third sector organisations whose venues have been used to supply and deliver the food packages to people)	
Used technologies/sources	The government started to digitalisation the health system of the republic, and there were created mobile apps,	"help requests" have been collected through a free-phone number managed by Civil Protection or by directly contacting the Municipal Social Services or the hubs	N/a
loss of life/ injury	About 30 000 lives were lost, injured about 300 000 people have a health issue called post-covid syndrome.	Total number of people infected with Covid-19 in the Metropolitan City of Turin (2/08/2021): 197,751 Total number of dead infected with Covid-19 (2/08/2021): 5,591	N/a
Major damage (not only structural damage but also non-structural)	The republic's economy is in bad shape due to the taken measures by the government, and Industry has taken a heavy loss. After the COVID situation, there is a lack of strategic goods in every industry field.	Direct consequences of Covid-19: rise in mortality, the shock to the NHS and social care systems Indirect effects: border closures, trade restrictions and confinement measures, the rise of people at risk of falling into extreme poverty or being undernourished	Health vulnerability
Recovery efforts after the hazard (what recovery plan)	Government make some recovery plan in every field of the republic economy.	The Italian government introduced some urgent measures allocating some funding for those workers unemployed by Covid-19: payments for the self-employed, food vouchers to those who can't afford groceries. Concerning the Italian Recovery Plan 2021, it does not include measures on food access.	Vaccination, social distancing
Major preparedness/ DRR measures prior to the hazard	Health and social system, insurance by the state institution	All the organisations involved have a close working relationship, mostly born and developed over time, particularly after the global financial crisis of 2008. The actors were already working with the City Council in the 'Social Inclusion Plan' (2018). It helped them easily perform different	Monitoring of the situation regularly, community visits, online platforms. The system collects and evaluates information from all localities on a 3-day basis for more than 10 epidemiological indicators (visits from abroad, tests, quarantines, hospitalisations, deaths, etc.).

		axes of intervention, such as community networks for social inclusion, solidarity networks for people in conditions of housing distress, territorial networks for the inclusion of citizens in conditions of serious marginalisation.	The interactive report from the given monitoring system is available online via access.
Lessons learned from the event.	It is hard to prepare for something with a whole world impact	The 12 institutions transformed into Hubs have rapidly re-shaped their functions to improve the system's adaptability. To activate different levels for collecting different types of resources (human, funds, food) but there must manage the action at the neighbourhood level The community network helped to integrate other requests such as school supplies for children and psychological support	specify the prevention and control of a pandemic in this environment present several possible vaccination scenarios for the future, the public health, social and economic impact on wellbeing then evaluated using statistical methods compare the proposed vaccination scenarios based on several criteria: economic versus social / health criterion, the prognosis of the epidemiological situation using deterministic and stochastic models, and evaluate the social impact on the individual and society.
Major changes/improvement in disaster risk management	New strategic plan, the new conception of sustainable development of the state	No information	Focus on the highly contagious measles disease, the epidemic of which currently appears to be the biggest threat in EU countries. https://www.zdraveregiony.eu/wp-content/uploads/2018/04/ZK_potreby_e-verzia.pdf. Use of GIS system to monitor the area, introduce regular terrain monitoring, data collection, develop a system of reporting

Violation and terrorism

Example: Extremism/school shootings	**21**
What type of disaster/extraordinary event	School shootings of 2007 and 2008 in Finland.
Caused by	The Jokela school shooting occurred on November 7th 2007, at Jokela High School in Jokela, Tuusula, Finland. The gunman, 18-year old Pekka-Eric Auvinen, entered the school that morning armed with a semi-automatic pistol. He killed eight people and wounded one person

	in the toe before shooting himself in the head; twelve others were also injured by flying glass or sprained ankles. Auvinen died later that evening in a Helsinki hospital. Next year, a "copycat" occurred when a school shooting occurred on September 23rd 2008, at the Seinäjoki University of Applied Sciences (SeAMK) in Kauhajoki, in Western Finland. The gunman, 22-year old student Matti Juhani Saari, shot and killed ten people with a Walther P22 Target semi-automatic pistol before shooting himself in the head. He died a few hours later at Tampere University Hospital.
Affected area	Seinäjoki University of Applied Sciences (SeAMK) in Kauhajoki, Western Finland. Jokela High School in the town of Jokela, Tuusula, Finland
Affected population	Students, staff and teachers of Jokela High School and Seinäjoki University of Applied Sciences.
Affected critical or strategic infrastructure	School buildings and property
Affected vulnerable groups	Students 17-25 years old, staff middle age
What combination of threats (na-tech) – please describe	In both cases, the actor was a disturbed person frustrated with his societal environment. They followed radical and violent internet pages as models for their terrorist-like behaviour. The shootings were well planned and prepared with the procurement of weaponry. The shooting was also by setting fires and using "Molotov cocktails". Chaos and panic resulted.
Identified critical assets to be protected	Educational facilities
Response+Identified potential threats based on cascading effect	Finnish police were also investigating whether and there was involved a copycat element after it emerged that both gunmen, Auvinen and Saari, had bought their guns from the same store. They both had taken photographs of themselves in similar poses, and they changed videos related to school shootings on YouTube and Finnish social networking site IRC-Galleria. Jokela, Copycat threats in Finland: On November 9th 2007, the Finnish police rushed to three schools due to threats of attacks posted on the internet. One of the schools was Hyrylä high school in Tuusula, Kirkkonummi, and Maaninka. The 16-year-old boy who posted a video titled "Maaninka massacre" on YouTube was arrested on November 11th. The suspect has stated that the video was a joke. Three weeks after the Jokela shootings, the Finnish police, flooded with hoax threats, made a public plea for threats against schools to cease. The police reminded prospective perpetrators of severe judicial consequences and the feelings of the families touched by the Jokela events. After the Kauhajoki school shooting occurred on September 23rd 2008, Finnish police stated that Saari "very likely" knew Pekka-Eric Auvinen, but there was no proof of that in the final investigation.
Access to sources/knowledge, experience, tools amidst disaster	
Used technologies/sources	The police found 75 casings and 327 new rounds of ammunition at the scene. In addition, the flammable liquid was found poured on the walls and floors of the second floor, suggesting that Auvinen had attempted to set the school on fire.
Loss of life/ injury	With a total of ten people killed, Kauhajoki shooting Kauhajoki: 9+1 people killed. was the deadliest peacetime attack in Finnish history, surpassing the previous highest count of 8+1 in the

Major damage (not only structural damage but also non-structural)	The School system interrupted, and local families were shocked and suffering from long term mental consequences.
Recovery efforts after the hazard (what recovery plan)	
Major preparedness/ DRR measures prior to the hazard	
Lessons learned from the event.	On November 9th 2007, the Finnish government decided to drop objections to the European Union directive on firearms. However, this mandated a common European minimum age limit of 18 years for gun ownership. Furthermore, the directive banning the use of guns was immediately adopted.
Major changes/improvement in disaster risk management	On November 13th, the Finnish government announced that it would set up a "Commission of Inquiry to investigate the Jokela school shooting and events that bear relevance to the incident". The investigation report was released in February 2009. On the day of the incident, a crisis meeting was held with government ministers, chairs of the parliamentary groups, and police officials all in attendance. Within days of the shooting, the police said they had received a sizeable number of tip-offs alerting them to suspicious photographs, videos, and comments on chat rooms. In addition, Finnish media reported several bomb threats and other threatening messages circulating among students nationwide in the few days after the shootings.

Cyberattacks

Example 5: Disruption of telecommunication/data transfer and electricity systems	**22**
what type of disaster/extraordinary event	Cyber-attack, phishing
caused by	It was not a targeted attack, but only the execution of malicious code in an e-mail attachment by a hospital employee, tightening Ryuk ransomware and encrypting data. Even though the systems and antiviruses programme were running up to date, the malware and defence system was unprepared. There was no contingency plan for the urgent surgeries. Because the network was partially segmented, no medical devices were affected. Nevertheless, they were preventively disconnected from the backbone network and reinstalled their operating system on the control consoles. For the above reason, there was stopped the operation of the Benešov Hospital for several days, and work began on removing malware and resuming operations.
affected area	Rudolfa a Stefanie Benešov Hospital, a.s., 2019-12-11
affected population	750 staff, 400 patients

affected critical or strategic infrastructure	medical devices - preventively disconnected from the backbone network and their operating system on the control consoles was reinstalled, there was stopped the operation of the hospital for several days
affected vulnerable groups	patients
what combination of threats (na-tech) – please describe	missing information about patients (inpatient part), missing personal data of patients (examination by device)
Identified critical assets to be protected	hospital internal information network
identified potential threats based on cascading effect	interruption of electricity supply, reduction of health care
Response efforts immediately after the hazard	disconnection from the backbone network (medical devices), reinstallation of the operating system
access to sources/knowledge, experience, tools amidst disaster	access to information limited, partial media coverage to citizens, patients
Used technologies/sources	network reinstallation
loss of life/ injury	0
Major damage (not only structural damage but also non-structural)	Loss due to attack CZK 40 million, Confidentiality violated - NO, Impaired integrity – YES, Impaired availability – YES, Impaired authenticity – NO, System compromise - YES
Recovery efforts after the hazard (what recovery plan)	malware removal and traffic recovery
Major preparedness/ DRR measures prior to the hazard	antivirus security and its control
Lessons learned from the event	more frequent inspection
Major changes/improvement in disaster risk management	-