DARE net

Practitioner Network to Strengthen Flood Resilience in the Danube Region

Public Report

Challenges and RDI Topics

Based on internal project deliverable
D1.1 DARENet Challenges and RDI Topics

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740750.

danubefloodresilience.net

Executive Summary

DAREnet aims for sustainable improvements in flood management in the Danube river region. Therefore, challenges practitioners might be faced with, build the foundation of further studies. They will be continuously updated over the course of the project cycles within DAREnet. Resulting from these challenges Research, Development and Innovation (RDI) topics have been identified. They describe topics to overcome or address challenges. These will be further examined, i.e. by comparison of available solutions and might finally address a gap in the portfolio of potential solutions that needs further exploration. Challenges and RDI Topics name subjects that need to be addressed to increase enduringly the resilience of civil protection practitioners and civilians against floods in the Danube river region.

This deliverable compiles a list of almost 100 RDI Topics thematically grouped in 14 distinct RDI Topic groups. Based on the first RDI Topic list issued here, future work within the DAREnet project will be planned. Concretely, RDI Topic Working Groups will be installed (Work Package 4 “Innovation Monitoring”) and evaluate RDI topics to specify further needs and identify gaps. This marks the start of the road mapping cycles (Work Package 5 “RDI Assessment and Roadmapping”) where results from the RDI topic working groups will be assessed, prioritised and ranked, indicating innovation opportunities. This will lead to practitioner-driven initiatives (Work Package 6 “Practitioner RDI Initiatives”) where practitioners will be supported and advised in realising own initiatives based on their experience and needs, addressing innovation opportunities identified in the DAREnet RDI roadmap.

Table of Contents

1. Introduction

Floods impose usually very complex crisis situations. Based on their rareness, compared to common emergency situations, like traffic accidents or construction fires, practitioners are less familiar with it, especially if these situations are over-regional or even cross-border. DAREnet will strengthen the flood resilience throughout the disaster management cycle (Figure 1) by increasing competency and efficiency in civil protection. For the first phase of DAREnet floods will be mainly limited to river floods and partly flash floods. Groundwater floods and other technical floods are not in the focus. However, many aspects are likely to be transferable and add value to the resilience toward these events as well.

Figure 1: Flood Management cycle following the four phases of the crisis management cycle, including examplified tasks during the four phases.

This deliverable provides challenges to flood resilience and Research, Development and Innovation (RDI) topics to address identified challenges.

For a better understanding of the DARENet project certain terms are defined in chapter 8 “Definitions”.

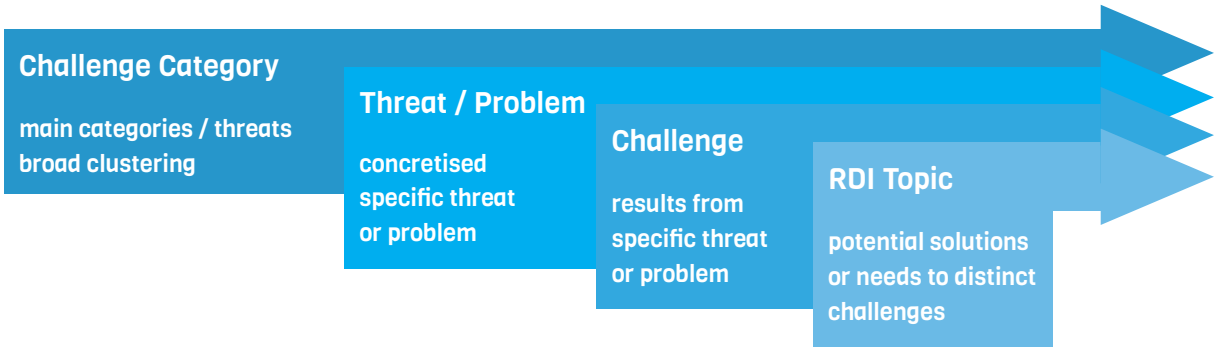

Figure 2: Hierarchy and derivation of challenges and RDI Topics

Identified RDI topics are directly derived from challenges that practitioners are faced with. These challenges are imposed by certain threats or problems during flood events. The decent of distinct RDI topics is illustrated in Figure 2.

DARENet will focus on (civil protection) practitioners and their tasks, since this is covered by the expertise of the DARENet Consortium and Community. Although, there are aspects touching other fields (e.g. legislative framework, land use or regional planning, or meteorology). These aspects should not be neglected, however DARENet will try to point to these interdisciplinary challenges and represent the civil protection/practitioner part. To address practitioner needs, relevant issues and the direct consequences or relation to the practitioner’s side will be named. The conclusive work up of such topics cannot be done solely by the expertise available in the DARENet consortium and therefore, will be communicated to relevant stakeholders outside the consortium in order to involve the practitioner network (DARENet Community).

2. Approach / Methodology

Figure 3: Flow chart illustrating the work flow followed to identify challenges and RDI topics.

To reflect the experiences and expertise of the DAREnet consortium as much as possible a multi-stage approach was chosen (Figure 3). Since the main goal is to identify challenges and potential RDI topics for the Danube river region in the field of flood resilience, the continuous contribution of the DAREnet consortium is vital to the relevance and acceptance of this paper. Therefore, two circulations of the drafted lists among the partners via the CMT online platform and during a physical meeting in January 2018 offered all parties the opportunity to add their perspective to these lists.

An initial list of challenges and threats was generated from a brainstorming session with all partners during the DAREnet Kick Off meeting in September 2017. The consortium was asked to name threats, problems and challenges which they see in future flood management. Already during this first challenge collection, a clustering in certain main categories was obvious (see Figure 4).

Figure 4: Initial clustering of challenges and threats.

This first evaluation of challenges was followed by an additional survey of incident reports of floods in Central Europe. Subsequent to a first circulation potential RDI topics were derived from the challenges.

This way, almost 100 RDI topics have been identified. For further explanation, each RDI topic is briefly described in chapter Identified RDI Topics “Identified RDI Topics”.

According to the DAREnet approach proposed in the description of work, this procedure was challenging, since it was thought to set up RDI Topic Working Groups to analyse certain RDI topics. However, since many RDI topics resemble thematically related clusters, they were grouped in 14 thematic groups. Further work on RDI topics will be performed by working groups assigned to a thematic RDI topic group. Based on this approach six RDI Topic Working Groups were installed in February 2018 (project month 6) and will perform their tasks in Working Package 4 (“Innovation Monitoring”).

Subsequent to the review this document will become public and will provide an orientation of possible topics that should be addressed to increase the flood resilience within the Danube river region.

3. Threats, Problems and Challenges

The identified threats and challenges have been clustered in eight categories. These categories resemble challenge themes or global threats ranging from natural/environmental events, over technical fields and to social questions. Following eight clusters were formed;

- Weather/Climatological Aspects
- Infrastructural and Geographical Challenges
- Civil Protection Resources
- Preparedness
- Information
- Communication
- Cooperation
- Political Aspects

Individual challenge categories are described in more detail in the subsequent sections (chapter 3.1 to 3.8). Each subchapter starts with a short list of identified challenges followed by a brief description. However, several challenges are not assignable to single categories and intersect or overlap with others. However, for easier reading they will be listed to their "main" topic. Where needed possible crosslinks or relevancies to other categories are further elaborated in the discussion.

3.1 Weather/Climatological Aspects

- Climate change
- „Common" floods (basin-wide or region-wide floods)
- Extreme weather
  - flash floods
  - flood after extreme draught
- Reliable and timely (local) weather forecast

Weather and climatological caused challenges towards flood management are very important in the context of climate change. While "common" flood events increased in number over the course of the last two decades (1; 2; 3) additionally an increase in extreme weather phenomena is observed, where the total amount of precipitation stays relatively constant, but the timing is shifted. Summers tend to be warmer and less humid, while winters bring more precipitation, but less snow, leading to higher run-offs (4). This shift to high volume precipitation events is also increasing occurrences of flash floods (5).

Another potential problem could be either long enduring rainfall, as in Central Europe in 2013 (6; 7) or in the Sava river basin in 2014 (8; 9), or massive rain after an extended dry period, where significant amounts of rain cannot infiltrate into the soil and cause a surficial run-off.
A huge challenge are reliable forecasts or "nowcasts", since only timely planning enables practitioners to take the necessary measures to minimise the impact of flooding events.

3.2 Infrastructural and Geographical Challenges

- Spatial extend
- Growths of metropoles
  - urbanisation
  - industrialisation
  - surface sealing
- Security of supply
  - blackout
  - lack of potable water
  - medical service
- Change of water way management
- Increasing dam heights
- Renaturation
- Dependency on water power plants
  - water turbines
  - dam structures
- Maintenance/modernisation
  - e.g. water level sensor renewal
  - locks/watergates or weir systems
- Cyber security

Infrastructural and geographical challenges are a wide field and sometimes difficult to confine. However, this section will try to respect all issues raised in relation to spatial, as well as to infrastructural threats and challenges.
One of the biggest challenges to flood management is the spatial extend of such events, since usually rather narrow areas located directly next to the waterway are massively affected over long distances. Additionally, flood situations evolve dynamically which means that different locations are at different phases of the disaster management cycle. Often this represents a logistical and prioritising issue. Moreover, resulting from the geomorphological appearance of the affected area, there might be specific challenges, for example a depressed area will be more difficult to protect against possible dyke failures as an uplifted plain.

Another important issue is a continuation of urbanisation and industrialisation if it interferes with water way management or planning. Consequently, higher population densities result in more people possibly affected by evacuation scenarios, or depending on supply with daily goods. The accompanying effect of increased surface sealing lowers natural retention of precipitation and so resulting in higher run-offs, or even flash floods. Ultimately resulting in faster evolving flood levels downstream, shortening reaction times of practitioners.
Infrastructural challenges result mainly from society's high dependency on security of supply and continuation of services. Possible interruptions of those are major challenges in disaster management. During floods, often the supply of potable water is affected, but also the lack of electrical power can cause trouble. Especially, if the electrical power is needed to maintain further services, such as ensuring radio transmission services, cooling power plants, water retaining structures or pumping stations, but also in the private sector (e.g. respirators, refrigerating, or heating). Another challenge is an interrupted medical service due to damaged doctor's offices or hospitals. Also the continuation of services like agriculture, transportation and waste management might be endangered.

3.3 Civil Protection Resources

- Material
  - technical equipment
  - tactical logistics
- Personnel
  - availability
  - demographic change
  - training
  - human factors/lessons-learned
  - health risks
- Steering/coordinating spontaneous volunteers
- Standardisation

Civil protection resources group all challenges related to the ability to respond to disasters, including material and personnel issues, but also organisational challenges, such as spontaneous volunteers or questions of standardisation.
Material challenges comprise the technical equipment available to the respondents, where functionality and robustness are of key importance. In the field of flood management this can be having barrier systems substituting classic sand bag barriers, having trucks equipped for mud and high-water levels or boats capable to operate in flooded urban areas. But also, even more basic questions are of importance, for example is the personal equipment and clothing of the responders sufficient? Ensuring the supply with the right

equipment or goods at right spot at the right time is essential for a sustainable and efficient disaster response.

Personnel covers another suite of challenges. Usually events like floods demand for a high number of responders. Many civil protection units rely on volunteers; therefore they are not immediately available, this requires mechanisms to make them available and mitigate possible economic damages to them or their employer. Another challenging fact is the demographic change in most European countries (10; 11). On one hand this faces disaster management with older volunteers, underlining the need for ergonomic technical solutions and aid. On the other, it means that the population also becomes older and potentially less mobile or depends on assistance (e.g. medical supply or mobilisation), which is challenging when dealing with evacuations, for example.

Another challenge is proper training for those involved in disaster management, since insufficient disaster management, due to lacking training and/or skills, is often named as a problem (12). Human Factors should be named in this context also. While the human factors analysis approach is a standard in high risk industries (13), aviation (14; 15; 16) and the field of medicine (17), it is rather absent in operational disaster management. Here, sufficient reporting and an exchange of lessons-learned would be beneficial for a sustainable increase in resilience.

Contamination due to natech accidents (18; 19) or from sewage systems during flood disasters always bear a high risk to health of affected citizens or responders.

A rather new phenomenon is the engagement of citizens who spontaneously volunteer. This can be very helpful, however there are new challenges and hindrances. For example, liability issues or the lack of training and understanding of the disaster management structures (e.g. chain of command). The efficient involvement of spontaneous volunteers requires training for responders & preparation of structures and processes in advance. This topic also resembles a communicational challenge.

In particular for cross border incidents lacking standardisation is a huge challenge, this reaches from used terminology to specific norms of equipment. This is intersecting with challenges in the field of communications, where the lack of standardised protocols becomes even more evident.

3.4 Preparedness

- Public
  - safety culture
  - increased vulnerability
  - awareness of citizens
  - resilience/self-protection
- Governmental
  - state of citizens' preparedness
  - warning systems
  - crisis management concepts
  - flood risk maps
  - evacuation plans
  - supply and logistics
- Civil protection
  - capacity building
  - training/establishing concepts
  - identifying suitable personnel
  - resilience of civil protection of personnel
  - lessons-learned protocols
  - concepts to involve spontaneous volunteers

Preparedness is a very important part to increase resilience. Here, three intersecting fields were identified. It starts with the preparedness of the public. Important for the vulnerability of a society is its security culture. Are the people aware of certain dangers and willing to act accordingly? This becomes even more obvious when the dependence on technical standards is taken into account. For example, changing communication technologies to digital formats, there will be a high dependence on electricity to guarantee those services, compared to classical landline services. Directly linked to the safety culture is the individual resilience of the affected, e.g. do they have necessary reserves (e.g. food and water) to be self-sufficient for a period of time, or even further do they know how to build a sand bag dam to protect their property. This determines their ability to self-protect.
The governmental preparedness takes into account questions related not to individuals, but to groups or society at all. In this field the state of citizens' preparedness is a huge challenge, since often incentives are needed for enduring reduction of vulnerability. In this context widespread warning systems resemble a challenge to enable timely warning and information.
Preparedness in the field of civil protection is a necessity, since during emergencies, such as a flooding event, time is a critical issue that demands a good preparation in advance. One of the most important tasks in this respective is capacity building. While it includes already aspects of training and planning, it is also an important task to identify suitable personnel

to fill staffs and find leaders. Bad disaster management and command has been reported as one major issue during the floods of 2013 (20). Also beneficial for future situations is in terms of sustainability the establishment of proper lessons—learned protocols to avoid bad decisions or mistakes from being repeated. Due to the relative scarcity of events like floods, compared to daily medical emergencies, extraction form cars, or firefighting, an active exchange between practitioners is extremely beneficial. As mentioned earlier, responders are in itself a limited resource, and therefore it is very important to increase their resilience (21). Especially, in those cases where responders are affected personally or their beloved ones, concepts are needed to enable them to focus on the actual tasks.
A potentially huge support can be drawn from spontaneous volunteers. During the Danube and Elbe floods in 2013 many spontaneous volunteers showed up and wanted to help (22). Their workforce was a good addition at sandbag filling stations, where they supported the logistics, filling bags or preparing them for transportation. However, new approaches to the classical coordination of responders during emergency situations are required, as mentioned above.

3.5 Information

- Information overflow
- Avoiding of "information white outs"
  - filtering, selecting, prioritising
- Efficient information management
  - language
  - accessibility/availability of data
    - georeferenced information
    - water level data
    - georeferenced (infrastructural) data
    - social/demographic data
- Flood risk maps and management plans
  - identification of critical infrastructures
  - evacuation plans
- Information flow path
  - technical support solutions
  - exchange of (digital) data
- Management of public information
  - warning of the public
  - authenticity
  - information of spontaneous volunteers

The challenge category information groups all aspects that handle the collection, processing, distribution of information during emergency situations. Naturally, many aspects overlap with the field of communication, this distinct category will be discussed further down.
One major challenge in today's information environment is the overwhelming availability of data. This bears various issues; the volume of information could slow, or even paralyse the decision-making process; technical capacity to handle, reliability issues due to various sources and actuality of various data sets.
Efficient information management is another potential issue, especially a uniform language and access to data. Legal regulation made flood risk maps and management plans obligatory in Europe, however proper training of people involved is necessary to enable a proper usage of those documents in case of an emergency.
The collection and handling of data is important, especially in spatially extended situations. But even more challenging is the distribution and sharing of data between involved parties. Here, technical systems, as well as various data formats require well thought solutions and possible standardisation.
Another field in the category of information is ensuring the information of the public. Already mentioned as aspect of preparedness, information and warning of the public are very important tasks to reduce the vulnerability. But also important is a high quality and transparency of information with authentic and verified sources, to avoid spreading of "fake news" and keeping the trustworthiness of information services. This also affects already mentioned spontaneous volunteers, since specific information can enhance the efficiency of their involvement, while uncoordinated communication could cause problems or frustration, e.g. due to controversial information where to help.

3.6 Communication

- Language
- Common terminology
- Cross-border
- Inter-organisational communication
  - different interests
  - data formats
- Technology options
- Reliability/Availability of networks

Communication, the process of sharing and exchanging information, is vital and often described as a challenge in disaster management. A major communication issue is language and common terminologies used. For collaboration and interoperability, it is crucial to understand other involved parties (practitioners, organisation or official agencies).
While problems seem obvious, cross border communication might cause additional other

(national) issues, e.g. the authorisation to exchange certain information or the security levels of individual information. But even on a national level, the inter-organisational exchange can be hindered, due to varying interests or technical issues (e.g. incompatible data formats). This leads to technical challenges like radio transmissions, where different systems are in use. This can affect the communication between different responders/organisations at the scene on a regional/national level, but becomes even worse during cross-border operations, e.g. that used frequencies on one side of the border are not available for this purpose on the other side.
Another technical aspect is the reliability of networks and services. While analogue radio transmission is limited in spatial extend, it could be extended by repeater/relay stations. The modern digital radio transmission enables calls and data transmission comparable to mobile services and is also encoded, however the system can be affected by overloads if too much traffic occurs and depends heavily on ground-based infrastructure e.g. terminals and base stations. Since modern telecommunication relies on continuous power supply for key components, services might become disrupted, because they are capable to bridge an outage only for a few hours.

3.7 Cooperation

- Cooperation awareness between various parties
  - governments and organisations
  - inter-organisational
  - flood managers and emergency personnel
- International/multinational cooperation
- Cross-border
- Strategic level coordination
- Differing organizational structures & hierarchies
- Interoperability

While common emergency incident (e.g. traffic accidents) are very local in extend and require cooperation between different organizations, flooding events are usually over-regional in extend. Therefore, these require even more cooperation of various parties. This calls for cooperation on all levels, reaching from (political) cooperation between governments and organisations down to the incident site were involved parties have to cooperate, e.g. exchanging (actual) information. Many times (personal) reservations are the reason for insufficient cooperation, or the lack of understanding varying structures, hierarchies and responsibilities among different organisations. Strategic guidance or legislative regulation could foster a strategic level cooperation.
Another already mentioned challenge is “interoperability”, i.e. the ability to cooperate efficiently, to fulfil tasks collectively, e.g. due to sharing equipment or common trainings.

3.8 Political Aspects

- Legal framework
- Financial resources
- Awareness for prevention
- Creating incentives
  - for prevention
  - for collaboration
- Fostering an understanding for global consequences
- Balancing back-country and riverside, or urban and rural areas
- Guarantee humanitarian standards

Political aspects usually set the frame, mainly due to a legal framework that enables effective disaster management and the availability of financial resources. Therefore, awareness for prevention and preparation is extremely important, since capacity building and preventive measures need to be established upfront to natural disasters. And disaster management demands a lot of upfront investment without immediate financial benefits, despite the proven benefit in the long term, e.g. (23).
Another political challenge is creating incentives for prevention and collaboration, as well as fostering understanding of consequences. This is especially true for rivers, since all measures undertaken upstream, might directly or indirectly influence the outcome downstream.

4. Identified RDI Topics

Following the approach depicted in figure 2 RDI topics were determined to address the identified challenges. Given the high number of initially named RDI topics further division was necessary. The grouping applied here is differing from those of the challenges, leading to 14 thematic topic groups. Based on this grouping RDI Topic Working Groups will start working on selected thematic groups.

The almost 100 identified RDI topics are grouped in the following 14 sub-groups:

- Resilience of Citizens
- Civil Protection Training
- Civil Protection Methods, Procedures and Technology
- Spontaneous Volunteers
- Communication
- General Data Management
- Academic Research
- Civil Protection Human Resources
- Critical Infrastructure
- Early Warning (Information)
- Legislative Administration
- Meteorology Services
- Situation Awareness
- Water Way Management

In the following section identified RDI topics are briefly explained one-by-one, ordered by aforementioned thematic groups. For a better understanding the underlying Threat/Problem and the resulting challenge is added in italics underneath each RDI topic.

4.1 Resilience of Citizens

Information campaigns

Feeling of guaranteed safety → Resilience/ ability to self-protection

Increased vulnerability → State of citizens preparedness

Societal unbalance along the Danube → Fostering an understanding for global consequences

A prepared society is less vulnerable, and the ability of self-protection is demanded by the flood directive. Here information on (a) dangers as well as (b) options to protect their property is helpful. This could also mean trainings on how to handle sand bags and build simple barriers.

Information as available by the International Commission for the Protection of the Danube River (ICPDR) should be further promoted to remind what happened in the past and how devastating floods have been to increase the awareness.

Recommendations for preparation

Feeling of guaranteed safety → Resilience/ ability to self-protection

Growths of metropoles → Urbanisation

Security of supply → Avoiding the lack of potable water

Civil population, especially in urban areas, has a higher vulnerability towards disturbances in daily life routines. Here, supportive recommendations might lead to a better preparation for disasters (e.g. storage of food, water, batteries).

Evacuation plans

Growths of metropoles → Urbanisation

Preparation of flood related information → Flood risk maps and management plans

Continuous urbanisation leads to higher population densities within urban areas, but also bears the danger to push living space into flood prone areas. Evacuation plans need to be developed and communicated. Practitioners should become involved already in the early conceptual phase to provide their knowledge to aspects directly related to their tasks. Evacuation routes need to be known, markings seem like a potential solution.

Concepts for evacuation

Feeling of guaranteed safety → Resilience/ ability to self-protection

General public needs to know about evacuation concepts, in terms of safe routes, timing and execution. Evacuations plans should be partly accessible to the public. Also, a well-established marking of safe routes would increase the efficiency.

Publishing/teaching the public about evacuations

Crisis management concepts → Evacuation plans

Evacuations are potentially chaotic and bear the danger of jamming evacuation routes, causing problems to those managing the evacuation, but also to responders who might be hindered to access the affected area. Therefore, evacuation plans need to be known by those to be evacuated.

Concepts for temporary emergency medical services

Security of supply → Ensuring medical service

Especially in remote areas, or where areas become isolated due to infrastructural failures (e.g. collapse of bridges) temporary solutions for (emergency) medical services are needed. This could be concepts for coverage from secondary and also cover improvised hospitals or doctor's offices.

Mobile solutions for basic medical supply

Security of supply —› Ensuring medical service

In the case of a flooding regular medical service might be interrupted due to devastated hospitals or doctor's offices or a possible cut-off of some places. These interruptions might last longer than a few days. Temporary support by e.g. truck-based doctor's offices could maintain a basic service to residents in the affected area.

Special concepts for medical services

Increased vulnerability → Increasing number of elderly people or with special needs

The increasing number of elderly people requires a critical review if existing concepts are sufficient in terms of maintaining basic medical services in during response or recovery in flooded/affected areas.

Cadastre of people with special needs, e.g. respiratory support

Feeling of guaranteed safety → Resilience/ ability to self-protection

In cases of evacuation or temporary supply responders would need to know where special aid is needed. For example, respiratory support systems requiring power supply or oxygen bottles for exchange. In cases of evacuations certain information, e.g. about immobile persons, would be valuable to efficiently plan these types of operations.

Concepts for temporary (water) supply

Security of supply → Avoiding the lack of potable water

In cases of massive interruptions in power, potable or waste water supply, concepts for temporary supply are needed such as transportation into the affected area, but also on the recovery of such systems.

4.2 Civil Protection Training

Training

"Flood (or disaster) dementia" → Resilience/ ability to self-protection

Lack of qualified personnel → Identifying suitable personnel

Training of civilians in terms of self-protection and abilities to protect their property could decrease workload on practitioners.

Soft skill training is needed although to identify voluntary personal, especially in the field of civil protection education.

Training method data base

Personnel → Training of personnel

Good training is a key component in increasing the resilience, therefore a collection of offered trainings could help to facilitate the exchange and knowledge transfer between involved organisations.

Comparison of available training programs

Personnel → Training of personnel

In terms of knowledge exchange and cooperation it is vital to get an overview about already existing and implemented as well as planned training concepts.

Evaluating personnel structure (volunteers vs full time)

Personnel → Availability of personnel

Besides the age structure the entire personnel structure needs to be evaluated. Substituting volunteers with full-time positions might become necessary in some cases to ensure operational readiness.

Expert-database

Lack of qualified personnel → Identifying suitable personnel

Especially for critical positions it is necessary to maintain a pool of experts. Besides faster reaction times during incidents, it enables a timely planning of (training) needs and recruiting of suitable substitutions.

Close cooperation in advance

"Giving away responsibilities" → Creating incentives for collaboration

Networking and cooperation well in advance of any disaster simplify cooperation in case of emergency, since parties get to know each others capabilities and procedures.

Exercises & workshops

Cooperation awareness between various parties → Flood managers and Emergency personals

International/Multinational cooperation → Strategic level coordination

Exercises are well suited to make all involved parties aware of each other and get to know the other actors. Usually, exercises require a lot of preparation and come at higher costs. Efficient and transferable simulation concepts are a possibility.

Exchange of knowledge

International/Multinational cooperation → Differing organizational structures & hierarchies

Networking as wells as joint workshops and exercises will increase the understanding of each other, and why various approaches are needed.

Lessons-learned protocols and revisions

Repeating errors → Establishing of a failure culture

A thorough failure management and installation of lessons-learned protocols will enhance the sustainability in civil protection. At reasonable intervals these reports need to be reviewed and updated.

Coaching those working with flood management documents (responders, officials)

Crisis management concepts → Flood risk maps

Crisis management concepts → Evacuation plans

Flood risk maps need to be known to all involved parties in advance. Besides publication of the documents, trainings and simulations increase the efficiency even more.
Evacuation maps need to be known to all involved parties in advance. Besides publication of the documents, trainings and simulations increase the efficiency even more. Difficulties may be the according levels of confidentiality.

4.3 Civil Protection Methods, Procedures and Technology

Failure management guidelines

Personnel → Human Factors/lessons-learned

Inter-organisational failure management should be a standard, however admitting mistakes is uncomfortable, especially inter-organisational. Recommendations might ease this process.

Best-practice/lessons-learned data base

Personnel → Human Factors/lessons-learned

The exchange on best-practices and the avoidance of known mistakes are vital to ensure an effective civil protection.

Protection concepts (vaccination, protective equipment)

Personnel → Health risks

Deployment in flooded areas bears also a significant risk to those getting in contact with the water itself or the remaining mud and debris. Especially, those responders getting in direct contact by submersion, e.g. swift water technicians or divers.

Logistics support (right material at the right spot at the right time)

Material → Tactical logistics

Flooding events are usually requiring a huge logistical effort, therefore in advance established concepts could decrease reaction and supply times.

Material stashes in flood prone areas

Feeling of guaranteed safety → Resilience/ ability to self-protection

Decentralised storage, in combination with well-trained civilians enables themselves to take first measures and reduces the workload for practitioners.

Decentralised material and logistics support centres

High (local) acute demand on-site → Supply and logistics

Especially during emergency situations time is critical, decentralised material and logistic support centres avoid long transportation ways as well as a better availability to local/regional responders.

Standard operating procedures (SOP) / guidelines

Interoperability → Lack of common terminology, structures, equipment, procedures, etc.

Crisis management concepts → Evacuation plans

Increasing the interoperability requires accepted common guidelines. This can reach from defined SOPs, to harmonised units or a dictionary, enabling a common terminology. Evacuations are stressful and require a thorough planning. To enable those responsible for the planning and organisation guidelines or even standards would secure that important aspects will be forgotten and face practitioners with unnecessary challenges in case of a flooding incident.

Standardisation of communication

Radio or telephone technologies → Compatibility

Interoperability → Lack of common terminology, structures, equipment, procedures, etc.

Cooperation is hampered by the lack of standards in terms of equipment, structures and procedure protocols. For example, different frequencies or even systems might prevent a quick and efficient collaboration across borders, or even in worst case local between various actors.

Standardisation of terminology

Language → Overcoming communicational barriers

Language → Common terminology

Interoperability → Lack of common terminology, structures, equipment, procedures, etc.

Cooperation is also hampered by the lack of a common terminology and symbols used. Although there are various translations, often these are not accompanied by clear and concise definitions, nor standardised protocols.

Civil protection dictionary

Language → Overcoming communicational barriers

Cross-border → Language

Especially while across border communication differing meanings of terms can cause serious issues during disaster management. There is no common language used. The assumption that all deployed responders are fluent in a common language can be misleading.

Uniform terms/ standardised procedures & equipment

Different civil protection systems → Standardisation/harmonisation

As mentioned above, standardisation or harmonisation would increase the efficiency of future collaboration.

Comparison of technical solutions available to practitioners (personal equipment & vehicles)

Outdated or non-compatible material → Advancing technical equipment

Similar to the comparison of trainings, used equipment should also be compared. This enables a comparison between organisations and countries and may lead to future improvements.

Advanced methods for dike defence

"Common" floods → Increased flood peak levels

Intense long-lasting precipitations → Weakening of dykes

Floods with higher levels are likely to happen more often, therefore advanced systems are required. Easy to deploy and handle especially when thinking of the demographic change, since this will also affect the civil protection personnel. Sand sack walls, for example, are very exhausting to build. Having the possibility to reinforce dykes with advanced systems, easy to deploy and uncritical to handle for small groups, could provide a solution.

Dyke monitoring systems

Intense long-lasting precipitations → Weakening of dykes

Due to the prognosed change in heavy rain events (periods with long lasting rainfalls) and longer lasting high stands dykes can be weakened. To ensure the safety behind these structures (both for civilians and CP personnel) continuous and easy to deploy monitoring systems are needed.

Establishing/maintaining simple fall-back solutions

Radio or telephone technologies → Reliability/availability of networks

Although modern technology offers great additions, plain simple technologies might be

more sustainable against failure

Landslide monitoring systems

Intense long-lasting precipitations → Increase in landslides

Due to change in weather, i.e. longer lasting more intense precipitations, the possibility of landslides also increases. To increase the safety within endangered areas reliable monitoring systems are needed.

4.4 Spontaneous Volunteers

Concepts to involve spontaneous volunteers

Civilians willing to help → Involvement of spontaneous volunteers

Concepts are needed for an efficient and secure involvement of spontaneous volunteers, i.e. those that are not affiliated to any response organization, nor have completed civil protection trainings. One important step is creating structures to get in touch with those willing to help. Further, technical/organisational issues such as liabilities/insurances or protective equipment need to be considered as well.

Dedicated trainings for flood management practitioners

Civilians willing to help → Involvement of spontaneous volunteers

Spontaneous volunteers → Steering/coordination spontaneous volunteers

Working together with untrained personnel is often challenging for civil protection personal. Since often the understanding of hierarchies and command chains, as well as tactical decisions and approaches are unknown to spontaneous volunteers, who are willing to help. Also, the understanding of dangers and risks is not necessarily given, and so this is also a challenge for CP personal to ensure the safety of spontaneous volunteers.
Cooperation with spontaneous volunteers requires trained and prepared civil protection personnel, since most likely they will be trainers-on-the-job, coordinators and have to sell the civil protection system (including command structures) to untrained civilians.

4.5 Communication

Interoperability of used communication technologies

Radio or telephone technologies → Different technological solutions

Comparative studies or surveys of what technology is used where by whom might be one of the first steps to lower these barriers.

Establishing of universal warning systems

Warning of the public → Early, simple and far-reaching warnings

Universal, easy to access and use warning systems are important to warn the public. Due to the progressing digitalisation, new options are available, but on the other hand the reliance on such specific systems may also weaken the resilience of the warning systems.

Accessibility of universal warning systems

Warning of the public → Early, simple and far-reaching warnings

Besides having warning systems; the accessibility is vital, fast protocols to warn the public must be established and well communicated among those included in the incident information flow, e.g. command posts.

Timeliness information

"Flood (or disaster) dementia" → Awareness of citizens

To make civilians aware of certain threats timely communication is necessary. To build a sustainable awareness, however continuous information is also needed to avoid the so called "flood dementia".

Assessing and benchmarking the quality of news

Management of public information → Authenticity

To keep the public informed it is important to have a quality check, which makes it easy to identify reliable news. However, this seems extremely difficult since the liberty of press must not be threatened.

4.6 General Data Management

Efficient information management

Information overflow → Avoiding of "information white outs"

Structuring and rating of available information as well as information distribution is a key factor to avoid hindrances due to too much unprocessed/unnecessary information. Efficient decision-making support tools may solve this.

Accessibility of the data

Short-term situations, highly depending

on the weather situation —› Reliable and timely (local) weather forecast

Especially in emergency situations a quick and reliable forecast/nowcast must be accessible by those at the scene.

Centralised data pool (containing e.g. water level data, georeferenced (infrastructural) data or social/demographic data)

Flow of information → Accessibility/availability of data

A lot of various data sets often from multiple sources are needed to enhance the process of decision making. One focal point can avoid the use of diverging information.

Central hub to collect & filter and send standardised information

Flow of information → Accessibility/availability of data

Flow of information → Data collection

The availability and accessibility of information (from reliable sources) to all involved parties and at various levels is still a great demand. A uniform data collection can avoid misinterpretations or contradictory decisions fuelled by diverging information. Since this is vital for strategic, operational and tactical decisions. Such a tool needs to be implemented and accepted by all involved parties.

Data exchange protocols/standardisation of data formats

Flow of information → Information handling

Inter-organizational communication → Data formats

While dealing with multiple sources of information, predominantly digital, several standards and protocols are used. This complicates the exchange as well as the handling of the data. Identification of the necessary data type and potential standards is necessary for sustainable and holistic solutions.

Technical front-end support solutions

Flow of information → Information handling

Efficient solutions/tools to get information exchanged between various sites and higher command structures are needed.

4.7 Academic Research

Simulation tools

Crisis management concepts → Evacuation plans

Development of easy to deploy simulation tools based on Geographic Information System (GIS), for example to stress test evacuations plans.

4.8 Civil Protection Human Resources

Acquisition of additional workforces

Personnel → Availability of personnel

Given the demographic change and the decreasing number of volunteers willing to commit to organizations and their trainings alternate strategies need to be worked out.

Attractive positions

Need for flood management practitioners → Capacity building

Involvement in civil protection in general, but especially voluntary work needs to be made more attractive. This is particularly true for high potentials.

Early substitutions, avoiding of loss of knowledge

Personnel → Demographic change

For civil protection organizations it is vital to ensure a knowledge transfer from experienced personal to new and younger substitutions.

Evaluating age distribution among practitioners

Personnel → Demographic change

Due to demographic changes some regions are experiencing a decrease in the number of (volunteer) practitioners. For future planning knowledge of the age structure within organizations will be important. Based on this future recruiting and training can be adjusted, as well as requirements to technical solutions, which need to be ergonomically and less wearing to practitioners.

Information and training to harden the personnel pool

Need for flood management practitioners → Resilience of civil protection personnel

Floods are usually a spatially extend situations, this bears high risks that practitioners are personally involved, and so the availability can be decreased. To avoid this and enhance the resilience, proper information and training for practitioners is needed.

Surveying organisational structures

International/Multinational cooperation → Differing organisational structures & hierarchies

A good understanding of structures and hierarchies within different organisations would be extremely helpful to increase a mutual understanding.

Training/establishing concepts

Need for flood management practitioners → Capacity building

Training concepts have a special meaning to a sustainable capacity building, since they enable a continuous education and training of civil protection personnel.

4.9 Critical Infrastructure

Detailed flood risk maps and management plans

Growths of metropoles → Surface sealing

Change of water way management → Increasing dam heights and water levels

Due to the growth of metropoles and the progressive urbanisation with ongoing surface sealing higher run offs within populated and industrialised areas can be expected. Especially regarding flash floods, this leads to new approaches when dealing with flood risks, since rather small changes in the topography, e.g. pedestrian walks or tunnels have significant meanings for the flooding effects and possible risks to civilians and responders. Detailed plans are needed to acknowledge changes in water way management. Higher dykes would mean potentially more damage in case of dyke failures and most certainly more impact on retention areas downstream. In case of populated housings in those areas special supply and evacuation measures might be needed. A sound combination of structural and non-structural measures is needed.

Identification of critical infrastructures

Preparation of flood related information → Flood risk maps and management plans

The identification of critical infrastructure is essential to plan for flood management or response missions. Checklists, for example, could provide assistance to the responsible persons.

Backup systems

Security of supply → Blackouts

Water way infrastructure → Maintenance/modernization

All critical infrastructures require in advanced planned backup systems.
The water way infrastructure needs backup systems to stay operational during flood events, especially if other systems rely on these components (e.g. weir systems).

Identifying affected parties

Security of supply → Blackouts

Supply of electricity is important to maintain daily life in all European societies. And while critical (official) infrastructure is well known and recordable, in the private sector this is not the case. Especially elderly people or people with special needs might rely on electrical support, like stairway lifts or respiratory systems. For practitioners' knowledge of certain needs could ease the prioritising as well as potentially lower the amount of emergency calls.

Mapping of possible contamination sources (HazMat)

Growths of metropoles → Industrialisation

The continuous industrialisation commonly involves dangerous goods, which can be harmful if released uncontrolled. A good knowledge of their distribution in possibly (flood) affected areas, as well as possible counter measures is mandatory to ensure the safety of the surrounding.

Emergency wells

Security of supply → Avoiding the lack of potable water

Concepts for the use and maintenance of temporary wells are needed to ensure access to potable water. For flooded areas this has a special implication, since these facilities need to be resistant against flooding and be accessible for maintenance reasons.

Theoretical analysis/stress test against manipulation

Cyber security → Vulnerability of flood management

Ensure that the applied technology solutions are resistant towards cyber-attacks. At least being able to switch to a back-up system must be guaranteed.

Re-evaluate after incidents

Crisis management concepts → Flood risk maps

Critical re-evaluations of the applied concepts after incidents in terms of failure management, lessons-learned and identification of best-practices is needed. At best there is a guideline/recommendation to be followed and assure a certain quality.

4.10 Early Warning (Information)

Official channels (e.g. radio or television)

Management of public information → Information of spontaneous volunteers

Management of public information → Warning of the public

Management of public information → Authenticity

It is important to have resilient systems to reach the public. Efficient communication strategies, also addressing the psychological impact on crowd behaviour needed.

4.11 Legislative Administration

Networking

International/Multinational cooperation → Strategic level coordination

International/Multinational cooperation → Differing organizational structures & hierarchies

Networks like DAREnet offer practitioners of all levels possibilities to exchange with each other. This should facilitate the exchange of experience and knowledge and increase the understanding of each other. Exercises, conferences and workshops also increase the networking between the different actors.

Bilateral contracts

International/Multinational cooperation → Cross-border

Cross-border assistance requires clear and transparent rules, for the responding as well as demanding party. Financial questions are an important part, but also technical and organizational questions.

EU Floods Directive

Legal framework → Various laws and rules

The upcoming revision of the Danube Flood Risk Management Plan will have a focus on civil protection/disaster management aspects, therefore of high relevance for practitioners. Strong cooperation between flood risk management and emergency response / disaster relief sectors on all levels is essential for an efficient protection of human lives and economic assets.

Organisational support, e.g. by ICPDR

International/Multinational cooperation → Cross-border

Existing networks and initiatives in the Danube River Basin can initiate or mediate cross-sectoral contacts.

Cooperation facilitators, e.g. ICPDR

Legal framework → Political cooperation

The political and technical cooperation on flood risk management within the Danube basin is well organised through the ICPDR, however the stronger cooperation in the field of civil protection needs political incentives and back up.

Contractual or legal transfer of duties

Cooperation awareness between various parties –› Governments and organizations

The transfer of duties and rights based on clear rules is essential for immediate actions in case of an emergency. A comparison between the partnering countries in DAREnet potentially identifies room for improvements.

Memorandum of Understanding

Inter-organisational communication → Different interests

Cooperation awareness between various parties → Inter-organisational

Clearly stated agreements on capabilities, responsibilities as well as communication strategies will increase the efficient cooperation in cases of emergency, whereas details and topics vary depending on the involved parties.

Allocating funds for emergencies

Often tight budgets on responsible levels → Financial resources

Allocating budgets in advance to secure citizens, but also enable the civil protection stakeholders to invest well in advance.

Founding programs

Prevention = short-term costs → Creating incentives for prevention

Prevention seems costly, therefore financial incentives are required to increase the attractively.

Transparent approaches to prioritisation, e.g. for response measures

Economic unbalance along the Danube → Balancing back-country and riverside, or urban and rural areas

In the past it has happened that people from the countryside felt left alone while much emphasis was put in the protection of larger cities and their population. This could lead to anger and cause trouble to civil protection units deployed in such regions.

Flash floods require much more detailed surveys

Crisis management concepts → Flood risk maps

Flash floods require a higher specificity compared to river floods, since the degree of flooding depends on many other factors, e.g. danger of slumping or debris flows and the drainage capacity.

4.12 Meteorology Services

Combination of precipitation and water levels

Flash floods → Reliable and timely (local) weather forecast

For strategic and tactical planning accurate and processed data is needed, especially with respect to water level projections.

Enhanced rain radar systems (automated rain alerts)

Flash floods → Increase in landslides

Flash floods → Faster deployments/decisions

Especially for heavy rain events, timely alerts and prediction would enhance the efficiency of disaster management.

4.13 Situation Awareness

Efficient coordination

Spatial extend → Good planning and operational structures

Having an emergency situation covering a spatially extend area within the Danube basin, efficient superordinate coordination is needed to avoid imbalanced distribution of resources. Protocols, agreement, clear hierarchies, decision making / command support tools, training and exercises are possible ways to achieve this.

Management systems

Spatial extend → Good planning and operational structures

Efficient disaster management systems (integrating situational awareness or decision support) in spatially extend and/or material intensive situations are required. However, efficient plain and simple back-up systems should be kept available and trained.

4.14. Water Way Management

Building retention rooms/higher dykes

"Common" floods → Increased flood peak levels

Building retention rooms is a sustainable solution to reduce water levels on a larger scale. However, building new retention areas might also affect existing concepts.
Building higher dykes is a very local measure and the political/social/economic impact is not subject to DAREnet. From the civil protection point of view this might be a local solution, however this poses a higher risk in case of a dam failure to the protect area. The current flow would be increased, and the challenges are dislocated to downstream areas.

Possible influence on flood management concepts

Change of water way management → Renaturation

Renaturation and the creation of natural retention spaces might influence disaster management, if for example roads lie within the area to be flooded. Any changes in the possibly affected area must be checked for potential influences. Catalogues of criteria relevant for civil protection to check for might be helpful for planners.

(Water level) sensor/infrastructure renewal

Water way surveillance/data collection → Maintenance/modernisation

Renewal and maintenance of such infrastructure is essential. If these sensors get modernised, solutions offer options to ensure a continuous measuring and transfer of data. This enables better forecast and situational monitoring.

Discharge protocols

Security of supply → Dependency on water power plants

Dams (water reservoirs or power plants) → Maintaining a sufficient water table

Electricity is one of the major supplies that is essential for modern (technologised) societies. Therefore, water power plants are of high importance. However, if they are linked to damn structures it might be vital to keep enough in it to be a reliable reservoir and on the other hand the discharge needs to be well planned and controlled to avoid major flooding downstream.

Potable water is one of the major supplies. Therefore, water power plants are of high importance. However, if they are linked to dam structures it might be vital to keep enough in it to be a reliable reservoir and on the other hand the discharge needs to be well planned and controlled to avoid major flooding downstream.

Rainwater run-off management

Growths of metropoles → Surface sealing

Progressing urbanisation leading to a enhanced surface sealing is causing less natural infiltration. In effect, this challenges sewage systems and might worsen flash flood situations.

5. Conclusions and Outlook

This deliverable identifies challenges and respective RDI topics to address them, to strengthen flood resilience within the Danube river region. Based on these RDI topics distinct RDI Topic Working Groups will be set up and the first RDI road mapping cycle will start.

The here published Challenges and RDI topic list will be reviewed and updated 4 times (project month 18, M30, M42 and M54). In this reviewing process future development, experiences and the outcomes of the DAREnet RDI road maps (D5.1, D5.2, D5.3, D5.4) as well as the practitioner expertise out of the DAREnet Community will be integrated in the Challenge and RDI topic lists.

6. Bibliography

1. **EMDAT.** 2018. Emergency Disaster Database (English). [Online] [last accessed: 28. February 2018.] http://www.emdat.be.
2. **Paprotny, D. et al.** 2017. Trends in European flood risk over the past 150 years.
3. **European Environment Agency.** 2017. River floods - Indicator Assessment | Data and Maps. pp. 14.
4. **Barinova, G. M. et al.** 2015. Changes of South Baltic Region Climate: Agroecological Challenges and Responses. In: Leal Filho W. (eds). Handbook of Climate Change Adaptation. Berlin, Heidelberg, Springer.
5. **Nissen, K.M. & Ulbrich, U.** 2017. Increasing frequencies and changing characteristics of heavy precipitation events threatening infrastructure in Europe under climate change. Nat. Hazards Earth Syst. Sci. 17, 1177-1190.
6. **ICPDR.** 2014.Floods in June 2013 in the Danube River Basin – A brief overview of key events and lessons learned.
7. **Ionita, M., et al.** 2015. Predicting the June 2013 European Flooding Based on Precipitation, Soil Moisture, and Sea Level Pressure. Journal of Hydrometeorology 16, 598-614.
8. **ICPDR & ISRBC.** 2015. Floods in May 2014 in the Sava River Basin – A brief overview of key events and lessons learned.
9. **Ivkovic, M., et al.** 2015. DRIHM Project: Floods in Serbia in May 2014. EGU General Assembly Conference Abstracts 17, p. 5807.
10. **Ainsaar, M. & Rootalu, K.** 2016. European Demographic Change and Welfare Challenges. Springer.
11. **United Nations.** 2017. World Population Prospects: The 2017 Revision, DVD Edition. Department of Economic and Social Affairs, Population Division, United Nations.

12. **Weichselgartner, J. & Pigeon, P.** 2015. The Role of Knowledge in Disaster Risk Reduction. International Journal of Disaster Risk Science 6 (2), 107-116.
13. **Kariuki, S. G.** 2007. Integrating human factors into chemical process quantitative risk analysis. TU Berlin.
14. **Reynolds, S. R.** 1946. The Story of Aviation Medicine. (Book Reviews: Through the Stratosphere: The Human Factor in Aviation). The Scientific Monthly 63, 143-146.
15. **Pitts, J., et al.** 1993. The National Plan for Aviation Human Factors. NATO ASI SERIES F COMPUTER AND SYSTEMS SCIENCES. 110 (1), 529-529.
16. **Eldar, Z.** 2010. The human factor in aviation security. Journal of Airport Management 5 (1), 34-39.
17. **Schaefer, H. G.,et al.** 1994. Human factors and safety in emergency medicine. RESUSCITATION -LONDON- 28 (3), 221-221.
18. **Albering, H. J., et al.** 1999. Human Health Risk Assessment: A Case Study Involving Heavy Metal Soil Contamination after the Flooding of the River Meuse during the Winter of 1993-1994. Environmental Health Perspectives 107 (1) 37-43.
19. **Johanning, E., et al.** 2014. Review of health hazards and prevention measures for response and recovery workers and volunteers after natural disasters, flooding, and water damage: mold and dampness. Environmental Health and Preventive Medicine 19 (2), 93-99.
20. **Thieken, A. H., et al.** 2016. The flood of June 2013 in Germany: how much do we know about its impacts? Natural Hazards and Earth System Sciences 16, 1519-1540.
21. **Sakurai, M. & Thapa, D.** 2017. Building Resilience Through Effective Disaster Management: An Information Ecology Perspective. IJISCRAM 9 (1), 11-26.
22. **Hälterlein, J., et al.** 2018. Integrating Volunteers in Emergency Response: A Strategy for Increased Resilience Within German Civil Security Research. Springer.
23. **Mechler, R.** 2013. Reviewing the economic efficiency of disaster risk management. EGU General Assembly Conference Abstracts 15, EGU2013-12728.

7. Definitions

Problem Any matter or situation involving uncertainty or difficulty in relation to disaster management.

Challenge Any circumstance (e.g. situation or task) that requires certain aides (e.g. skills, techniques, equipment) to overcome.

RDI topic Describes a topic to overcome or address a challenge. It should be further examined, i.e. comparison of available solutions and might finally address a gap in the portfolio of potential solutions that needs to be explored further.

RDI Research, Development and Innovation

Research Scientific activities focusing on specific objectives, encompassing technological developments, social and natural sciences.

Development Activities taking research results from a low or medium Technology Readiness Level (TRL) to a high one.

Innovation A new (or not recognised) solution (technical or logical) that is either an idea, yet to be developed, a previously unknown or newly available solution that may even need further development.

Disaster Management Dill used throughout this document, as describing any action or tasks related /associated with overcoming a natural disaster or (technical) accidents. It comprises the 4 phases of the crisis management cycle (prevention, preparedness, response, recovery). It is not further differentiated from crisis management.

Practitioner Professionals or volunteers working directly and on a regular basis on the management of flood events, including prevention, preparedness, response and recovery.

Responder Any person who is involved in any kind of emergency/disaster/crisis response (e.g. Emergency Medical Technicians, Fire Fighters, Technical Relief personal, related specialists, police, etc.).

Abbreviation / Acronym	Description
CMT	Community Management Tool
DAREnet	Danube river region Resilience Exchange network
HazMat	Hazardous Material
RDI	Research, Development and Innovation
SOP	Standard Operation Procedure
WP	Work Package
GIS	Geographic Information System

8. Administrative Information

Grant Agreement no.	740750
Call identifier	SEC-21–GM-2016/2017
Project full title	DAREnet – DAnube river region Resilience Exchange network
Author	Christian J. Illing (THW)
Contributors	Danka Foitik Schmidt (ARC) Igor Liska (ICPDR) Rob Testelmans (Stad GEEL) Gaby Gurczik (DLR) Ronald Nippold (DLR)
Coordinator Contact	Federal Agency for Technical Relief (THW) Christian J. Illing project.darenet@thw.de
Management Team	ARTTIC Balazs Kern, Andreas Schweinberger darenet-arttic@eurtd.com
Website	www.danubefloodresilience.net

Important notice

This deliverable is currently under EC review.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740750.

The DAREnet Consortium

Federal Agency for Technical Relief

International Commission for the Protection of the Danube River

Austrian Red Cross

International Security and Emergency Management Institute

Hungarian Civil Protection Association

National Protection and Rescue Directorate

Sector for Emergency Management, Ministry of Interior

APELL National Center for Disaster Management

ITTI

Fire Safety and Civil Protection Directorate General

Faculty of Security Studies, University of Belgrade

German Aerospace Center

City of Geel

ARTTIC