IN-PREP

"An INtegrated next generation PREParedness programme for improving effective inter-organisational response capacity in complex environments of disasters and causes of crises"

D2.4 Recommendations on relevant organisational, policy, social and human factors relevant for system developments

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Executive Summary

The IN-PREP project is creating a platform to enable crisis responders across Europe to collaborate, train together, and to share their viewpoints with each other. This way, the big picture is always in view and immediate actions can be directed in the most effective way possible. The platform will be a "Mixed-Reality Preparedness Platform" (MRPP), a tool that combines many types of technologies, supporting information provision for responders on the ground, and for the direction of resources.

To support the development of the MRPP in a way that realistically allows the system's implementation and use, the consortium has set out to identify recommendations for system development based on organisational, policy, social, and human factors. They are based on desk research and a total of nine interviews conducted with possible users of the MRPP from within and outside the project consortium.

The description of **organisational factors** includes a reflection on innovation processes, especially in public sector organisations, since most of the targeted user organisations are public. It further comprises issues to be considered regarding information management, inter-organisational communication and cooperation processes, as well as requirements for changes in organisations.

The elaborated **policy factors** concern different ways of crisis governance, the influence of political incentives on developments in crisis management relevant for system development, and the differences in political culture and climate.

Social factors to be considered in system development relate to public expectations and acceptance, crisis communication, and data protection concerns.

The **human factors** address those that are relevant for the work in command & control rooms. They comprise cognitive processes (such as processing of information, perception, memory, team cognition, and decision making), and issues to be considered regarding the user interface design.

Recommendations for the development of the IN-PREP MRPP are drawn from the description and analysis of these factors, and are categorized by cross-cutting "guiding principles", which consider common aspects across the themes of organisational, policy, social, and human factors. The guiding principles are: usability, compliance, interoperability, transparency, flexibility & adaptability, neutrality, evaluation & documentation, and knowledge management.

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Glossary of terms and abbreviations used

Abbreviation / Term	Description
CECIS	Common Emergency Communication and Information System
CI	Critical Infrastructure
CPM	Civil Protection Mechanism
DRM	Disaster Risk Management
ERCC	Emergency Response Coordination Centre
EU	European Union
FEMA	Federal Emergency Management Agency
FP7	Seventh Framework Programme for Research and Technological Development
GDPR	General Data Protection Regulation
HCI	Human-Computer Interaction
HFE	Human Factors Engineering
HNS	Host Nation Support (Guidelines)
HSI	Human System Interfaces
ICT	Information & Communications Technology
INSARAG	International Search and Rescue Advisory Group
IPCR	Integrated Political Crisis Response arrangements
IT	Information Technology
MRPP	Mixed-Reality Preparedness Platform
NATO	North Atlantic Treaty Organisation
PB	Participatory Budgeting
PPEW	Platform for Promotion of Early Warning
UK	United Kingdom
UNISDR	United Nations International Strategy for Disaster Reduction
US	United States
USAR	Urban Search & Rescue

1. Introduction

While Europe has not seen many transboundary crises in the past, which is fortunate, such events are likely to become more commonplace in the foreseeable future (Boin, Rhinard 2008). At the same time, it can be argued, the EU as a whole lacks the capacities to deal with such events. Addressing this gap in managing transboundary crisis is thus of utmost importance.
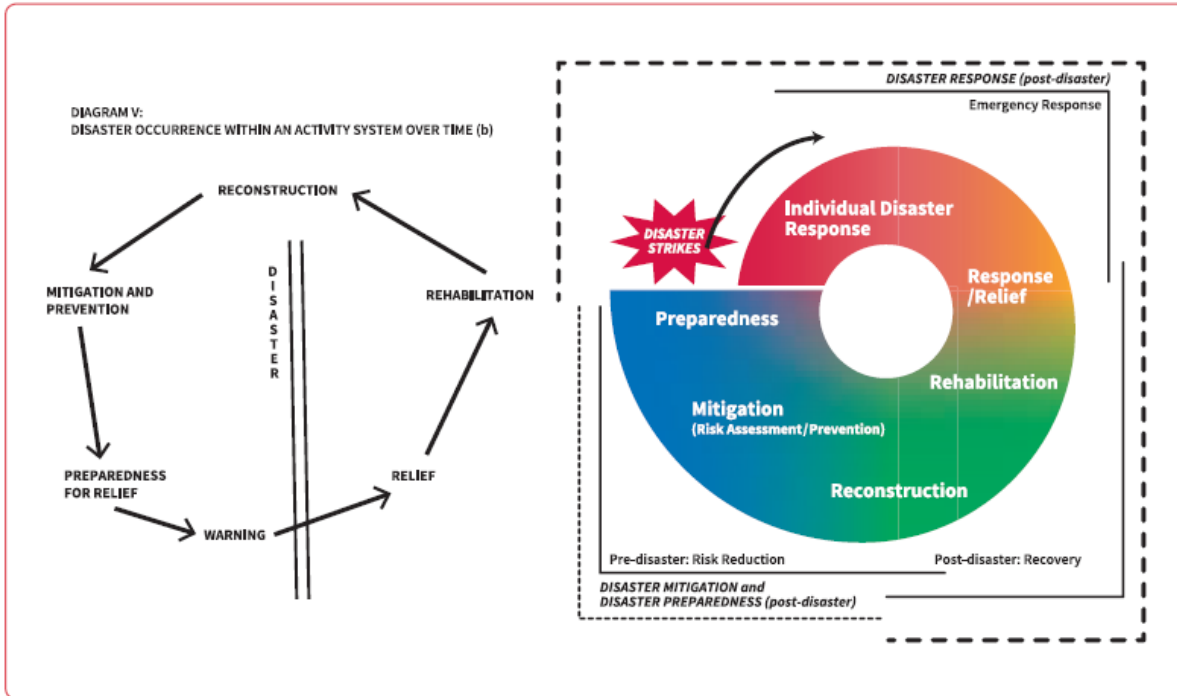
Figure 1: The Disaster Risk Management Cycle and its Phases (UNISDR 2015) based on (Baird et al. 1975) and (Khan et al. 2008)

Drawing on the UNISDR Disaster Risk Management (DRM) cycle as shown above, crisis management only takes place in the immediate aftermath of a disaster/crisis. Successful DRM however, as has also been stated in IN-PREP deliverable D2.1, requires mitigation / prevention and preparedness activities which take place before crisis response (Berchtold et al. 2018 (forthcoming)). Given that one of the main findings of the ACRIMAS[1] project was the need for major improvements in preparatory tasks related to crisis management, which would "contribute substantially to improve crisis management as a whole" (Stolk et al. 2012, p. 23), IN-PREP therefore addresses a key need of European DRM as a whole.

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[1] Aftermath Crisis Management System-of-systems Demonstration Phase I (FP7)

Terminology

While preparedness technically is part of DRM rather than crisis management, the term mainly used throughout this deliverable is crisis management. The main beneficiary of the IN-PREP MRPP are crisis management organisations, which use the preparedness phase of the DRM cycle to train for their main duty, which is response. This is also reflected in the fact that most technological innovation in the field of DRM has covered response activities, resulting in a rich literature also used for this deliverable.

Another important terminological issue is the use of the words "end-user" and "practitioner". While not necessarily identical, in this case the people using the finished product are both: end-users of the MRPP and practitioners of crisis management.

A further definition regards "capabilities" and "capacities". The use of these two concepts tends to be blurry. Capacities are understood as trained personnel and special machinery requiring specialists, thereby incorporating to some degree the concept of "assets". These capacities make up capabilities, which are special tasks such as Urban Search and Rescue (USAR), Flood Control, Pumps, etc.

Figure 2: Terminology used in this deliverable

The IN-PREP project aims at enhancing preparedness for transboundary crisis management. To this end, a so-called Mixed Reality Preparedness Platform (MRPP) will be developed, giving crisis management practitioners a powerful training tool.

However, there are organisational, policy, social and human factors, which can influence the ability to successfully implement such a system, and should thus be considered already during development of the system. Task 2.3 ("Describing relevant organisational, policy, social and human factors relevant for system development") was tasked with elaborating these factors, using desk research and semi-structured interviews with stakeholders. Relevant organisational, policy and social and human factors were identified and analysed. Recommendations, extracted from desk research and interviews shall provide guidance for the process of system development.

The four topic fields addressed in this report can be categorised by the level that they concern – the micro-, meso-, and macro-level (see below): Organisational factors, as understood in this report, relate to structures, processes and modes of interaction both within and among crisis management organisations, which are of importance for system development, therefore aiming at the meso-level of crisis management. In contrast, the chapters on policy and social factors analyse the broader environment in which crisis management organisations operate, or the macro-level so to speak, and how it can influence system development. And finally, the chapter on human factors covers the micro-level, the way humans within crisis management organisations deal with technology.

Macro-level	• Policy Factors • Social Factors
Meso-level	• Organizational Factors
Micro-level	• Human Factors
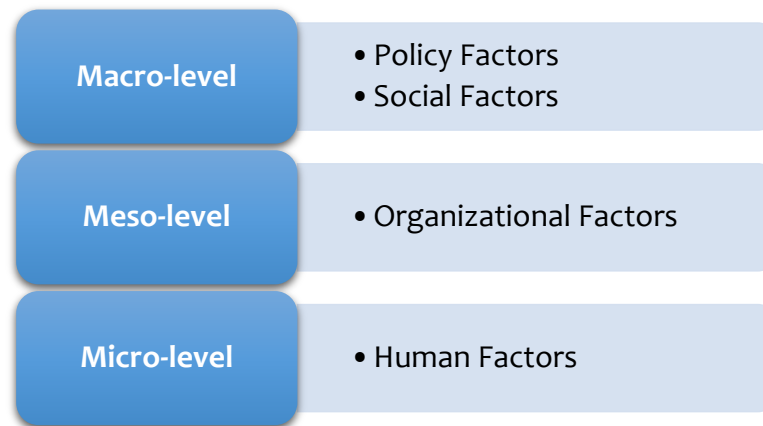
Figure 3: Levels of analysis

Since the IN-PREP MRPP is mainly used in the field of command and control, the analysis of human factors is focused on the behaviour of humans in command & control rooms.

As part of this task, nine interviews with stakeholders / possible users of the MRPP from within and outside of the consortium were conducted. The interviewees come from different professional backgrounds related to crisis management – police, fire & rescue, emergency services, and civil protection. The interviews were conducted in a semi-structured manner, using interview guidelines with questions related to the different factors and based on the results of the literature analysis (see Annex 1). The interviewees were given much space to answer the questions, to make full use of their professional experience and opinion. The results of the interviews have then been analysed by first summarising / paraphrasing the answers, and extracting keywords. This allowed the incorporation of results both on an individual as well as a meta level using the abstract keywords to trace similarities and differences across the responses.

During research and interaction with consortium partners certain issues emerged that are cross-cutting in nature. Some of them relate to success & failure factors for crisis response, which are extensively covered in Deliverable D2.1. Also of importance are legal and ethical aspects of system development, which influence organisations, policy, and social as well as human factors, such as data protection and information security. To avoid duplication we mainly refrained from covering ethical and legal aspects in this deliverable and refer to Deliverables D2.2 and D2.3 which cover them comprehensively. Finally, considering the user requirements as identified in Task 2.4 and Deliverable D2.5 is crucial for generating acceptance of the IN-PREP MRPP within organisations and from individual end-users. Consequently, there is partial overlap to the end-user requirements and some findings of the end-user workshops are also considered in this deliverable.

1.1. Addressing the IN-PREP Description of Action

This report addresses IN-PREP Grant Agreement (GA) requirements for Task 2.3 as follows:

IN-PREP GA requirements	Section(s) of present deliverable addressing IN-PREP GA	Description
Literature Review – "(…) this sub-task will conduct an analysis of state-of-the-art peer-reviewed literature (…)"	The results of the literature analysis are presented in chapters 2-5.	A thorough literature review has been performed using mainly research articles, other research projects, conference proceedings and official documents.
"The review will be interdisciplinary, covering human and social sciences (…)".	The results of the literature analysis are presented in chapters 2-5.	Literature from a wide array of disciplines has been used, including organisational studies, sociology, psychology and ICT.
"*Semi-structured* interviews - partners will firstly identify relevant stakeholders and then conduct a maximum of 10 semi-structured interviews (…)."	The results of the interviews are presented in boxes within chapters 2-5.	Interviews were conducted with crisis management experts from both within and outside of the consortium, working in the fields of police, fire & rescue, emergency services, and civil protection.
"*Recommendations* – Partners involved in this task will (…) develop a set of recommendations."	Recommendations are listed at the end of each sub-chapter in chapters 2-5, and in chapter 7.	Recommendations were derived from literature analysis and the interviews.

Table 1: Deliverable's adherence to IN-PREP objectives and Work Plan

1.2. Document outline

The structure of this document is based on the four factors addressed in the report (organisational, policy, social, human). These factors make up the main chapters (2-5). During a preliminary literature analysis, topics pertaining to these factors were identified, which were then used as a basis for further research and analysis. For each factor relevant for system development a number of topics were eventually singled out. Each of these topics is used as a sub-chapter. The sub-chapters on organisational, policy and social factors are further divided in a descriptive part and

recommendations derived thereof. Due to the specific nature of the contents, the chapter on human factors has subchapters for each topic and a single subchapter on recommendations.

The individual recommendations were summarised under categories capturing their essence. These categories are understood as "guiding principles" underlying the recommendations. The results of the nine interviews are incorporated into the sub-chapters using text boxes.

Chapter	Title	Topics (Subchapters)	Structure
2	Organisational Factors	1. Organisational structures and internal processes 2. Innovation in public sector organisations 3. Information management 4. Inter-organisational communication and cooperation 5. Organisational change	Two subchapters each: 1. Description 2. Recommendations
3	Policy Factors	1. Governance of crises 2. Political incentives 3. Political culture and climate	
4	Social Factors	1. Public expectations and acceptance 2. Crisis communication 3. Data protection	
5	Human Factors	1. Cognitive processes 2. Processing of information 3. Decision making 4. Group processes 5. Communication 6. Collaboration 7. Recommendations 8. Design of user interface	One subchapter per topic One chapter on recommendations

Table 2: Overview on relevant factors covered

Deliverables from other EU projects were checked for overlap. Namely we screened deliverables from the on-going projects HEIMDALL[2], DRIVER+ [3] and DARWIN[4]. The results of this screening can be found in chapter 6. Findings from the already finished ACRIMAS[5] project are used throughout this deliverable.

Chapter 7 provides the overall recommendations for system development considering organisational, policy, social, and human factors. It gives an overview on the established guiding principles for system development, followed by individual recommendations grouped beneath them.

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[2] HEIMDALL – Multi-Hazard Cooperative Management Tool for Data Exchange, Response Planning and Scenario Building, May 2017-October 2020, http://heimdall-h2020.eu/
[3] DRIVER+ – Driving Innovation in Crisis Management for European Resilience, May 2014-April 2020, http://www.driver-project.eu/
[4] DARWIN – Expect the unexpected and know how to respond, June 2015-May 2018, https://h2020darwin.eu/
[5] ACRIMAS – Aftermath Crisis Management System-of-systems Demonstration, February 2011-May 2012, https://www.acrimas.eu/

2. Organisational factors

2.1. Overview

Systematic planning processes, as well as adequate responses to crises, require fair knowledge and understanding of the capabilities and capacities, procedures, but also of cultural context and norms of the organisations involved, as well as the organisations' objectives and mandate. This has to be reflected in any training environment (Hamrin 2012; Stolk et al. 2012). Furthermore, when introducing any new technology, system, or process to an organisation, its successful implementation strongly depends on several pre-conditions of the organisation. While some of these pre-conditions cannot be changed, others might be open for adaptations in favour of the innovation. Organisational factors that seem relevant in this context include general characteristics such as the size of the organisation, or the existence of an innovation strategy. Crucial factors in view of the IN-PREP MRPP are **current working processes** and used tools for **information management**, in which the IN-PREP MRPP shall be integrated. Since many end-user organisations belong to the public sector, where innovation processes principally differ to those in the private sector, the specific characteristics of **innovation in the public sector** are addressed. Further, dependencies on, and collaboration traditions with other organisations play a major role, because cross-border and **cross-organisational collaboration** is a key factor of the IN-PREP MRPP. Specific aspects influence the principal **willingness or ability for change**, which is also addressed in this chapter.

The recommendations gathered at the end of each sub-chapter within chapter 2 should pose answers to the following question: *What can be done to make organisational factors influence the implementation of the IN-PREP MRPP in a positive way?*

2.2. Innovation in public sector organisations

2.2.1. Description

Most of the organisations expected to make use of the IN-PREP MRPP are public organisations, with different **pre-conditions** for innovation processes as compared to private organisations. Traditionally, the public sector has been seen to be rather conservative and bureaucratic, and thus slow in adapting innovations, while implementing innovations only in a fragmentary way. It has also been claimed that the public sector is just a passive recipient of innovations from the private sector (Bloch, Bugge 2013; Naranjo-Gil 2009). It is thus worth highlighting some of the specifics of innovation processes in the public sector.

Drivers of innovation

Main difference to the private sector affecting the innovation culture is that public organisations are not driven by profit-seeking motives. Instead, there are **societal objectives** which may require other incentives, drivers and barriers. In addition, public sector organisations often possess limited autonomy in decision making. "The decision making and organisational structure that public sector organisations operate within are thus central in shaping the conditions for innovation" (Bloch, Bugge 2013, p. 135).

Different studies have identified main drivers and barriers for innovation in the public sector. While Bloch & Bugge identify political mandates as well as internal actors (initiatives both from management level and from other staff) as most important drivers for innovation (Bloch, Bugge 2013), Blind et al. find that besides political mandates, new laws and regulations are one of the top drivers for innovation in the public sector (Blind et al. 2012).

Barriers to innovation

Important **barriers** to innovation in the public sector are seen in lack of resources/funding, lack of incentives, lack of time available for actions to innovate, and legislation. Risk aversion however, which is often attributed to the public sector, seems not as important as traditionally assumed (Bloch, Bugge 2013; Blind et al. 2012).

Further, an innovation often requires other innovations in order to be successful. Naranjo-Gil (2009) has for example shown in an empirical study with public sector organisations that the combination of technical and administrative innovations increases the performance of the organisation (Naranjo-Gil 2009).

Innovation strategy

The overall attitude of an organisation towards innovations can also be reflected in the organisation's **strategy**. A proactive strategy, i.e. a strategy that supports frequent changes or adaptation, can also ease the implementation of new technologies or processes. However, clear empirical evidence is missing (Naranjo-Gil 2009). It has been even stated that "…it would appear that innovations are responses to specific problems or challenges, and less a part of long term or overall strategies" (Bloch, Bugge 2013, p. 141).

Size of the organisation

Also regarding the size of an organisation, there is no clear evidence, especially within the public sector, on its influence on innovation processes. However, there are good arguments for the hypothesis that bigger organisations have **better conditions** for innovation: Many of them have better access to resources required to implement innovations, and stronger depend on sophisticated information and control systems, which make them more open for innovations in this field (Chenhall 2003; Naranjo-Gil 2009).

Another, crucial aspect of organisational structure and internal processes regarding the implementation of the IN-PREP MRPP is information management, which is addressed in sub chapter 2.3.

Practitioners view

A significant part of practitioners that were interviewed are actively involved in IN-PREP. A general **"driver"**, i.e. main motivation to participate in IN-PREP, is a recognised need to improve cross border and inter-agency cooperation. Practitioners see the opportunity to gain and improve knowledge within their organisation through the collaboration (Interviews 2, 3, 4, 5), and especially to improve training abilities (Interviews 2, 4, 5, 6). Strong benefits from a uniform tool such as the IN-PREP MRPP are expected (Interviews 2, 3, 4, 7, 9). Practitioners further see opportunities from implementing (a system such as) the IN-PREP MRPP in their organisation in terms of improved possibilities and capabilities for information sharing (Interviews 1, 4), and of a more efficient use of resources (Interviews 1, 6).

However, practitioners also see a number of challenges or **"barriers"**: The differences in language, terminology, and structure seem difficult to overcome (Interviews 1, 6, 8), as well as barriers on information sharing, e.g. due to security levels, and/ or data protection (Interviews 1, 8, 9). The tool can further only be successfully used if people are trained and motivated accordingly, which costs time and energy (Interviews 3, 6), and when it fits into the organisational structures (Interviews 4, 5, 8). The tool will only be useful if all relevant organisations use it, while it has to compete with other solutions that are on the market, or currently being developed (Interview 5). The difficulty of turning project results into actual use has also been recognised (Interview 2).

In addition, **decision making** in public organisations sometimes depends on the superior governmental agency, so that changes on the political level can influence the work (Interviews 2, 6). Further general barriers to innovation following the practitioner's experience include a lack of knowledge and understanding the innovation's benefits (Interviews 1, 2, 3, 4, 5, 6, 9), missing resources (including missing priorities) (Interviews 2, 3, 6, 8), resistance of people to use new systems (Interviews 2, 9), but also contractual obligations (Interview 5).

2.2.2. Recommendations

Usability

In principal, innovation supporting measures are amongst others seen in **involving users** in innovation processes; introducing innovation incentives to staff; having an active role in innovation on management level; or tolerating trials of new ideas, no matter if successful or not (Blind et al. 2012).

Since drivers and objectives of innovation in the public sector are often not as clear as in the private sector, it will be useful to recap them both during the development of the system and when implementing the system. During development of the MRPP, the **drivers** for participating in IN-PREP (see box above), revealing main expectations towards the MRPP, **should be considered**. This means that IN-PREP partners should check if the system meets these expectations and what can be done to enhance the situation. Finally, when implementing the system, the users should reflect on their individual drivers, concentrate on making use of the MRPP's support regarding these drivers, communicate the system's benefits within their organisation, and organise respective training, if needed.

Transparency

While some of the interviewed practitioners act quite autonomously, including the ability to take decisions on new tools or systems to be used (e.g. Interview 4), others depend on governmental organisations and/ or persons (Interviews 2, 6). If a user organisation and its decision-making processes are dependent on another (governmental) organisation, it is important to **involve all relevant actors** at an early stage.

The report at hand as a whole already highlights the necessity of having an **holistic view on diverse context factors** that can decide about the implementation of the IN-PREP MRPP to be successful or not. It is thus necessary to check if/ which other organisational components or processes require change.

Flexibility

Flexibility and adaptability are key aspects of modern day crisis management, since the context and nature of crises is constantly changing and evolving (Kroener et al. 2017). Consequently, there is no single best way to deal with crises and disasters (Boin et al. 2014a). It is therefore advisable, as also experiences from the EU Horizon 2020-funded iTrack project have shown, to design systems to be **reactive** and **effective**, offering end-users **choices** as to how to use them. This enhances the likelihood that the system actually reflects the environment it is used in (Kroener et al. 2017).

Mendonça et al (2007) suggest ICT systems should focus on work **processes**, rather than outcomes, offering support on how to achieve goals set by the end-users rather than defining these goals. They argue that pre-defining the system for a certain set of possible conditions (e.g. pre-defined scenarios) can contradict the work practitioners

do in the field. Practitioners, they state, need the flexibility to pick and choose technology to fit their needs.

Depending on organisational values and political pressure, some organisations try to adopt a lean approach to management, valuing efficiency and reducing redundancies. In crisis management this can have adverse effects, leading to a lack of adaptability and innovation and potentially produce barriers to effective crisis response (Drennan et al. 2015).

Since large-scale disaster events often play out in unforeseeable ways, **improvisation** is a big part of crisis response (Mendonça, Wallace 2007). One example is volunteer management, which is becoming more and more important for crisis response (Bähr 2017). Practitioners need the possibility to quickly adapt to evolving situations, also acting outside the book. If the MRPP doesn't offer the flexibility to do so, practitioners might feel the need to work around the system or abandon its use. Tailoring the system to reflect only predefined responses to given scenarios can thus run counter to the experience of end-users in the field.

2.3. Information management

2.3.1. Overview

In information management in crisis management, **simplicity** and **efficiency** in entering and accessing information is paramount. During a crisis event, first responders need to gather and relay information quickly and reliably to allow for informed decision making.

Efficiency

For example, Urban Search & Rescue (USAR) groups, as defined by the International Search and Rescue Advisory Group (INSARAG 2015), need to gather a variety of information. INSARAG explicitly notes that "efficient and effective capture, processing, dissemination and use of information will underpin the success of large-scale coordination efforts." (INSARAG 2015, p. 38) This information is for example required to decide which buildings need to be prioritised and what needs to be done to ensure safe evacuation. Within the Illinois Fire Department this information used to be sprayed on to the building itself using spray paint and then relayed by telephone or even paper to other first responders. This inhibited a high degree of unreliability, and paper forms can take hours to reach command and control. In addition, spray paint can become unreadable and in large buildings it can take a while to identify the location of the markings. This lead to the development of an electronic system to simplify and **expedite the process of gathering structural information** and make it more resistant to failure (Chen et al. 2010). This can be transferred to many other aspects in crisis management, to make required information accessible and usable in the best possible way.

Simplicity

As has been noted by previous research, information sharing among organisations is difficult as it is. Crisis events, with the resulting stress, uncertainty and dynamics, only exacerbate this problem, making it even harder to share and also process information – not just among, but also within organisations (Kapucu 2009). While advanced information management technologies can help they are only as good as the data fed into them – and if people don't use them (or don't know how) they are useless ('t Hart, Sundelius 2013). Thus, besides the quality of data, the information it provides should **be clear**. This has also been highlighted during the interviews (Interviews 3, 4, 5, 6).

Usability

At the same time, work procedures defined in an information system need to adequately reflect work processes on the ground. As soon as there is a "**disconnect**" or cognitive dissonance (Mays et al. 2011) **between technical solutions and operational procedures**, end-users are left with no choice but to work around the system. Also, in connection to the human factors detailed below, the existence of multiple IT systems, different interfaces etc. can lead to problems. They can overstrain end-users, confuse them, cause conflicts with existing workflows etc. (Mays et al. 2011). In principal, "methods and tools [for cross-boundary exercises] must take into account the independency of agencies, cultural and organisational differences as well as financial constraints." (Hamrin 2012, p. 13)

Practitioners view

The information management systems currently used by practitioners, range from manual processes (Interviews 2, 6) to advanced IT systems established in several collaborating organisations, using common interfaces (Interviews 3, 5). Following the practitioners' experience, introducing a new IT system requires well organised communication of benefits, enormous training, and changes in procedures (Interviews 1, 4, 5, 6, 7, 8, 9). Also the introduction of a system in several organisations at the same time is a challenge, especially when an IT system is supposed to replace a manual system (Interviews 1, 2). The easier a system is, the more likely it is that it will actually be used (Interviews 3, 4, 5, 6), while acceptance also depends on individual technological affinity (Interview 9). It has also been noted that easily trusting information provided electronically can be risky (Interview 7).

Practitioners see a need for the IN-PREP MRPP to be adaptable to individual contexts (Interviews 2, 5). Thereby, the ISO norm for information security would need to be applied (Interview 3).

2.3.2. Recommendations

Usability

As also stated in the interviews, information flow through the IN-PREP MRPP needs to be **adjustable** to individual needs. This is not only important for the platform to be compatible to existing work processes, but also to enhance usability. If end-users can pick the information they specifically require for their operations, relevant information can be conveyed faster and more effectively (Hamrin 2012). Each end-user needs the ability to identify which information they want displayed easily and fast. If the choice which information is displayed is pre-determined there is a likelihood of practitioners not receiving what they need (Mendonça et al. 2007).

IN-PREP should focus on how to enhance information flows and **highlight the benefits** of its information management components. Users also need to highlight the benefits within their organisation and related organisations/ decision makers. This can help overcome reservations from politicians to invest in and from professionals to use them. For this to work these components have to be meticulously adapted to end-user needs – not developers' visions. If even the slightest doubt as to the usefulness of the system exist it will seriously damped its chance to be used further.

By introducing simple and unified interfaces, therefore reducing visual complexity and allowing end-users **easy access** to the functions and information they require while phasing out anything else, the IN-PREP MRPP can be

used alongside existing platforms. It can also be easily integrated into existing workflows, procedures and processes if it isn't seen as burden but as added benefit to the operation. This can additionally be facilitated by allowing organisations to customise interfaces by using for example their own symbols and pictograms (Barth 2017).

However, it shall be taken into account that there is a **risk of trusting digital information blindly**, instead of avoiding misunderstandings through direct communication (Interview 7).

Flexibility

Giving crisis managers an information management system alone will not facilitate effective crisis response. Such a system needs to be designed with **flexibility** in mind to make it useful for the highly dynamic situation of a crisis event, in contrast to the requirements of more static organisations or environments (Hallberg et al. 2012).

Interoperability

Data gathered through the IN-PREP MRPP needs to be **compatible** with systems used by different organisations. It is therefore important to know, which data types are used and weather IN-PREP supports all the different data types.

2.4. Inter-organisational communication and cooperation

2.4.1. Description

Communication barriers

Fischer at al. (Fischer et al. 2016) conducted a systematic literature review on communication barriers between crisis management organisations. One key finding is that communication problems often arise from **organisational differences**, such as norms and rules, hierarchies, working methods and terminologies, shaping specific organisational cultures. This was also highlighted in the interviews (see below). Even differences in personnel, such as military or civilian staff, can lead to barriers. These differences can lead to a lack of understanding for the other, and eventually to a lack of trust. Indeed, as Kapucu et al. (2010) show in their work on the response of American crisis management organisations to Hurricanes Katrina and Rita in 2005, trust, refusal to be held accountable and competition are among the main reasons for problems in inter-organisational crisis response.

In addition, to effectively raise trans-boundary capabilities, a **common planning** approach involving all relevant actors is needed. This involves common standards, harmonisation, and synchronisation (Stolk et al. 2012). This is linked to other factors, such as mutual trust and understanding, common standards and respect for different cultural norms and legal frameworks. Yet even if all these factors are given, gaps in information flow still can occur (and are actually likely to). The only way to mitigate this is by constant interaction which will step-by-step reduce these barriers (Constantinides 2013).

Complexity

Inter-organisational cooperation is necessary to respond to transboundary crises. However, every interaction of organisations in such an event is likely to generate complexity. In other words: **complex crises create complex systems of interaction.** The crisis situation doesn't allow any single organisation to have all the necessary capabilities

or information to effectively respond, so cooperation between different organisations at different levels is required (Kapucu 2009; Roche et al. 2013). And at the local level, which usually is the first level of crisis management to engage a situation, organisations are rarely equipped to deal with crisis events on their own. Cooperation among different and independent situation is the norm rather than the exception (Hallberg et al. 2012). The complexity of inter-organisational cooperation obviously impacts communication as well.

Whether at national or EU level, inter-organisational cooperation needs a foundation in law enabling the services to coordinate and share resources and information. In the UK, for example, all emergency services received an obligation to cooperate through a new law, which also aims at enhancing efficiency and streamlining management (Kane 2018).

Common understanding

An important aspect of inter-organisational cooperation is the creation of **shared experiences**, either through training (also stated in Interview 2) or real crisis events. For these experiences to actually lead to closer cooperation, a common understanding of the past event, how it was handled and what implications can be deduced is needed. Otherwise the feedback won't have any positive effect and could even have negative consequences for future events (Constantinides 2013). Shared experiences also build trust, a requirement for effective cooperation.

A common understanding of the crisis at hand is necessary for effective decision making among different organisations. It can result, as already explained, from shared experience, common terminology and, as a result, common expectations of decision making and crisis response (Constantinides 2013). Such a common understanding can also be achieved through a common process for the gathering of appropriate data, analysis, dissemination, implementation and evaluation, regardless of the type of data collected (e.g. best practices, operational data). This includes a common language to describe capabilities and integration of existing efforts in mapping and describing capabilities. Stakeholders should be involved throughout the process to ease concerns about potentially exposed vulnerabilities or weaknesses, privacy and information security (Hamrin 2012).

Harmonisation[6]

The ACRIMAS project has identified two important organisational problems concerning harmonisation: dispersed responsibility (the existence of many actors engaged in various stages of crisis management) and institutional barriers against standardisation (meaning standardisation mainly takes place on an intra-agency, not cross-agency basis, thus requiring a top-down approach) (Stolk et al. 2012). As with other aspects, harmonisation relies heavily on a **common terminology** (Stolk et al. 2012). But technological standards also play their part. For example when it comes to communications between organisations, the use of different and often non-interoperable technologies presents a significant barrier to cooperation (Fischer et al. 2016). However, technologies are, as research suggests, only a symptom of organisational culture. Harmonisation and cooperation are thus only possible if a certain amount of trust exists among organisations (Kane 2018).

Harmonisation requires agreed **standards and guidelines of operation**. In the absence of a central authority which can ensure a top-down harmonisation effort, coordination and an open dialogue based on a shared goal among organisations is necessary, also specifying the exact topics which should be addressed (Stolk et al. 2012). This makes harmonisation a cross-cutting issue, involving both organisations and policy making.

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[6] Harmonization as general process of creating equal standards and benchmarks across organizations, and as specific process covering niche areas and enhancing efficiency through standardization (Stolk et al. 2012).

Roles

Another prerequisite of successful inter-agency cooperation that needs to be addressed is the assignment and inter-organisational communication of clearly **defined roles**. To be effective, this needs to be done in ways that can manage the flexibility necessary for playing multiple simultaneous roles or quickly shifting roles as events shift. There are several general facets that need to be defined, such as authority, mandate, assignments and tasks. But there are also facets regarding the interplay with other organisations, such as focal or contact points for managerial and strategic tasks, covering everything from providing information to partners, conducting the planning, facilitating the operations, etc. (Hallberg et al. 2012, p. 6). But while planning how to cooperate is important, it is common knowledge that crisis events tend to be unique and develop in unforeseeable ways. For this reason flexibility, adaptability and creativity during the response phase are a vital aspect of inter-organisational cooperation (Mendonça et al. 2007).

<table>
<tr>
<td></td>
<td>Practitioners view

The interviewed practitioners see hurdles in inter-organisational cooperation especially in the different languages and terminologies (Interviews 1, 2, 5, 7, 8), different structures, procedures, and authorisations, even within a country (Interviews 1, 3, 8). But also different security levels/ clearances (Interview 1) can strongly restrict information sharing among organisations. Also (communication) systems differ and are often not interoperable (Interviews 4, 5, 6). Further, a lack of joint training strongly supports hurdles in inter-organisational cooperation (Interview 2),</td>
</tr>
</table>

2.4.2. Recommendations

Flexibility
A study on inter-organisational cooperation in the UK showed that there is **no single model** for cooperation. Rather, successful and effective cooperation depends on local circumstances, the modus of cooperation thus cannot be predefined (Kane 2018). The IN-PREP MRPP should thus be able to accommodate different ways of cooperation, from superficial to in-depth, giving practitioners the flexibility to find a use suitable to their needs. This would also make sure that end-users have enough leeway to cooperate in the field as they see fit, depending on the specific circumstances of the operation.
Knowledge management
A common understanding of crisis events and harmonisation can be promoted through a commonly accepted way of **structuring knowledge** about crisis events. This means, in a nutshell, that when talking about a crisis event, a set of elements regarding the nature of the event is covered using a standardised way and language to describe the dimensions of the event. These elements, mutually agreed, will provide all end-users with the same information, structured in a way that leaves little to no room for ambiguities.
The IN-PREP MRPP should thus introduce a way to structure knowledge about transboundary crises along agreed-upon elements and make said knowledge available in an accessible way. Elements should cover the context of the crisis situation; the potential partners that can be mobilised and invoked; and the objectives associated with the

faced situation (Bénaben 2016). It is, in other words, a way of processing the information gathered through the various technological solutions and organisations' input, using a strictly defined, yet adaptable, **formal model**. Each element is further detailed by sub-elements, which help making sense of the situation and inform decision making. The sub-elements need to be specified by the end-users to reflect their needs and make the whole process useful to them. This model of knowledge management needs to be open and continuously adapted to the circumstances and the practitioners using it and in order to avoid entrenching cultural assumptions and historical precedent into future analyses. New situations and end-users will require adaptations so the model retains its useful qualities.

Obviously **knowledge about the process** of actually managing the crisis needs to be included as well, e.g. the status of deployment of assets and their whereabouts, needs and requirements of practitioners on the ground such as personnel and materials, number and type of injuries, etc. This feeds directly into the aspects of information management and inter-organisational communication.

Usability

The general **roles** of different partners in transboundary crisis management should be clearly defined by the European Civil Protection Mechanism (CPM), especially regarding mandates and assignments, which are handed out by the agency in charge. However the roles regarding the actual cooperation are related to internal structures of the participating organisations. Ideally the people filling these positions are easily **identifiable** through the platform. This would allow any crisis manager to know exactly who to contact regarding information, planning, operational activities etc. The easier it is to know who to speak to and how, ideally directly through a communication module in the platform itself, the easier it is for organisations to coordinate. This ties in closely with inter-agency communication.

2.5. Organisational change

2.5.1. Description

Resistance to change

The introduction of the IN-PREP MRPP is without a doubt a **change** to all organisations involved. However, organisations are often resistant to change. Some scholars of organisational theory have pointed towards the "stickiness" of institutions and therefore organisations, referring to historical path dependency (Boettke et al. 2008). Others described this phenomenon as "structural inertia", induced by internal (e.g. costs or political will) and external factors (e.g. legal barriers) and the fear of loss of legitimacy as a result of radical changes (Hannan, Freeman 1984), meaning the "speed of adjustment relative to the temporal pattern of key environmental changes" (Hannan, Freeman 1984, p. 161). Specifically the reliance on reproducible routines and structures, often found within organisations, can prohibit change (Hannan, Freeman 1984). Similar resistance is felt between generations of responders and organisations with different familiarities to technology, with many citing that entrenched organisational culture and senior staff skills are important factors in shaping the update of new technology, such as social media . Regardless of the specifics, organisations seem to resist fundamental changes.

Drivers of change

But still, change does happen. Indeed, some argue that since organisations are constant reiterations of routines that are themselves performed by humans, change is ingrained in organisations (Tsoukas, Chia 2002). The question then is how change actually happens. Literature points to different **change processes**:

Endogenous change	Change can be generated from **within** an institution (**endogenous**) (Hannan, Freeman 1984; Boettke et al. 2008).
Exogenous change	It can be forced upon an organisation by **external actors**, such as political decision makers or other relevant stakeholders (**exogenous**) (Hannan, Freeman 1984). In this case change can only be successful if the change process is subsequently internalised by institutional actors, meaning that it has to be accepted as the only viable way to proceed, otherwise chances are high that change will be rejected (Boettke et al. 2008; Tsoukas, Chia 2002).
Event-driven change	Organisations can be influenced by **external events**, such as large-scale disasters, which open a window of opportunity for change to happen or result in pressure to adapt to changing circumstances (Birkmann et al. 2010; Boin et al. 2009). In the latter case it is important for organisations to change fast enough for the reorganisation to be applicable to the new environment, before it changes again (Hannan, Freeman 1984).
Dynamic change	Conceptually it can make sense to understand change not as a singular event but as **dynamic process**. If organisations, as mentioned above, are composed of human interaction, processes of change might be happening constantly as part of the reiteration of routines. Understood like this, change is inseparably tied to the humans making up the organisations (Tsoukas, Chia 2002; Piderit 2000). A change process is thus not finished with the introduction of a new technology, but continues as its users experience it, work with it and incorporate it into their workflow (Tsoukas, Chia 2002).

Table 3: Overview on different dynamics of organisational change

Cases of change exogenous and event-driven change (triggered by external actors and through external events) have been described in the interviews (see below).

Hannan and Freemen (1984) point out that change as a reaction to a changing environment also means grasping new possibilities, e.g. offered by technology.

Regarding the difference between reaction endogenous and exogenous pressures to change, Tsoukas and Chia (2002) claim that the only thing that matters is how organisations react to changing environments – which is an endogenous process. Thus the internal structure of an organisation, its self-understanding and capability to adapt, modernise and innovate are crucial factors. And it depends on the people making up an organisation and their mind-set. Similarly, Piderit (2000) emphasises the importance of the workforce for change. Should their concerns remain unaddressed and wishes and ideas be ignored this can seriously hamper any organisation's overall ability to successfully implement change processes, including crisis management organisations (Stolk et al. 2012).

	Practitioners view
	Drivers for practitioners to participate in IN-PREP, which can in the end imply an organisational change when finally implementing the IN-PREP MRPP, are summarised in chapter 2.2. They mainly concern the

need to improve cross border and inter-agency cooperation, to improve training abilities, to develop a uniform tool for collaboration, to improve information sharing, and to use resources more efficiently. However, changes triggered by either external actors or crisis events (or both) have also been explained, summarised in chapter 3.3.

Evaluation

Evaluation and performance assessment are **key components** of any form of organisational development. They can, however, also pose some serious issues, such as unwillingness to take part in such exercises or excessive workload. This can have serious implications, such as acceptance of the system as a whole by end-users. For effective use of evaluation/assessment, transparent methodologies and procedures have to be developed, tested and implemented, taking needs and concerns of end-users into account and raising awareness about the benefits (Hamrin 2012). The additional element of peer reviews from practitioners of the same cluster can enhance acceptance for proposed changes, or strengthen commitment to a change process that has already begun (Downe et al. 2018).

2.5.2. Recommendations

Interoperability

A new platform, such as the IN-PREP MRPP, needs to fit as **seamlessly** as possible into existing contingency plans in order to avoid friction. If the platform requires too much adaptation from organisations, e.g. by changing established and rehearsed routines, this can lead to rejection (see also the chapter on information management). It is therefore important to strike a balance between a broad approach able to encompass as many types of preparedness planning and imposing changes on organisations to make full use of the platform

The new system should also interfere as little as possible with existing processes and procedures within the end-users' organisations. Experiences from an exercise using a newly developed common operating environment within the US Coast Guard has shown that unintended consequences can arise when a new system is tested or implemented (Benson et al. 2010). In order not to upset organisational structures the implementation of the IN-PREP MRPP needs to be **fine-tuned** to the individual organisation's operating procedures. However, there will be requirements that organisations need to fulfil, demanding a certain change within the organisation. These requirements should be identified carefully, and communicated clearly. Feedback from the different exercises shall provide guidance.

Transparency

When developing the aforementioned system for gathering structural information of buildings to inform Urban Search & Rescue decision making (see chapter 2.3.1), some key challenges faced during development were: the system needed to integrate a variety of data from different sources, which then in turn needed to be presented to end-users in a way that added a clear benefit compared to the old method of information management (spray paint). The benefits identified are saving of time, the possibility to relay more information than before and to do so

more efficiently (Chen et al. 2010, pp. 2–3). When developing the IN-PREP MRPP, clear emphasis should be on the **"added benefit"**. Right from the start existing problems or shortcomings identified by the end-users should be addressed, making as transparent as possible the software or technology which engages with machine learning and data aggregation so that end-users can understand the results enough to see value or concerns. By doing so, end-users and decision makers can easily identify why the IN-PREP MRPP is a valuable asset. At the same time, the platform would have a real impact, as it would improve the work of crisis management organisations.

Since not all organisations will have the same resources for change and innovation processes available to them, making the platform as easily useable for end-users is highly important. The **gains** of using the IN-PREP MRPP need to be **visible** from the start while the **costs** need to be as low as possible (e.g. for internal adaption and implementation). One potential gain for organisations could be the availability of scenarios. Creating a scenario can be costly, so organisations might be reluctant to develop their own ones (Drennan et al. 2015). If, via the IN-PREP MRPP, the creation of scenarios can be shared, this might be an incentive to join and use the platform. However, this requires clear terms as to how the scenarios can be used by other organisations than the creator(s).

Usability

Acceptance can also be achieved by focusing not on what can be done, but what **end users need** to do (Hallberg et al. 2012). Neglecting user needs can, in fact, lead to rejection of the system. Placing user requirements towards the system and how the system will address their needs in the centre of development can ease fears and highlight the added benefit of the IN-PREP MRPP. Thus, during the development of the system, the identified needs, especially in T2.1, T2.3, and T2.4, should be carefully considered. Also recapping the drivers, i.e. reasons for end-users to participate in IN-PREP, or to work on possibilities to create and/ or implement the IN-PREP MRPP, will support the process of change (see text box in chapter 2.2.1).

3. Policy factors

3.1. Overview

Organisations obviously don't exist in limbo, they are embedded in political and social **contexts**. Especially the political environment, often highly volatile, can have profound influence on the way crisis management is conducted. Policy also provides the framework in which crisis management organisations operate. As such, policy factors also play an important role for the development of the IN-PREP MRPP. Political dynamics, changing policy frameworks and agendas, as well as political culture (as an expression of political values, institutional set-ups and history) can influence the way the IN-PREP MRPP is perceived by different actors, but also how it is implemented and what constraints and barriers need to be addressed a priori. Since governments are also responsible for laws and legal issues there clearly is an overlap with legal factors. These are addressed in Deliverable 2.3.

In this sub-chapter we will explore **policy factors** regarding crisis management and system development. The traditional definition of the political sphere differentiates between politics (processes), polity (institutions) and policy (content). While the title of this chapter is entitled "policy factors", we will also include institutions and processes where necessary to provide a broader picture. The analysis therefore focusses not only on existing frameworks and strategies, but also on political reactions to crises, political pressure and the impact of political culture on crisis management. Policy itself isn't static and is influenced by both polity and politics. Since the IN-PREP MRPP should not only provide solutions for the current state of affairs, but should itself be prepared to provide answers to future challenges, it is necessary to take into account dynamics that will change the political environment and come up with solutions to address these changes.
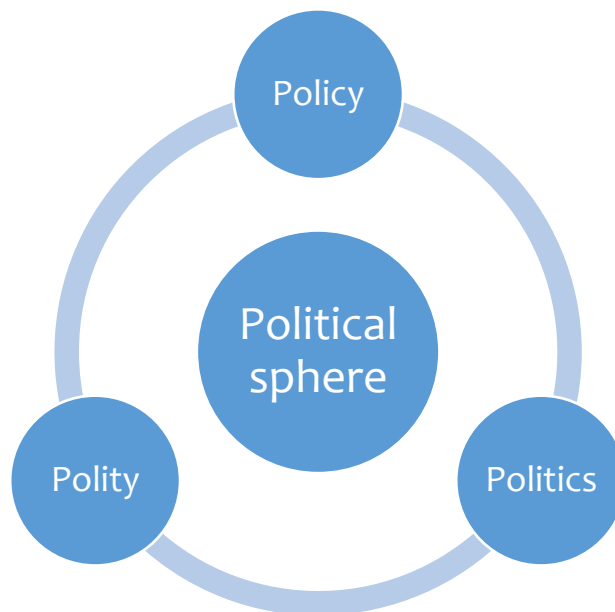
Figure 4: Dimensions of the political sphere

To analyse the potential impact of these factors, we have conducted research on literature and openly available government papers, both on national and EU level. We also conducted nine interviews with end-users to complement and verify our findings.

The recommendations gathered at the end of each sub-chapter should pose answers to the following question: *How can the political environment influence a successful implementation of the IN-PREP MRPP?*

3.2. Governance of crises

3.2.1. Description

The IN-PREP MRPP is developed at a given moment, meaning that it is a reflection of the political environment of that time. But it is important to remember that policies have the tendency to **change**. No policy framework governing crisis management is set in stone, neither at EU nor Member State level. For example, the UK experienced a major shift in responsibility for emergency services, and thus organisations and agencies involved in crisis management, amounting to an almost complete restructuring of the field (Murphy, Ferry 2018; Murphy, Greenhalgh 2018a, 2018b).

Governance of crises is closely tied to the prevailing political climate. New governments, for example, can introduce new ideological-based ideas which change the governance system profoundly (Kane 2018). Change has been already addressed from an organisational point of view, but it also exists at a political level. The specific dynamics of political change will be explored in chapter 3.3, but it is important to keep in mind that the governance of crisis, as depicted in this chapter, is subject to changes.

Decision making

Social reality arguably has and continues to increase in complexity, which in turn enhances **complexity** of governance structures (Kapucu 2009; Boin et al. 2014a). Governance of crises has evolved into two main systems which have tried to adapt to complexity in their own ways: hierarchical and decentralised systems. Each of these systems has its own peculiarities, as well as advantages and disadvantages. The point to be made here is that these systems fundamentally differ, having profound impact on crisis response. Given that training activities in the preparedness phase aim at enhancing response capabilities, taking these differences into account is crucial in developing the IN-PREP MRPP.

In systems where decision making is **hierarchical** and top-down, and where responsibilities are divided on the horizontal level, some specific issues can arise which influence how crises are dealt with (Sapountzaki et al. 2011). Among them are political interference and difficulties to reach consensus. Indeed, as the explosion of confiscated arms-related material on the Cyprus' naval base Mari shows, early preventive action was undermined by higher political levels (Constantinides 2013). But regardless of the reasons, the way the crisis was governed allowed higher political levels to make decisions contrary to the concerns of the professionals on the ground. Such issues are common in crisis management systems involving different levels of decision making where lower levels are dependent on higher levels (Sapountzaki et al. 2011). As Kapucu (2009) notes, the reason for the failure of the US National Response Plan during Hurricane Katrina, despite trying to involve a broad spectrum of actors, can be found in its attempt to streamline all actors within a linear, hierarchical model of crisis management. This resulted in profound coordination difficulties, which can be seen as a policy-related governance problem. Drawing on Taylor's failure of foresight framework, Constantinides (2013, p. 1668) notes that "decision-makers with the political responsibility to actually make a difference in the outcome of crisis management efforts [often] (…) apply their rationality only after having greatly simplified the choices available, while underestimating possible hazards and minimising emergent danger."

Decentralised systems exist, for example, in Sweden, where it is deeply rooted in the prevailing political culture (Svensson 2018). National legislation on fire and rescue services exists, but the way it is applied, organised and executed at the local level is the sole responsibility of the municipalities. There is also a clear division of responsibilities for different rescue tasks between the national and local level, leaving no ambiguities (Svensson 2018). Another example of a highly decentralised system is Germany. As a federal state based on the principle of

subsidiarity, crisis management in Germany is mainly in the hands of the sixteen states and their communes. The federal states responsibility is dealing with risks and dangers stemming from international crises, conflicts and war. Transboundary crises are therefore dealt with at federal, state and communal level. Additionally, Germany places high importance on the role of volunteers in crisis management, in contrast to other states where crisis management tasks are fulfilled mainly by professionals (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe 2010).
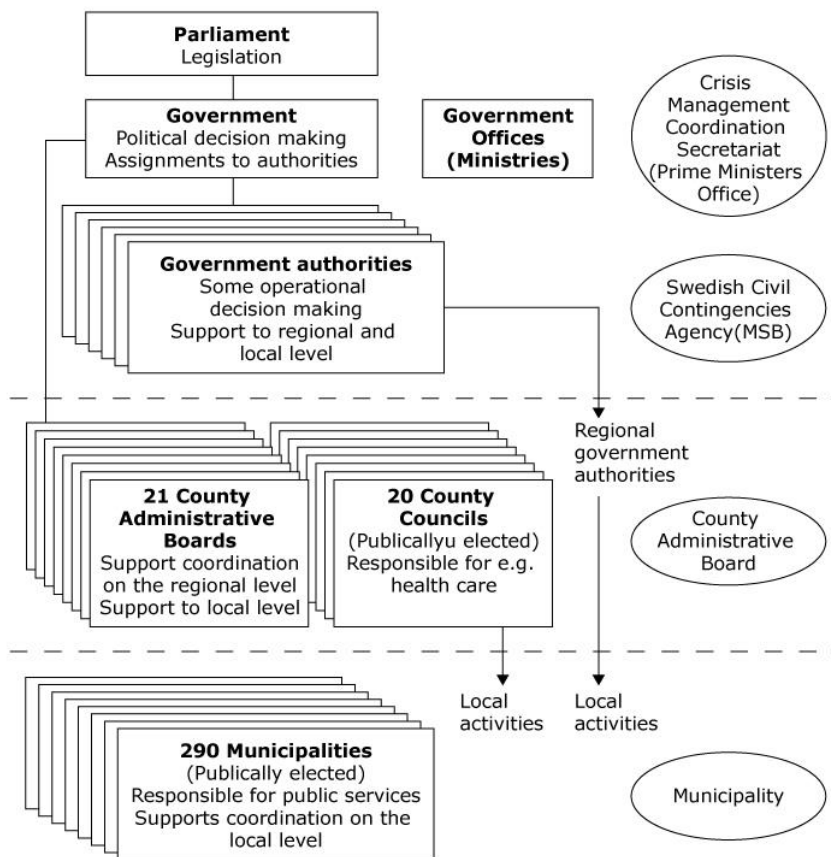
Figure 5: Swedish Disaster Management Structure (European Commission 2017b)

This is not to say that a decentralised system poses the answer to all governance-related problems. The multitude of actors, each with different competencies and responsibilities, increases the requirements to coordination, cooperation and consensual decision making. In most cases, were such a system exists, it is deeply rooted in socio-political and historical contexts. And, as the EU project ANVIL concluded, even in decentralised systems some degree of centralisation is present – usually in the form of legislation allowing the up-scaling of responsibilities, or through federal coordination centres (Boin et al. 2014a).

Regardless of the specifics of a particular governance system, **flexibility** and **participative** and **inclusive decision making** are important factors highlighted by practitioners and academics. For example, the US' FEMA moved from a hierarchical organisation to an interorganisational network system following the events of Hurricane Andrew in 1992 and the realisation that the old system didn't work as required (Kapucu 2009). But, as has been described, this approach was not wholly implemented and the traditional governance model including strict hierarchies and

hierarchical decision making still prevailed. A training platform should therefore not outline detailed operational plans or proscribe modes of interaction among specific agencies.

Practitioners view

The results of the interviews paint a mixed picture about the level of political influence on decision making. There are two main aspects to be separated here: hierarchy of and influence on decision making.

Several interview partners acknowledged that their decision making processes were political, meaning that the highest level of authority within the **hierarchy** rests with a political office, often the mayor (Interviews 2, 3, 4, 6, 8, 9).

Influence on decision making is something that several respondents mentioned. One respondent highlighted that the political level in decision making can block effective response (Interview 4). Three respondents went so far as to state that crisis events tend to be politicised, which can happen both during and after the events (Interviews 2, 8, 9). On the other hand, three respondents mentioned being autonomous in their decision making making within their respective responsibility (Interviews 1, 3, 5).

Several respondents highlighted that they were **dependent** on information provided by other organisations (Interviews 1, 4, 5, 7, 9). This was found to be the case regardless of hierarchical or decentralised systems and also with organisations that are autonomous in their decision making.

Regardless of hierarchies and influence, most respondents mentioned having clearly defined **responsibilities** (Interviews 1, 2, 3, 4, 5). This coincides with the existence of clear frameworks, guidelines and regulations.

In conclusion it can be stated that organisations of all respondents exhibit some degree of interdependency, which is hardly surprising given the nature of the task. However, the extent of these dependencies and their nature however vary significantly.

Accountability

Another aspect drawn from the Mari example, but also from the reaction to Hurricane Katrina, is how the event was followed up on. The way the crisis was governed allowed for a diffusion of **responsibility** and **accountability** among the various actors. Operational responsibility was undermined by political control. However, those exerting political control, usually the political executive, weren't held accountable by those overseeing them. As a result no one felt responsible for what happened, no one "owned" the mistakes, leading to frustration among the people affected by the event and also the actors involved in managing the crisis (Constantinides 2013). Scrutiny and accountability have also been central concerns in the reform governance of fire and rescue services in the UK, identifying the need for emergency services to be accountable to the communities they serve (Farrell 2018). Trends to increased involvement of private and for-profit actors within crisis management are likely to raise further questions of accountability (Boin et al. 2014a).

Accountability, not just within crisis management organisations or national crisis management frameworks, is also an important legal aspect when it comes to transboundary crisis management. It is analysed in greater detail in Deliverables D2.2 and D2.3. Since issues of accountability will most likely come up when using the IN-PREP system, it has to be addressed already during development of the system.

	Practitioners view
	Accountability, covering aspects such as overlap of responsibilities, was explicitly mentioned by two respondents as a likely challenge for the IN-PREP MRPP (Interviews 4, 6).

Most respondents acknowledged their organisation having clearly defined responsibilities (Interviews 1, 2, 3, 4, 5). The consequence for IN-PREP would be to translate these responsibilities into the system so that organisations have a clear picture of what their partners can and cannot do.

Fragmentation

Crisis management within the EU has to deal with another governance issue: **fragmentation**. There already exist various organisations and structures at the Member State level, involving state, private and volunteer organisations (Boin et al. 2014a), which have been joined by additional structures and institutions at the EU level. However, the competencies of these EU institutions, while more unified than before, are still dispersed and, in some cases, opaque. This, it can be argued, leads to increased bureaucracy and complexity, complicating effective coordination (Rhinard, Boin 2009). In addition they mostly rely on voluntary contributions, commitments and contributions, lacking "hard" powers to push their mandate. This adds another layer of complexity, since the EU level exists and needs to be involved. The scope of this involvement however remains contested.

Transboundary crisis management in the EU is thus defined by a multitude of actors and layers, ranging from local to European. This is likely to have a profound impact on any training activity, and as such also for the implementation of the IN-PREP MRPP.

	Practitioners view
	When asked about the challenges for transboundary crisis management and cooperation, respondents mentioned different procedures and responsibilities of (potential) partners (Interview 2, 4, 7, 8), lack of

knowledge about structures on other countries and organisations (Interview 7), different understandings of concepts such as "risk" (Interview 5), interoperability issues (Interview 1, 6, 7), and the lack of standards (e.g. terminology) (Interview 1, 5, 9), and lack of proper communication channels (Interview 1).

At the same time they highlighted the potential to increase efficiency in response and the use of resources through cooperation (Interviews 1, 2, 3, 4, 5, 6, 7), the creation of common standards (Interview 2, 3, 9), knowledge transfer and subsequent organisational development (Interviews 2, 3, 4, 5, 6, 7, 9) , and better information flow (Interviews 4, 5).

While fragmentation was not mentioned explicitly, all of these aspects pertain to the number of actors, systems, frameworks and regulations in place.

Governance Frameworks

Crisis management at EU level, including transboundary crisis management, is governed by the principles of subsidiarity and proportionality (European Council 2016). Effectively this means that help provided by other Member States through the Civil Protection Mechanism (CPM) cannot go beyond what is required to achieve the objectives

laid out in the legal framework. It also means that help can only be provided once local resources are deemed insufficient and help is requested by the Member State which is handling the crisis.

There are three major institutionalised frameworks for crisis management at the EU level. The **Civil Protection Mechanism** highlights the importance of strengthening preparedness, e.g. through training programmes and exercises (European Parliament, Council of the EU 2013). The CPM focusses in particular on scenario-building, asset mapping and the development of plans for the deployment of response capacities to increase preparedness (European Parliament, Council of the EU 2013). The legislative framework of the CPM also introduced the Emergency Response Coordination Centre (ERCC) as permanent monitoring and coordination centre for crisis response (Icelandic Red Cross 2012). An instrument complimentary to the CPM are the **EU Host Nation Support Guidelines** (HNS), detailing in a non-binding way "all actions undertaken in the preparedness phase and the disaster response management by a Participating State, receiving or sending assistance" (European Commission 2012, p. 3). A third instrument are the **EU Integrated Political Crisis Response arrangements** (IPCR), which are meant to reinforce coordinated response and fast decision making at a political level. This instrument is, however, mostly concerned with response and is therefore not relevant for IN-PREP (Icelandic Red Cross 2012).

Several EU member states have national frameworks in place. Due to differences in political systems these frameworks can have different scopes. Examples from the consortium are (non-exhaustive):

Country	Framework	Scope
Germany	Konzeption Zivile Verteidigung (Bundeministerium des Inneren 2016)	Federal
Netherlands	Safety Regions Act (Dutch Ministry of Security and Justice 2013)	National, Regional
United Kingdom	Joint Emergency Service Interoperability Principles (Chief Fire Officers Association, Association of Ambulance Chief Executives and National Police Chiefs' Council 2016)	National
Republic of Ireland	Framework for Major Emergency Management (An Garda Síochána, the Health Service Executive and Local Authorities 2005)	National

Table 4: Overview on some domestic DRM frameworks

In addition to the institutionalised frameworks there exist several informal mechanisms for crisis management within the EU. Due to the special situation along the Irish border, the Republic of Ireland and the United Kingdom work together on an ad hoc basis. There is also a longstanding tradition of mutual assistance between health, fire and police services and the coast guard across the Irish border (Icelandic Red Cross 2012).

The IN-PREP platform should be closely linked with these existing frameworks, not ignore, but support and complement their intentions.
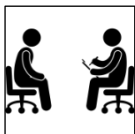
Practitioners view

One respondent explicitly mentioned the possibility of using the cooperation established through the

IN-PREP MRPP to enhance bilateral cooperation (Interview 5).

Several respondents mentioned the existence of frameworks governing crisis management, or DRM as a whole (Interviews 1, 2, 3, 4, 5, 8). The IN-PREP MRPP needs to adequately reflect these. One respondent mentioned that otherwise the chance of the system being rejected by the people using it would be high, since it would not have a clearly visible benefit to them (Interview 2).

Linking in with the topic of organisational procedures, the existence of different approaches in the different emergency services as result of the governance systems in place can require different types of scenarios (Interviews 3, 5, 7). This is to some degree similar to crisis management systems using all-hazard approaches in contrast to specialised approaches. The IN-PREP MRPP needs to cater to all these specific requirements.

3.2.2. Recommendations

Flexibility

Given the fact that governance systems can **change** fundamentally, either due to a change in political climate, external events influencing the political climate, or sheer necessity, the IN-PREP MRPP should be flexible enough to accommodate these changes. In particular this means that changes to the IN-PREP MRPP should be easy and fast. It should not be necessary for programmers to spend hours understanding the way the system was programmed in order to make changes, since personnel working on the platform will fluctuate. At the same time the way the system is built should allow for changes to be tested quickly, without the need to conduct major tests or even taking the platform offline or inconveniencing the users otherwise. This was confirmed by interviewees (Interviews 5, 6). This links in directly with the topic of usability, which was mentioned throughout almost all interviews as a major aspect to be considered (Interviews 1, 3, 4, 5, 6, 7, 8, 9).

Since different models of governance for crises exist among the Member States, from strictly hierarchical to entirely decentralised, this needs to be taken into account by the IN-PREP MRPP. Scenarios generated through the platform need to be easily **adapted** to different governance structures. This could be achieved through a checklist or a short questionnaire, allowing users to quickly modify scenarios to a context. Lack of adaptability to different methods of governance has contributed to ICT failures during crisis response in the past (Mendonça et al. 2007), so this is important to improve the chances of the IN-PREP MRPP being used by different crisis management organisations. This recommendation is mirrored by the need for the IN-PREP MRPP to fit as seamlessly as possible into existing organisational structures, identified in chapter 2.2.

As mentioned above, the interviews with end-users confirmed the variety of different forms of hierarchy and influence. At the same time end-users reiterated the need for the system to fit and adequately **represent** their local context, referring to governance structures, with one respondent even citing the lack of adaptation of the MRPP to the local context as a major challenge for implementation (Interview 2).

Transparency

The system should be transparent as to clearly **assign roles** for the management of crises within the scenarios which can also be retraceable retrospectively. This has several benefits.

1. One key issue in transboundary crisis management is the lack of **knowledge** about the posts individuals

from other organisations hold. Clearly assigning roles within the system thus helps their partners, greatly facilitating training efforts and making the whole system more efficient to use. That way it also increases knowledge about partners and helps create a shared understanding of crisis management. Given that several interview partners highlighted the wish to enhance their knowledge about partners from different countries and agencies, build up a network and thereby enhance efficiency, this also meets end-users' wishes (Interviews 1, 2, 3, 4, 5, 6, 7, 9).

2. **Accountability** is an important issue in creating legitimacy, making it also an important social factor. Development of the IN-PREP MRPP should make sure that responsibility and accountability for actions and outcomes cannot be diffused. By logging decisions and actions within training environments, issues of accountability and responsibility can be identified.

3. By clearly assigning roles and **tracing decisions** and actions, organisations can also, if they desire, optimise training curricula based on individual performance evaluation. This was identified by respondents as an interesting feature for the IN-PREP MRPP (Interviews 4, 5, 6).

Ideally, the scenarios should also **synthesise** all available information on the exercises and demonstrations, from decisions made at different levels to the impact of the actions on the ground. As a result a coherent narrative of the exercise would emerge, allowing decision makers from all levels and the practitioners on the ground to share a common view of the exercise. This not only helps creating shared experiences, it can also help answering questions of accountability. This can, for example, be achieved by providing proper documentation of exercises which clearly demarks decisions taken by all relevant parties. This aspect is closely tied to the need for a proper module for evaluation within the IN-PREP MRPP.

Evaluation

To adapt to the changing (and increasingly transboundary) nature of crises, 't Hart and Sundelius (2013) call for a capacity-building process throughout all levels of governance focussed on sense-making, steering and synthesising, meaning-making, and adapting. This process should especially involve the preparedness phase of crisis management. All of these aspects aim at creating a shared understanding of tasks and ultimately a common approach.

This is mirrored by interview responses highlighting the lack of common understanding of key elements of crisis management, such as the concept of "risk" and the lack of knowledge about partner's structures and work processes (Interviews 5, 7). The result is a juxtaposition of different approaches which ultimately have the same goal, yet differ in the way this goal is meant to be achieved.

IN-PREP can deliver vital information on these aspects, if a proper **evaluation and dissemination** mechanism specifically aimed at such a process is implemented. By providing data and a narrative based on training exercises among multiple partners it is possible to pinpoint areas for improvement, identify commonalities and work on creating common approaches.

Since there often is a lack of scientific data on the performance of governance in emergency services (see for example Farrell 2018), IN-PREP could provide valuable **information** for academics, policy makers and practitioners alike. Through an evaluation mechanism it could also be possible for national crisis management organisations to detect potential shortcomings of current institutional set-ups and identify room for improvement on the institutional level. However, since this is a very sensitive issue such a function needs to make a clear distinction between neutral meta data and more detailed information on performance. The latter data set can only be available

for the organisation in question. The evaluation mechanism should also be complimentary to the mechanism used by the EU for the CPM (European Commission 2014). Indeed, security issues in handling information were also mentioned by one interview partner (Interview 1).

For assistance provided and coordinated within IN-PREP scenarios it is important the principles of **subsidiarity** and **proportionality** are adhered to. The system should thus include detailed documentation that allows ex-post evaluation of the chain of events. Such documentation would allow crisis management organisations to better assess their own capacities and when and under which circumstances help was required – and the scope thereof. By including this documentation the requirement of monitoring of emergency support provided by other Member States would be fulfilled as well (European Council).

The CPM is also intended to **measure readiness** for disasters by measuring "the quantity of response capacities included in the voluntary pool in relation to the capacity goals referred to in Article 11 and the number of modules registered in the CECIS [Common Emergency Communication and Information System]" (European Parliament, Council of the EU 2013, Art. 3.2.b). The HNS Guidelines also ask participating countries of the CPM to analyse their national risks and potential capacity gaps, as well as to identify all relevant actors (European Commission 2012). The IN-PREP MRPP could therefore lend service to this endeavour by linking it with the CECIS and providing non-sensitive data to the Emergency Response Coordination Centre – should the participating organisations agree.

Knowledge Management

During the first IN-PREP end-user workshop in Leiden, the need for an **asset capacity register** was highlighted by several end-users, as explained in D2.5 (Weller 2018 (forthcoming)). In short this would entail an overview of existing assets with a description of their abilities. This description needs to be as broad as possible while being detailed enough to extract all relevant information. The exact level of detail would therefore need to be specified be end-users themselves, which constitutes a user requirement elaborated in D2.5. Such an asset capacity register within IN-PREP could be complimentary to the CECIS mentioned above by using the same terminology. A register for training purposes, providing fictive information, would for example allow training using a scenario with scarce resources. It should further be analysed if a real time register providing real information would be useful within IN-PREP, by weighing up the benefits against the additional effort for organisations that would be required to keep information up-to-date.

3.3. Political incentives

3.3.1. Description

Political incentives can take different forms and have different causes. As detailed in the chapter above, new governments can introduce new policy ideas. Incentives can also be derived from experiences of handling a crisis, either at home or by monitoring the reaction to a crisis somewhere else. In any case, political incentives will have an impact on system development, since they symbolise the ever changing dynamics of day-to-day politics.

Incentives are, in this context, understood as motivations to change the status quo. As such they can be derived from external events, political agency (personal ambition by organisations as a whole or by individual decision makers), strategies and frameworks, or broader agendas.

External events

In a similar way to organisational change, external events can also trigger political pressure to adapt new legislation on crisis management, thereby contributing to change in crisis management organisations (Boin et al. 2009). Boin et al. (2009, p. 82) state that "It appears that disruptions of societal routines and expectations open up political space for actors inside and outside government to redefine issues, propose policy innovations and organisational reforms, gain popularity and strike at opponents." They propose to see the dynamics of such events as "framing contests". Consequently there is no way to tell how exactly a crisis affect political dynamics and what consequences will arise – this depends on how interpretative struggles turn out and what narrative of the crisis emerges victorious (Boin et al. 2009).

However, if a governance framework is based on constant evaluation and adaption, chances are good that a crisis will lead to **changes** – either through new policy or adaption. Within the EU, national disaster management has generally shifted from military-focused civil defence to civilian primacy, and from specific threat approaches to all-hazards approaches (Boin et al. 2014a). The US Emergency Management Assistance Compact can also serve as an example to illustrate policy changes. It introduced an iterative process to adapt coordinated crisis response based on every experience made using the system, thereby replacing an old and rigid hierarchical system with a leaner, streamlined and decentralised version (Wilson, McCreight 2012). In Germany, the terrorist attacks of 9/11 and the large-scale floodings of 2002 led to change in the perception of crisis management. While civil defence and disaster protection ("Zivilschutz und Katastrophenschutz") were previously seen as to separate pillars, they were now increasingly seen as intertwined in the idea of civil protection. Also deepened cooperation between the different layers of crisis governance (federal, regional, local) was now seen as more important than before, within a dynamic instead of a fixed framework with predefined performance indicators (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe 2010) . Another example of how a crisis led to policy change was the 2004 tsunami in the Pacific region. It led to increased prominence of the Platform for Promotion of Early Warning (PPEW), which national governments of the affected countries now actively used to help implement early warning systems. Before the tsunami awareness of the need for early warning was low. The extensive disruption caused by the tsunami however led to a change in policy (Pattie, Dannenmann 2008).

Practitioners view

External events, or the way they are followed up, do play a large role for several interviewees. Most respondents agreed that external events had lasting impact on the way they carried out their work (Interview 1). The extent and dynamics, however, vary.

In some cases, external events led to the introduction of new frameworks, which can be framed as event-driven change (Interviews 1, 3, 6). Public pressure building up after crisis events and the corresponding urge of some politicians to act on them were mentioned as well (Interviews 1, 4).

In one case politicisation of crisis events was highlighted, yet the operating environment itself was described as relatively stable from such influence (Interview 2).

Two respondents acknowledged event-driven change to be behind major structural reform, this was described as a one-time event resulting from a string of incidents, with the current operating environment being relatively stable (Interviews 1, 3).

Urgency

In crisis preparedness two main factions exist: those who worry about the **impact** of a crisis event (crisis management organisations), and those that focus in its **likelihood** (governments, business leaders). Often, preparedness for major crises exists on paper, yet the capacities are rarely tested or even needed. Since major disasters are relatively speaking quite rare, policy makers often feel a low sense of urgency and don't necessarily see the need for proper funding of crisis management organisations and preparedness activities. But to effectively prepare an iterative process of testing and adjusting is needed, not just within but also among organisations and boundaries. This does require some level of political support ('t Hart, Sundelius 2013; Drennan et al. 2015). It also requires a clear and shared understanding as to what constitutes a crisis – and therefore what response is justified. This process, the framing of events, is directly related to political sensitivities as it can be used to downplay events or exaggerate them (Drennan et al. 2015).

Practitioners view

Two interviewees, when asked about political support, explicitly mentioned the fact that money is spent where there are problems, so if an organisation does its job well it does not receive more funding even if it otherwise receives political support (Interviews 4, 9). One respondent also highlighted the negative impact of budget cuts, while also highlighting that even while budgets are cut money still goes to areas identified as problematic (Interview 1).

One interview respondent mentioned experience from previous EU projects, highlighting the need for a strong exploitation concept and political will to bring the final product to the market (Interview 2). Another respondent remarked that experience has shown that a fragmented market can lead to the finished product of projects not being used by a sufficient number of organisations. For this reason political support in getting project results to the market are required (Interview 5).

Strategies

Some countries have existing strategies pertaining to **specific aspects** of crisis management, such as information management. In the US, for example, new systems for information management need to comply with the goals stated in the National Incident Management System's Incident Command System (Benson et al. 2010). Such strategic documents can also cover other aspects related for example to operational guidelines – see also the chapter on governance of crises. At the EU level, several initiatives to boost transboundary crisis management exist. The most notable are the above mentioned EU CPM and the EU HNS Guidelines. These initiatives are mostly based on voluntary contributions. The HNSG for example were, by 2012, only adopted partially by several EU Member States – despite the expressed commitment to do so (Icelandic Red Cross 2012).

Political incentives with an influence on crisis management do not necessarily have to be directly related to crisis management. Political incentives related to the UN Sustainable Development Goals, for example, can impact resilience to crises and preparedness. In a cross-reference to political climate, incentives can also be derived from a broader government agenda. Government reform in the UK, for example through Comprehensive Performance Assessments, had a profound impact on fire and rescue services, ranking prevention and preparedness higher on the agenda as was previously the case (Murphy, Greenhalgh 2018a). However, if budgetary efficiency is an item on the political agenda, e.g. by reducing redundancies, this can have serious effects on crisis management. Reliability and

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efficiency unfortunately often cancel each other out. This can also have effects on the ability of crisis management organisations to adapt and innovate (Drennan et al. 2015).

The introduction of technological systems in government agencies can be a disaster in itself, leading to loss of money and reputation (Drennan et al. 2015). It is therefore possible to encounter less than enthusiastic responses by political decision makers to support the introduction of a new system.

3.3.2. Recommendations

Flexibility
The implications of political incentives for system development are opaque: a disaster event can result, for example, in more or less resources for crisis management organisations, more or less deep structural reforms, or have no consequences at all. Such events will most likely result in structural changes if existing structures fail – this can be concluded from the literature and interviews. **Flexibility**, as an overarching theme, is thus not just required from organisations, practitioners and governance frameworks, but also from the IN-PREP MRPP. If the system is easily expandable and adaptable it can be easier to justify spending money on it. A **tie-in** with other projects, movements or organisations developing solutions or standards in crisis management can also enhance IN-PREPs impact and make it more attractive to potential end-users. This would also help alleviate the issue of standards and harmonisation.

Evaluation
During development it could prove useful to specifically target existing problems in managing transboundary crises, based on input from the end-users. As mentioned the aftermath of a crisis often sees a "framing contest", involving questions of preparedness, accountability and possible shortcomings. The better equipped the IN-PREP MRPP is to identify challenges, the higher its viability for decision makers will be. Development should thus follow as closely as possible the specific requirements of the end-users and how the platform allowed for the identification of capability gaps etc. This can be facilitated by an evaluation module. The specificities of such a module, however, would need to follow closely the requirements of the people using the system.
Also, if the gains of implementing and using the IN-PREP MRPP are clearly **visible** for political decision makers, they might be less averse to put their weight behind a broad roll-out throughout all government agencies involved in crisis management. For this to be successful the system needs to have demonstrated its usefulness and its functionality. This point has been confirmed by interview respondents (Interviews 1, 8).

Neutrality
To avoid getting caught up in political framing contests or similar issues, the IN-PREP platform should be designed with **neutrality as guiding principle (see also D2.2/2.3)**. Neither should the platform itself be based on assumptions (such as the ideal crisis response), nor should it be possible to politicise it (e.g. by using it to highlight potential shortcomings of partners). Neutrality concerns both functionality of the modules and the interfaces used by practitioners. Instead of using, for example, terminology and symbols from one particular national crisis

management system, internationally agreed neutral terminology and symbols should be used.

Compliance

The IN-PREP MRPP needs to **comply with national and EU strategies** on crisis management. Otherwise political or even judicial barriers towards implementation can be hard or impossible to overcome. This adaptation can be done during development for the project partners' countries based on end-user feedback and lessons learned from the exercises and demonstrations. After the project has finished, however, the platform needs to be agile enough to **accommodate potential changes** of national strategies or the adoption of the system by partners from new countries with their own strategies. This need to comply with local provisions and to have the system be adaptable to local contexts has been mentioned by interview partners several times (Interviews 1, 2, 3, 4, 5).

IN-PREP, as an EU project, should be as **closely related to existing EU initiatives** as possible, such as the CPM and the HNS Guidelines. This avoids redundancies but can also strengthen both IN-PREPs appeal and the EU initiatives themselves. To achieve a close relation and integration of the systems and mechanism, it is important to use EU terminology and taxonomies (derived from crisis management and legal frameworks), integrate systems, exchange information and use pre-existing tools and methods of coordination and cooperation – where possible. In this sense, IN-PREP could contribute to standardisation, something several respondents mentioned during their interviews is needed (Interviews 1, 2, 5, 6, 8).

Transparency

Under normal circumstances decision makers often refrain from investing in crisis management, especially in preparedness activities. This could have negative impacts on the implementation of IN-PREP (Interviews 2, 5). In order for the IN-PREP MRPP to become a viable choice on the market and to ensure exploitation of the project results, it is highly advisable to make the benefits of the system as clear as possible. If decision makers can easily see them, the more likely widespread implementation is.

3.4. Political culture and climate

3.4.1. Description

As crisis management involves an array of organisations concerned with security tasks special consideration should be given to the **particularities of security policy**. More than many other policy fields it is governed by sensitivities and national particularities, which can be summarised under the idea of political culture. Institutional set-ups, historical experiences and special emphasis on values create different sets of political culture that will have an impact on the development and particularly the implementation of the IN-PREP MRPP.

Political culture also plays an important role in crisis management, while also feeding back directly into other factors analysed in this deliverable, such as governance of crises, political incentives, social acceptance or organisational change. The governance of fire and rescue services in Sweden is also profoundly influenced by the tradition of local self-government, which is part of Swedish political culture – which is not to say that local services are marked by extreme divergence, since inter-municipal cooperation also plays an important part in Swedish political culture (Svensson 2018).

Constraints

Political constraints to enhance cross-border capabilities are manifold. Politicians and decision makers might fear for national sovereignty, publication of sensitive data, feel they are locked in competition with other countries, or refuse the general idea of foreign help for to inner political reasons (Pattie, Dannenmann 2008). Political sensitivities, security concerns and lack of resources within the agencies concerned can also hinder common (cross-border) description of capabilities and capacities.

While transboundary cooperation through system such as IN-PREP can provoke issues with **political sensitivities**, concerns over **sovereignty** over data, **competition**, or other **political constraints**, international cooperation can also facilitate the development of national capabilities and their integration into a cross-border system for crisis management. In the case of the 2004 tsunami the devastation caused led to significant momentum. Cross-border cooperation was enhanced, technological solutions for early-warning established and standards harmonised (Pattie, Dannenmann 2008).
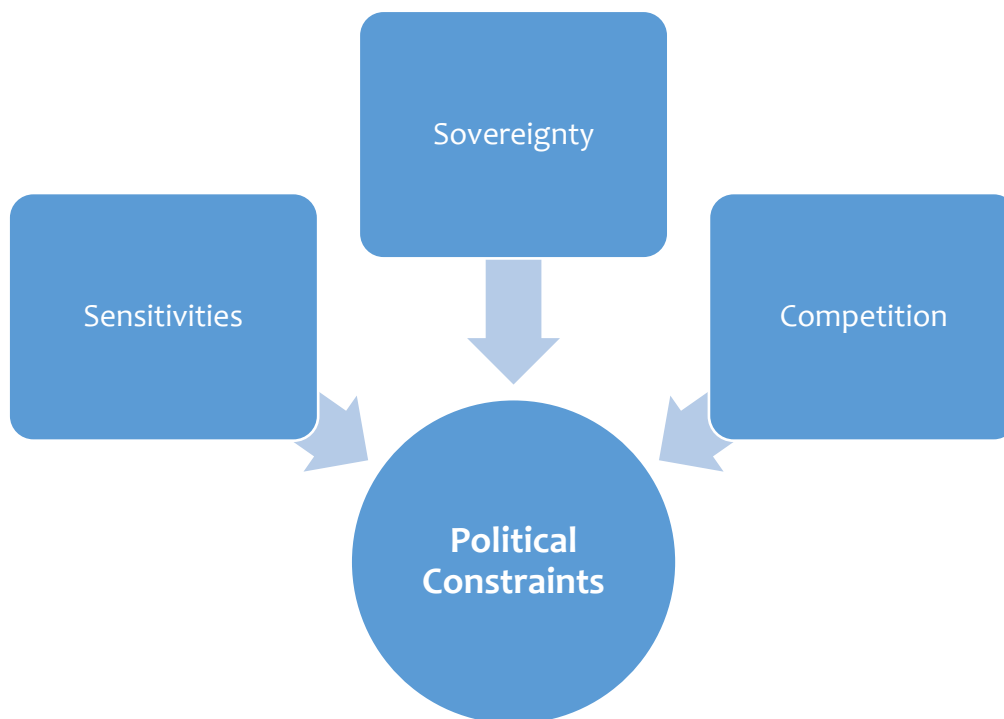
Figure 6: Potential political constraints for IN-PREP

Evaluation of crisis management policy can be complicated by political sensitivities and accessibility of data (Stolk et al. 2012, p. 66). Incorporating an evaluation system to enhance preparedness would thus need to address country-specific sensitivities and cultures to create acceptance by policy makers. Furthermore, no common set of indicators exist, which makes comparison of findings difficult (Stolk et al. 2012). Finding such indicators is a prerequisite for any evaluation platform within a preparedness platform.

Practitioners view

Security issues in the development and implementation of the MRPP where voiced by several respondents, mainly from the police spectrum (Interviews 1, 7, 8, 9).

Political sensitivities regarding cross-border cooperation where also mentioned by one respondent, suggesting that this had hindered successful cooperation in the past (Interviews 6).

More broadly, most interview partners highlighted the need for stringent data protection measures (Interviews 1, 2, 3, 4, 5, 5, 8, 9). This includes issues such as privacy (e.g. of patients), but also the handling of classified information and access restrictions based on internal classification by some organisations/countries.

Political climate

Crisis management, as a policy field, is subject to the **general political climate** in the same way as any other policy field. Prevailing sentiments and trends can influence the way crisis management can operate by imposing constraints, opportunities or reforms. For example, the reform of fire and rescue services in the United Kingdom during the New Labour Administrations was not only shaped by events, in this case several civil disasters. The end of the cold war and the bigger discussion about "new public management" (with its emphasis on rationalisation and service-orientation) played a crucial role in re-defining the role of and expectations towards the emergency services (Murphy, Greenhalgh 2018b).

Other examples highlight that system development for crisis management can be subject to changes and development in political culture not related to crisis management at all. Data protection and privacy, whose implications are detailed in deliverable D 2.3, have been the scene of some of the most intense political debates in recent years. As a result the EU has adopted one of the strictest data protection regimes (Easton 2016). However, it is not unlikely that these legal frameworks will continue to evolve in the future, possibly becoming stricter. Moreover, if the IN-PREP MMRP becomes standard throughout the EU, then it will not necessarily be readily usable with countries along the EU's Eastern Borders or with external mutual exchange countries, such as Australia or the U.S. that are not required to follow the GDPR.

Practitioners view

The influence of politics on the work of crisis management has been mentioned by some interview partners. However, this mostly takes place during and after a crisis event and can take the form of politicisation (Interviews 2, 8, 9), the framing the events, creating a narrative that serves exploitation of crisis events for political ends (Interview 2), or political influence on decision making in crisis situations (Interviews 2, 4, 6, 7, 8, 9).

Crisis management is hereby used by politicians as seen fit to further their agenda. Related to the influence of external events, see chapter 3.3, a series of shortcomings in crisis management structures can lead to policy change and structural reform (Interviews 1, 3, 5). These are, however, processes related to specific incidents. Three respondents mentioned explicitly influence exerted by reforms or policy changes without any incident (Interviews 4, 8, 9).

3.4.2. Recommendations

Documentation

Since the effects of a crisis event on the political climate are hard to predict, practitioners are well advised to maintain their own **narrative** of their work. By being able to swiftly provide good examples of their work they can not only justify their need for resources, but also steer political discourse and reduce pressure. This is not to say that crisis management organisations should be at the forefront of political debates, but that they should be prepared to engage in them if necessary – ideally by having empirical evidence to support their cause. The IN-PREP MRPP should ideally provide meaningful documentation of the exercises and demos in an accessible and systematic way to provide this empirical evidence.

All but one of the interview partners mentioned the need for proper documentation of training exercises to enhance both organisational and individual capabilities (Interviews 1, 2, 3, 4, 5, 6, 7, 9). This means a proper documentation capacity within the IN-PREP MRPP is required anyway, so this can be seen as potential for synergy: one functionality can serve two means.

International cooperation in security-related areas is a **sensitive** issue in most countries. The necessity to cooperate is generally acknowledged but often not translated into action. In the Indian Ocean region, following the 2004 tsunami, issue pertaining to political sensitivities as described above could by and large be overcome through coordinated support to all countries participating in the new early warning mechanism (Pattie, Dannenmann 2008).

For the IN-PREP MRPP this means that extensive documentation of the project and the platform, as well as centralised support to all organisations involved is needed. In short, the more practitioners and decision makers know about the platform, how it works and what information is actually shared when and with whom can **ease concerns** about sensitive issues.

Two interviewees highlighted the positive effects openly showcasing functionalities can have to increase acceptance (Interviews 5, 8). One interviewee especially emphasised the positive effect continued support and inclusion of users in the development had on the introduction of a new system in their organisation (Interview 5).

To **mitigate potential concerns** about sensitive data, technological solutions in general should allow organisations to "control and maintain ownership of the information they provide" and protect potentially sensitive information (Hamrin 2012). IN-PREP therefore needs to make sure that sensitive data can only be accessed by people with clearance to do so. The need to place special emphasis on this issue has been highlighted by almost all interview respondents (Interviews 1, 2, 3, 4, 5, 7, 8, 9).

Neutrality

The impact of political culture on system development itself is also very hard to assess. Some Member States are centralised, while others are characterised by decentralised or devolved decision making systems. Security policy and crisis management are seen from different perspectives, with some Member States pursuing a more interventionist approach and others being more restrained. Consequently it is nearly **impossible** to speak of one prevailing political culture in Europe with a potential impact on system development. The IN-PREP MRPP should thus be as neutral as possible when it comes to assumptions on how to organise crisis management. Even the slightest normative position, e.g. on hierarchies or best practices for crisis response, can trigger rejection.

Deliverables D2.2 and D2.3 will discuss this aspect in further detail.

Two interviewees mentioned the need for scenarios generated through the platform to be open, not to have a single solutions or pre-determine the outcome (Interviews 4, 5).

Flexibility
Since political trends aren't static, as the example of data protection shows, relevant aspects of the IN-PREP MRPP need to be highly **agile and easily adapted** to changing circumstances. This can include data protection, handling of sensitive data (where even what constitutes "sensitive" can change), organisational structures or national and EU policy frameworks.

4. Social factors

4.1. Overview

Any governmental effort to prepare for crises and disasters must be rooted in **societal support**. Crises mark potential breaches in the (implicit) social contract between citizens and government, which promises that government will protect its citizens against threats to core values, citizen well-being and the functioning of critical infrastructures (Rosenthal et al. 1989; Boin et al. 2005; Boin, Ekengren 2009). In the modern "risk society" (Beck 1992) this contract has come under pressure. New threats, which find their origins in the rise of transboundary (tightly coupled) systems (Boin 2009; Boin, Lodge 2016; Turner, Pidgeon 1978), have made citizens increasingly aware of new threats and hazards. This creates expectations with regard to government performance. It also creates a challenge for governments to communicate intentions. The resultant outcome of expectations and communications defines the social space for governments to initiate preparatory efforts such as those embodied by the IN-PREP project.

Public expectations can influence crisis management in a variety of ways. Depending on the type of crisis or disaster, for example, very specific public interests can emerge (Drennan et al. 2015). The "public" is a heterogeneous group of citizens with **different interests**. Efforts of crisis preparedness need to take this into account. Crisis management organisations need to establish a rapport with the population and engage in trust building activities. Otherwise public reactions might undermine crisis management efforts. This dynamic is most visible in the wake of terrorist incidents, which can provoke intense discussions about the nature of required preparation (C.A.S.E. Collective 2016).

Public awareness and support for crisis management are crucial to ensure adequate funding of preparatory projects (Hamrin 2012). In the absence of societal support, based on acceptance of certain measures, preparedness can be severely hamstrung. As Sapountzaki et al (2011) showed, efforts to include spatial planning in crisis prevention and preparedness, such as zoning, building codes etc., can either be dismissed by decision makers due to low support, or circumvented by the public through (illegal) practices.

In this section, we look at three types of factors that define the social space in which governments can and should engage with crisis management preparation:

> **Public expectations** about crisis management performance and societal acceptance of allocating significant resources and collaborating with foreign organizations

> **Governmental efforts** to influence the legitimacy basis through social media (as channel for information from and to the public)

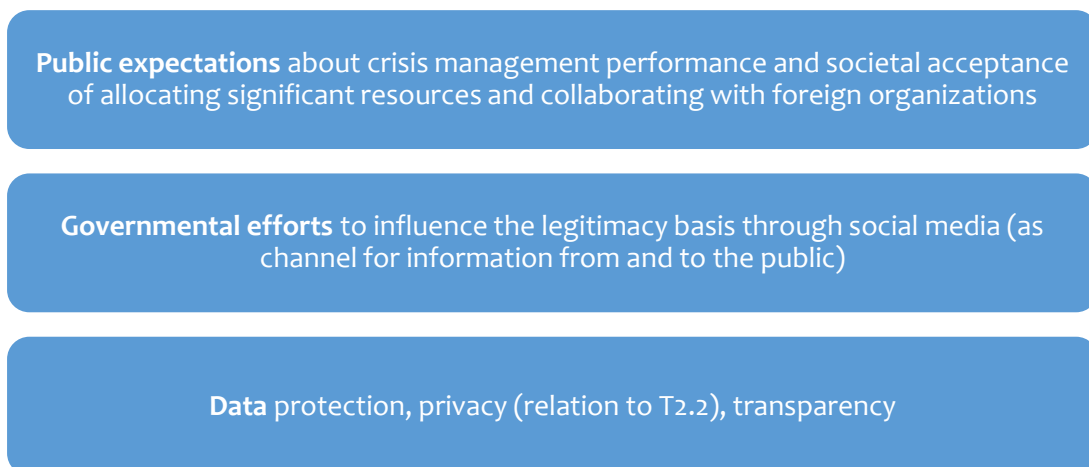> **Data** protection, privacy (relation to T2.2), transparency

Figure 7: Social space relevant to crisis management

The question we seek to answer here is *"What influence does society potentially have on a successful implementation of the IN-PREP MRPP?"*

4.2. Public expectations and acceptance

4.2.1. Description

Risk assessment

The public support for crisis management in general relies heavily on the public's assessment of risks. This **risk awareness** typically varies across cultures, regions and time periods (Douglas, Wildavsky 1982). Crisis management professional are typically aware of the quantifiable risks posed by natural disasters and human-made crises. They will have an informed idea of potential loss of life and possible material damages. The general public usually is not that well informed as to the professional understanding of the risks being faced, and will often have their own local and situational expectations and perceptions of risks (Walker et al. 1999; Wynne 2004) . For instance, these differences in approaches to risk can be particularly strong when a society has not experienced disasters in a while or, the public may not expect one to happen. This disconnect, in turn, can lead to crisis management being treated as policy area with low priority when it comes to funding and/or innovation – a dynamic combining public sentiment and political climate (Drennan et al. 2015).

 "Subjective" and "objective" risk assessments often differ, which poses a real challenge to professionals in crisis management ('t Hart, Sundelius 2013). Objectively speaking, even though their frequency seems to be increasing, major risks are still relatively rare. Yet, we know that the public tends to overestimate risks that have recently materialised (Gardner 2009; Kahneman 2011). Scholars do not always agree on how to bridge this knowledge gap between expert and public risk perception (Pidgeon 2012). Some argue for more education on technical aspects of risks, e.g. through the use of statistics; others propose a dialogue which addresses outrage felt by people if confronted with a crisis that is uncontrollable and, often, incomprehensible for them (Weisæth et al. 2002).

Practitioners view

The thesis of public risk assessment being based on recent experiences with crisis events is supported by interview respondents (Interviews 1, 8).

One respondent stated that in their country, risk assessment by the public is often influenced by politicians influencing public opinion. This can, according to the interviewee, have significant influence on how crisis management is conducted (Interview 4). The same interviewee then stated that frequent exercises involving the public can help build confidence and thereby alleviate overblown perceptions of risk probabilities. Other respondents said that raising awareness on crisis events how they are handled can help increase a feeling of security in the general public (Interviews 7, 8).

Role of the government

Public expectations about the role of government also matter. These **expectations,** again, can vary widely (even within countries). For instance, American citizens tend to expect less from their government than Europeans do (Dalton 2007). These expectations may then differ yet again when it comes to the role of government in times of crisis. The FP7 ANVIL research project found that specific crisis expectations varied in the 22 countries studied (Boin et al. 2014c). Within the United States, the citizens of the fifty states also harbour different expectations (Dalton 2007). We can generally state that the more citizens expect from their government, the more willing they will likely be to support spending on crisis and disaster preparation.

These differences in expectation come into sharp focus in debates about **societal resilience** (Comfort et al. 2010). People who advocate resilience as a strategy at least recognise the limited role of government in times of a disaster. Their expectations of government assistance tend to be lower than those who advocate a strong role for government. Preferences for resilience as a strategy have been associated with cultural characteristics (Douglas, Wildavsky 1982; Lodge 2009). In cultures that emphasise individual responsibility, resilience attracts more praise than in societies that emphasise collective responsibility. These perspectives on the role of government, we may expect, translate into preferences and expectations with regard to crisis preparation. This, in turn, is likely to correlate with a willingness to spend scarce resources on crisis preparedness.

A related factor is the societal preference for centralised crisis **governance**. In some societies, a strong preference for centralised crisis leadership may exist whereas other societies may prefer local crisis leadership. These differences are being exacerbated by the introduction of crowd sourced or participatory methods. Transboundary crisis management preparation may not fit either conception of preferred crisis leadership. If that happens, societal willingness to invest will be more limited.

Another closely related factor is the level of **societal trust** in key crisis management actors (Boin et al. 2008). These actors can differ, of course. But political leaders who must play a part in the crisis response typically enter a crisis with a higher or lower level of trust depending on their popularity and performance, which are not necessarily crisis-related. A failure factor is found in the dismal crisis performance of sitting leaders as perceived by a substantial part of the population. If trust is low, that may well translate in a limited willingness to invest in transboundary cooperation.

> **Practitioners view**
>
> Building trust was mentioned as a key factor in overcoming societal concerns in crisis management about the introduction of the IN-PREP system (Interviews 4, 5). Three respondents said that a good communication strategy was needed to inform the public about measures being taken (Interviews 1, 4, 5).

Public support

The collective will to invest in transboundary crisis preparation (that is after all the goal of IN-PREP) is also likely to be influenced by the collective attitude towards **international crisis cooperation**. The EuroBarometer shows that European citizens generally support international crisis cooperation. In fact, they expect it (European Commission 2017a). But when it comes to national support for actual initiatives, we again see variation ((Boin et al. 2014c). For instance, northern EU member states appear less willing to invest in shared crisis resources (such as fire fighting planes and flood pumps) than southern member states. A clear failure factor for designing transboundary crisis preparation is the level of federalisation it entails: if there is even a hint of centralisation, some member states are likely to resist.

However, Harteveld et al. (2013) contradicts the notion above (Boin et al. 2014c). Citizens' trust in the European Union is heavily dependent on their trust in the government of their country of origin. According to Harteveld et al. citizens that trust their country of origin to a lesser extent are less trusting towards the European Union and subsequently transboundary cooperation (Harteveld et al. 2013).

The debate does not solely centre around the question of EU involvement. It becomes more complex as other types of international collaboration are included. Some European countries, for instance, may see a strong role for NATO

or the United Nations; other countries may be more inclined to invest in bilateral or regional arrangements. A failure factor is the mismatch between the international anchoring of new types of collaboration: when participating actors do not recognise or appreciate the international context in which the collaboration is situated they are unlikely to invest with enthusiasm.

Another failure factor may lie in the inclusion of institutions that are not viewed as acceptable crisis actors. For instance, in many Western countries the involvement of military assets in crisis management can provoke strong reactions (Hamrin 2012). Not so long ago, the role of the military in a crisis response operation was taken for granted. But most Western countries experienced a shift towards civilian crisis governance (a shift that started in the 1970s). The role of the military is now less obvious (Boin et al. 2014b).

Practitioners view

Public support for crisis management is also dependent on budgetary issues. One respondent stated that the introduction of new technology such as the IN-PREP MRPP can be hard to justify to the public if budgets are cut elsewhere (Interview 1). Improving an organisation's performance and improving the perception of crisis management operations can also be an asset in enhancing the legitimacy of spending money (Interview 1, 2, 8)

Other respondents also highlighted the fact that the public is largely unaware of preparedness activities in general and would thus be largely uninterested in the project's outcomes (Interviews 2, 3, 6). However, one respondent highlighted the need to take public opinion into account, especially when it comes to political sentiments (Interview 5). One respondent added that successful trainings and insights gained through simulations can enhance confidence in crisis management (Interview 4).

Attitudes towards technology

Finally, the societal attitude towards (new) technologies may be a **dealmaker** for technological projects such as IN-PREP. There is the level of trust in the role that technology may play in organising a crisis response. One can imagine the society where technology is widely viewed as a solution to all sorts of problems. First responders enthusiastically embrace all sorts of new "toys" that are developed and procured with heavy governmental support. One can also imagine a society in which distrust towards the functionalities of technology reigns. In these latter societies, technology may even be viewed as a source of incidents and disruptions.

In conclusion, we can identify various factors that inform the societal perception of crisis events, crisis actors, crisis responses and, by implication, crisis preparation. We know that these perceptions – whatever they may be – feed into the political discourse that governs the resource allocations in the crisis arena (Boin et al. 2009). This directly influences the prospect of crisis management organisations adopting systems or even collaborating with those who develop them.

Practitioners view

One interviewee explicitly stated a perceived public mistrust in the use of technologies in crisis management activities, while acknowledging that the new technology has led to increased demands regarding information (Interview 5). Other respondents claimed that modern technologies have led to increased public expectations in crisis management organisations (Interviews 1, 2, 3, 4, 5, 8, 9).

Many of these responses directly relate to crisis communication, as the public is seen as being much more demanding regarding the provision of up-to-date information. Interview respondents feel like the public expects them to use modern technology to provide information faster and via (for some organisations relatively new) channels such as social media (Interviews 2, 5, 8, 9).

Two respondents mentioned the perceived wish of the public for them to use information provided via social media to use in crisis management operations, pointing out the operational and legal difficulties in doing so (Interviews 3, 4).

4.2.2. Recommendations

Transparency

Experiences drawn from IN-PREP should give crisis management organisations arguments for two important discussions. First, they need to clearly **communicate** what the technical measures actually allow them to do and what not. The IN-PREP MRPP should support them in this endeavour. Secondly, the reason for measures taken, whether based on technological grounds (such as simulations) or experience from field exercises, should be clearly communicated to the public, whenever the situation allows it. Societal perceptions play a role here in determining the success of new crisis management technologies. This is confirmed by interview respondents (Interviews 3, 4, 5, 8). It was also highlighted that communication efforts should not stimulate fear among the public (Interview 8), instead they should be used to foster a climate of feeling safe (Interviews 1, 4, 7)

One of the ways to address and possibly counteract a lack of support for the investments in the project would be **Participatory Budgeting** or PB. This is a procedure to include societal actors in the budgetary decisions. Starting at the local level, PB has led to an increase of perceived legitimacy of (local) governments (Swaner 2017). By including end-users in the project consortium, the project incorporates practitioners' input and feedback, increasing the acceptability of the final IN-PREP MRPP. This will increase the support of the budget by these and corresponding organisations (Sintomer et al. 2008).

The **potential benefits** of IN-PREP for the public should be made clear. An IT system can help provide the public with critical information during a crisis on the availability and use of response resources; it may also nurture trust in the ability of different actors to coordinate their efforts in a complex response network. Such information enhances transparency and allows members of the public to assess the situation themselves. This can also help create realistic expectations towards crisis management efforts (Rogstadius et al. 2013). This point was also mentioned by interviewees (Interviews 1, 2, 8).

Accountability, already mentioned in chapter 3.2, is also crucial in shaping public acceptance. If public expectations are not met it should be clear "what went wrong and where". Facilitating cooperation cannot be allowed to lead to a diffusion of responsibility. The IN-PREP MRPP should therefore be as transparent as possible, while keeping privacy and security concerns in mind, as to who does what (roles, coordination and supporting activities).

Flexibility

In "selling" IN-PREP to end-users, we need to take into account **public perceptions**. We believe the IN-PREP project

should fit various value constellations. But this will require a form of deliberation between potential end-users and societal stakeholders. That discussion will deliver an empirical basis for decision makers to help tailor IN-PREP to the particular context in which it must function. The importance of public perception was also mentioned during the interviews (Interviews 1, 2, 3).

Documentation

Public **expectations** will vary depending on the crisis context. Ideally, public expectations are already considered during the preparation of contingency plans. And, ideally, the public is already involved in preparedness activities. IN-PREP can support this crucial task for example by providing crisis communication units with helpful data. This was explicitly mentioned by several respondents during the interviews (Interviews 4, 5, 7, 8).

4.3. Crisis communication

4.3.1. Description

Crisis management can only be successful if it can build on a strong **bond** between crisis management actors and the public (Suchman 1995; Rhinard 2012). In addition to the factors mentioned above, we should stress an important strategic dimension of this discussion. Crisis managers can work to affect (strengthen) this relation. Crisis management does so through the two-way street of communication: listening to understand the demands and expectations of the public; communicating to influence societal expectations.

Media

Proactive communication requires both traditional media and social media as allies in times of crisis (Stern 2017). This includes building a rapport with representatives and creating a presence on social media. Both can then be used to disseminate information as needed ('t Hart, Sundelius 2013). Dissemination may lead to a greater level of trust towards the government. However, a clear presence on social and traditional media entails risks as well. Greater levels of transparency might entail greater public sector accountability. This is especially the case if information regarding public sector processes and outcomes is publicly disclosed (Porumbescu 2016). Furthermore, the presence of public institutions on social media may lead to a high level of public attention, which is not always preferred by crisis managers (Lin et al. 2016). Moreover, as the public starts to engage more in social media, crowdsources, and participatory communication practices, new forms of risk literacy are emerging that need to be engaged with (Liu, Palen 2010). Therefore, it is important to carefully consider the communication strategy.

Practitioners view

A good communication strategy was mentioned by several interviewees (Interviews 1, 4, 5). Especially the use of social media seems to be an issue many crisis management organisations are currently debating (Interviews 2, 3, 4, 7, 8, 9). One respondent suggested including a (social media) communication module in the platform to train end-users on how to effectively communicate with the public (Interview 2).

Involving the public

Self-organised public participation in rescue operations and the provision of citizen-generated data (e.g. through geo-tagged photographs and social media posts) are likely to increase due to **new communication channels** offered by modern technology. New communication channels, such as social media, also offer new possibilities to warn and inform the public (Stolk et al. 2012). Preparation for crises should account for these new phenomena, which should be reflected in a training environment. Concerning cross-border events this would require a common approach of all entities involved, e.g. through a common communication strategy, joint communiques, standards on the use of citizen-generated data, etc. The ACRIMAS project (FP7) has identified existing tools to enhance crisis communication and the EMERGENT project (FP7) and PREP1 (Elrha's Humanitarian Innovation Fund programme) have examined in detail social media use in relation to emergency services and the Red Cross, which might offer feasible solutions for the IN-PREP system.

Practitioners view

Several respondents suggesting suggested a functionality that would allow them to circulate information to the public or to use the IN-PREP MRPP to raise the general public's awareness of measures being taken (Interviews 1, 3, 4, 6, 7, 8).

Communication barriers

In reaching the public, crisis communicators should take into account possible failure factors. For instance, culture – understood here as a set of values, norms and history shared by a group and acting as an identifying trait – is largely based on **language**. Different usages of language, even within one single country, let alone use of different languages, can pose a significant barrier (Fischer et al. 2011).

Communication barriers can also arise in the interplay of different agencies involved in complex crises (Bähr 2017), which is highly relevant to IN-PREP and its focus on transboundary crisis management.

Moreover, it is important to tailor communication according to the specific crisis: don't spread perpetuate common rumours during a natural disaster; in the case of terrorism it is important to keep in mind that terrorism only functions due to perception of the act itself. It is also important to keep focused on the risks at hand and not perpetuate risks in the form of well-established disaster myths that are still commonly part of the media and regulatory rhetoric (Tierney et al. 2016). In general, no single message and way of communicating can be appropriate in all contexts, so communication needs to cater to specific cases (Bähr 2017).

Practitioners view

One interviewee mentioned the wish for IN-PREP to allow for the verification of information and the ability to create an authoritative narrative of a crisis event (Interview 5).

4.3.2. Recommendations

Knowledge Management

To effectively use the media to inform the public in times of crisis it is vital to have verified and accurate **information** as quickly as possible. The information management components of IN-PREP should thus have the functionality for press officers or others engaged in communication tasks to have access to important information in a simple and comprehensible way (Interviews 1, 3, 4, 5, 6, 7, 8).

Transparency

Engagement with the public is also important to gain legitimacy and accumulate political capital to influence the political discourse in favour of one's organisation. Since the political pressures described above derive from the perception of crisis by relevant audiences, e.g. the general public, **building trust** with the public and promoting the organisation's approach to crisis management is important (Boin et al. 2009). This was also confirmed by interview respondents (Interviews 1, 3, 4, 5, 6, 7, 8).

Crisis management organisations need to make full use of all **communication** channels these days. This requires a coherent communication strategy and knowledge about these new methods. One interview respondent suggested including a (social media) communication module in the platform to train end-users on how to effectively communicate with the public (Interview 2). This could also be extended to a knowledge sharing channel on communication strategies in general and best practices in crisis communication in general.

4.4. Data protection

4.4.1. Description

Data gathering

Systematic gathering of **personal and sensitive data**, such as movement data, can raise privacy concerns and has ethical and legal ramifications (Kuner, Marelli 2017; Hamrin 2012). As organisational, social, and human factors become user requirements, they shape the type of data processing considered necessary for effective disaster IT tools in ways that can have ethical, legal, and societal implications. While these will be discussed in greater detail in D2.2/D2.3, specific focus should be given here to the potential impacts of the design and use of data with respect to data protection. These aspects are considered of high importance for IN-PREP in general, and specifically for the design and development of the technological tools of the project, which will interact with and impact on end users and wider stakeholder communities. They are also necessary components in order to ensure society accepts and trusts IN-PREP.

The recommendations above suggest data could potentially be drawn from a range of sources about the public and end-users to help achieve them:
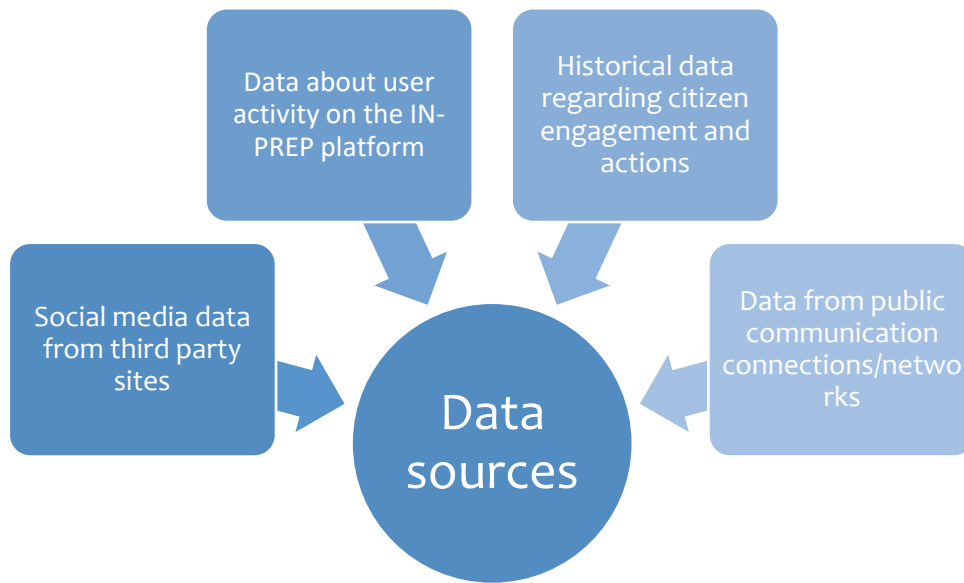
Figure 8: Sources of data about the public

A number of these implicate specific aspects of IT design as well as elements of relevant European legal frameworks. The latter include, but are not limited to:

Figure 9: Potential triggers of data protection law

These potentially trigger elements of data protection law, because they often rely on processing (collecting, analysing, storing) or aggregating personal or sensitive data. While most of the data used is not personal or sensitive data because It is either already anonymised historical records or general demographic data already engaged with by emergency responders for their work in relating to public and vital interests, there are still issues around data processing that are relevant, particularly when considering the aggregation of or restrictions around sensitive data gathering and the storage of data for sharing or future use. This also becomes an issue as the IN-PREP MMRP moves from training to response, from sample data to live data.

	Practitioners view
	The gathering of data can be problematic depending on national legislation, as some emergency services are not allowed to gather certain types of data or receive it from other organisations (Interview

1, 3, 9). Storage of data needs is governed by various rules and regulations, as most respondents confirmed (Interviews 1, 2, 3, 4, 5, 6, 9).

Data processing

For example, **demographic analytics**, in particular to perform analysis regarding local public reactions and preparedness feedback, could involve collecting special categories of data or processing data about social media responses and interactions. This data needs to be collected and processed in accordance with the requirements of the GDPR. It should not encroach upon end-users' or citizens basic rights, interests and legitimate expectations, and it should not be used in ways that unintentionally discriminate.

The *General Data Protection Regulation (EU) 2016/670* (GDPR)[7], as well as general rules governing citizen and disaster responder rights[8], encourage personal protection and societal security through **data protection**. Anonymity, for instance, offers individuals safety to a person who could otherwise be threatened if identified. Providing data protection is one step towards a secure public civil society, providing potentially vulnerability individuals the safety and social authority they need to participate in public life and take personal responsibility (Hansen, Nissenbaum 2009).

However, anonymity becomes limited when dealing with data aggregation, particularly when combining general demographic data with other data (e.g. photographs of communities) in a way that the data aggregation makes for pseudonymity, or allows for someone to identify a specific group of people. While not revealing the identify of an individual, it is possible to make a group of migrants traceable by, for example, revealing the number of individuals in a stream of people fleeing a situation and combining that with aerial imagery of the scene. These two pieces of information, while in isolation not revealing any personal data, could create sensitive data if that information is enough for the fleeing group of people to be located and they are people at high risk of being targeted with violence (Kuner, Marelli 2017). Machine learning that define rules based on past examples can also aggravate these types of situations of the nuances of how the data working together can create sensitive information are not considered in depth.

Furthermore, acknowledging the technical challenges of data protection, however, these laws also leave some room for exception to these rules. The GDPR states that it is lawful to process personal data – without consent – if it is necessary 'to protect the vital interests of the data subject or of another natural person' or 'for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller' (EU GDPR 2016/679: Article 6 (d and e)). Similarly, it is possible to process personal data without consent for 'humanitarian purposes, including for monitoring epidemics and their spread or in situations of humanitarian emergencies, in

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[7] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC, OJ L 119, 4.5.2016, p. 1–88.
8 For example, Opinion 01/2015 on Privacy and Data Protection Issues relating to the Utilisation of Drones, The Sendai Framework for Disaster Risk Reduction 2015-2030

particular in situations of natural and man-made disasters' (EU GDPR 2016/679: Recital 46). In other words, sharing health data of traveling individuals could be considered in the vital interest of the public during a pandemic and thus legal without asking the data subjects.

Taking **anonymity** as a specific case, the law states that anonymity is considered acceptable, even if not complete, if a reasonable attempt at providing it was granted, taking into account 'all objective factors, such as the costs of and the amount of time required for identification, taking into consideration the available technology at the time of the processing and technological developments' (EU Regulation 2016/679: Recital 26). What counts as these objective factors dependents on the situation: the amount of money and time needed to create and use algorithms to run a specific data set using a specific technology. It can be more legally acceptable and permissible to have technology that can temporarily allow exceptional data processing to make decisions about the situation than simply examining the regulatory 'status' of the data used (Jasmontaite 2016). The transgressions are both excusable and necessary for social cohesion and resilience, and it is important to acknowledge technically anonymity can both provide or limit security depending on context (Petersen et al. 2017).

When these exceptions are made, when a decision about the vitality of a situation is taken, can shape social power relations, public trust, and the legitimacy of the claim for extraordinary measures (Sandin, Wester 2009). Consequently, they require an extra layer of accountability and transparency. The GDPR encourages this by making these legal requirements in Article 5(2) that require demonstration of compliance to these principles. Whatever the reason, though, any processing of the data gathered (including storage for future analysis) needs to fit the purpose of initial gathering. If the data was gathered under the pretext of vital interest, the processing for later research might not be a legal use without full anonymisation.

Practitioners view

Interviewees highlighted the difficulties in sharing data between different organisations, mentioning not just data protection regulations but also security clearances (Interviews 1, 2, 3, 4, 5, 9). These difficulties can be more pronounced depending on the country in questions or the emergency service, with the police obviously having tougher restrictions on sharing information.

End-users as Data Subjects

This accountability extends not just to the public, but also to the end-users of the system, as traces of their activities and decision-making are visible in what is recorded. While much of this is acceptable through direct statements in practitioner contacts (e.g. their job requires them to share their personal data when in the field and thus have it logged and recorded), IN-PREP also needs to consider how this data could be used to create novel situations of liability and responsibility. For instance, it is possible to take what had been a team responsibility and pin it on an individual now that their actions are traced in the system at the individual level? While legal, there are ethical ramifications around liability, blame, and autonomy that need to be addressed. These will be discussed in greater detail in D2.2/D2.3.

4.4.2. Recommendations

Documentation

Records should be maintained of personal data and processing activities in order for actions to be **traceable** and publically **liable**. In addition, records should be maintained of the decision-making schemas and actions that lead to exceptional data processing actions. Individuals should be allowed to monitor processing and automated algorithms. Along with this adequate and appropriate organisational and technical measures need to be taken to ensure that IN-PREP and its use will be accountable and transparent. This includes making these processes accessible (e.g. user-friendly language and descriptions). This needs to be done in line with regulations on the use of personal data. Deliverables D2.2 and D.2.3 will discuss this aspect in further detail and should thus be studied carefully.

Usability

Along with this adequate and appropriate organisational and technical measures need to be taken to ensure that IN-PREP and its use will be accountable and transparent. This includes making these processes accessible (e.g. user-friendly language and descriptions).

Transparency

Privacy-by-design techniques should be applied where possible to minimise the risk to data subjects. This could include building into the system an informed consent process regarding the use of trainees' personal data, so that it can be freely and meaningfully given, with open information about risks. Users and data subjects should be explicitly and adequately informed about the extent of the use of their data for automated decisions and other purposes. The MRPP should also support accountable and transparent data aggregation so, as individually private data is aggregated, privacy can be maintained to the best of IN-PREP's ability.

This also suggests that the system should not run the risk of aggregating data in a way that potentially leads to loss of anonymity, privacy, or dignity or puts vulnerable individuals or communities at greater risk. Adherence to the GDPR is a pre-requisite.

Flexibility

Lastly, because the determination of exact **data protection needs** is situational, the training and validating scenarios and exceptional activities need to be matched in advance such that the use of data can be clearly deemed necessary for operations. One-size-fits-all solutions will struggle to find legal bases given that regulations differ from country to country.

5. Human factors

5.1. Overview

Due to society's increasing reliance on computers, children and adults alike are now being required to interact with computers in all settings, including educational ones. Likewise, schools, universities, and even job training settings are now finding that computer programmes are effective in reducing educational and training costs (Rifkin 1994). The ways and means by which humans deal with technology are important to consider not only with respect to the fact that more so now than ever before our lives revolve around technologies but also in view of rapidly changing technologies and technological environments.

Technology, as both a product and a process, can be defined as "the entire system of people and organisations, knowledge, processes and devices that go into creating and operating technological artefacts, as well as the artefacts themselves" (Karwowski 2005). Whilst it is worth noting that **ergonomics** as a discipline has in the past been driven by technology (representing a reactive design approach), it has increasingly begun to drive technology (representing a proactive design approach) (Karwowski 2005).

For the purpose of this chapter, the understanding of human factors focuses primarily on **cognitive processes** and the way such processes can be **implemented** and taken into account when designing a large technical system like the MRPP that will be developed in the context of the IN-PREP project.

The impact of human factors (in individual or team work) in complex technical environment is quite well understood in areas like e.g. medicine (Sarcevic et al. 2012) and (military) control rooms. However, research is **lacking** on human factors in civil protection Command & Control rooms. When it comes to Critical Infrastructure (CI), human factors rank third, after mechanical failure and external events, as a cause of disruptions (Clini et al. 2010). Relevant human factors for the design of a complex technical system vary from the design of the Human-Computer Interface, to human factors in decision making, to cognitive processes such as processing of information.

Many of these factors have been analysed in the development of different mixed-reality systems in other areas such as medicine, automation of work or innovations in mobility and transport (Rauterberg 1995).

Before describing pertinent factors of cognitive processes (sub chapter **Error! Reference source not found.**) and the user interface design (sub chapter **Error! Reference source not found.**), the main related scientific fields are introduced:

Human factors and ergonomics

Human factor issues focus on **improving** peoples' productivity, safety and comfort while at the same time optimising the process in which humans and technologies work together effectively (Meshkati 1991). Ergonomics represents a system development discipline that is **design-oriented** (Karwowski 2005). While Ergonomics aims at the optimisation of working environments and the reduction of mistakes human factors focus on the psychological factors (Barth 2017). Within the development of a system such as the IN-PREP MRPP, there are two main stages to consider with respect to human factors: the **design process** and the **operating phase**. In the design phase questions of the design of the control room, the control panels, training, the layout of the working stations, workload estimation or the clarification of hierarchies and procedures are raised (Barth 2017). In the operating phase, on the other hand, the focus is on the performance of the operators, causes for errors and mistakes as well as misjudgements (Meshkati 1991). The understanding of human factors in this chapter thus focuses mainly on cognitive processes.

Some research also emphasises the importance of a third phase of **continuous system adaptation** that occurs after the system has been redesigned. It involves six actions of participation necessary in the design of the system:

Interaction, which involves the on-going interaction with the organisation that develops the system; *Design and Redesign*, in which the aim is defined and modelled; *Adaptation*, which contains continuous improvement; *To Learn*, which entails constant activities to promote learning, and *To Make Sense*, where it is necessary to understand the changes and the impacts (Carayon 2006).

Human Computer Interaction (HCI) and Human Factors Engineering (HFE)

Human-computer interaction (HCI) study focuses on the intersection between psychology and the social sciences, on the one hand, and computer science and technology, on the other (Carroll 1997). Throughout the past decades, HCI has progressively integrated its scientific concerns with the engineering goal of **improving the usability** of computer systems and applications, which has resulted in a body of technical knowledge and methodology (Carroll 1997). HCI is a science of design. It seeks to understand and support human beings interacting with and through technology. Much of the structure of this interaction derives from the technology, and many of the interventions must be made through the design of technology. HCI is not merely applied psychology. It has guided and developed the basic science as much as it has taken direction from it. It illustrates possibilities of psychology as a design science.

Human Factors Engineering (HFE), in contrast, focuses on systems in which humans interact with their environment. The environment is complex and consists of the physical environment ('things'), the organisational environment (how activities are organised and controlled), and the social environment (other people, culture) (Moray 2000, Wilson 2000, Carayon 2006; Dul et al. 2012). One major impact of the trends described above are the increased **interdependencies** between economies, industries and companies. ICT developments have brought about many changes in work organisation and organisational design. These include for instance greater focus on teamwork, the rise of virtual organisations, remote work including working from home, fading borders between occupational and private life, and increased complexity of networks of organisations (Carayon and Smith 2000; Dul et al. 2012). HFE specialists can contribute to the design of systems to allow people to work together and share information across organisational boundaries (Woods and Dekker 2000). For example, HFE can influence the design of virtual sociotechnical systems by showing how trust and collaboration can be enhanced when team members work remotely and communicate via technology (Patel et al. 2012). HFE can also contribute to the design of natural user interfaces in human-computer interactions (Dul et al. 2012). HFE design reviews existing and planned process control systems and Human System Interfaces (HSI) (Geary, Mastromonico 2005).

5.2. Cognitive processes

5.2.1. Description

Human-computer interaction research has produced consistent results bearing on a well-established body of knowledge in cognitive science (Hoc 2000). Dynamic situations with high temporal constraints create occasions in which small teams (including humans and machines) can cooperate on an almost cognitive basis, reducing social or emotional effects (Hoc 2000).

Recognising that over 70% of accidents are associated with **human performance failures** in operational control environments, British Energy has developed a programme to address the training and development needs of control room staff (Davies 2001). A key enabler within this programme has been the introduction of a Crew Resource Management training package entitled 'Human Performance Foundation's experience'. It has shown that this training is an effective catalyst for significant improvement in operational systems, culture and human performance. Reportable events associated with human performance in the control and supervision of operations have been

reduced in both number and severity. Practical improvements in the environment and tasks associated with control room operations have also been initiated as a consequence of the training (Davies 2001).

5.2.2. Processing of information

As a mental task routinely undertaken by human beings, the processing of information represents an activity that – due to the increasing volume of available information – increasingly requires the distribution and allocation of **attention capabilities**. Especially during times of stress information processing can be difficult as stress can impair memory and can have an inhibitory effect on brain function (Conrad 2011). One common human reaction to **stress** is to focus on operative tasks and to neglect the analytical tasks which are required to find proper solutions to a situation. This concerns all levels of management and includes persons in leadership positions. Stress also leads to a reduction of mental flexibility, and can lead to rigidity of perception and cognition, effectively making an individual less able to adapt to a specific or evolving situation (Weisæth et al. 2002).

Inconsistencies among information systems (or within them) are a major factor in reducing their overall efficiency. Too many different interfaces, user requirements, terminologies, access authorisations etc. can be reasons for users not to use systems properly or at all, especially when decisions need to be made in stressful environments. Similarly, if too many systems or databases exist separately, this reduces the likelihood of them being used in decision making (Mays et al. 2011).

However, in this context it is also worth noting that research has found that first responders' cognitive absorption **increases** highly in challenging times which allows them to deal with an overload of information in these complex situations (Carver, Turoff 2007).

The quality of working life and the system (enterprise) performance is affected by matching of the positive and negative outcomes of the complex compatibility relationships between the human operator, technology and environment. **Positive outcomes** include work productivity, performance times, product quality and subjective psychological (desirable) behavioural outcomes, such as job satisfaction, employee morale, human well-being, commitment, etc. (Karwowski 2005). The **negative outcomes** include both human and system-related errors, loss of productivity, low quality, accidents, injuries, physiological stress and subjective psychological (undesirable) behavioural outcomes such as job dissatisfaction, job/occupational stress, discomfort, etc. (Karwowski 2005).

Practitioners view

Some of the practitioners note the challenge of attaining relevant information, i.e. receiving concrete and accurate information in real time in crisis situations. Others, in contrast, point to the sheer quantity of data that is made available and that has to be filtered and analysed regarding relevance in order to derive at decisions and plans of action (for instance Interviews 5, 9) All of them agree on the importance of information and the correlation and interdependence between data and time in the context of efficient crisis management. Considering the speed with which data is transferred and the quantity of data that can be transmitted technologically, it remains important to bear in mind that incoming and outgoing data has to be sorted, filtered, analysed, and passed on in order to lead to decisions and actions.

Moreover, the practitioners report that a variety of communication systems and network are currently in use (Interview 1).

At times information is also derived from social media messages posted by the public (Interview 2).

5.2.3. Perception

Perception refers to the reception of signals via the human sensory system, and the processes by which human beings **make sense** of the sensory signals that they perceive. Constituting sensory input to the brain, perception thus describes the ways in which "we access the external world" (Raftopoulos 2009). Cognition, on the other hand, can be seen to refer to "all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" (Linton 2017). Taking place outside of conscious awareness, the processing of sensory input – although being based on a complexity of nervous system functions – appears to occur with ease (Goldstein 2010). The reception of sensory input takes inter alia place via the senses of sight, hearing, smell, taste, and touch, as these senses perceive information for discernment.

Research has traditionally especially focused on **visual perception**. This is because visuals can be seen to document and communicate the world with an immediacy that only visuals can provide, containing a visceral, tactile quality (Benjamin 1970). Explaining this is the fact that human beings are better equipped for processing visual information rather than information that is perceived through other senses. We are a visual species as our sense of vision exceeds the senses of hearing, smell, taste and touch to the extent that "we pull in and send out far more information through our eyes than all our other senses combined" due to human physiology in which out of all the sense receptors it is the eyes that are by far the most powerful information conduit to the brain, allowing us to "register a full-colour image, the equivalent of a megabyte of data, in a fraction of a second" as the nerve cells devoted to visual processing account for about thirty percent of the cortex of the brain in contrast to a mere eight percent of nerve cells devoted to touch and three percent to hearing (Lindstrom 2002). Hence, human access to and understanding of the world appears characterised by a distinctively visual aspect and the domination of the human psyche by the visual demands the recognition of humans as visually oriented beings. Indeed, it appears irrefutable that "depiction, picturing and seeing are ubiquitous features of the process by which most human beings come to know the world as it really *is* for them (Fye, Law 1988b, 1988a, 1988a). The significance of visuals as a mode of communication can therefore not be underestimated.

In the context of an increasingly **complex information environment** that is part of what Lars Qvortrup calls a "hypercomplex society" (Qvortrup 2003, 2003) – characterised by increasing social complexity of which communication mechanisms constitute a significant feature – the speed and reach of the dissemination of different types and modes of communication (such as visuals) bears on cognition and perception capabilities. Especially in the form of electronic data transfer, the quantity of information that can be transmitted in complex technological environments represents a scope that can pose impediments on processes of human perception. The biological basis of the processes of perception and cognition, and human capabilities in dealing with sensory information in terms of identifying, categorising, and interpreting data – and limits thereof – ought therefore to be kept in mind.

5.2.4. Memory

In the context of cognitive processes, akin to perception memory likewise constitutes a mental process. Similarly to perception occurring internally, the processes of memory are biological and biochemical in nature. Whether considering short term memory, i.e. short term storage of information, or long term memory, i.e. information that is stored and maintained for a longer period of time, the cognitive processes of memory allow human beings to **recall previously acquired information** and experiences.

Memory as a process that enables the "storage and reproduction of learned information" is commonly considered to constitute a "prerequisite of learning" (Deyn et al. 2003). Intrinsically linked to learning, processes of memory involve for instance the storing of perceived information, the acquisition of skills as well as the recall of previously acquired information and the recollection of previous experiences. As such memorial functioning can be seen to not only be essential to the encoding, storage and retrieval of information, but also as intrinsic to human cognition in all its forms (Richardson et al. 1996).

Thus, such processes as thinking, reasoning or problem solving are in large part **dependent** on the human abilities of memory and remembering. Accordingly, memory can be considered to be critical in all our functioning (Weisberg, Reeves 2013).

Since memory as a mental process denotes the continuous addition of new knowledge to the archive of existing data from which an individual can draw, its correlation to the accumulation of experiences becomes evident. As additional data that is stored in memory is acquired through experiences, and as experiences build knowledge, it is from **experiences** that skills are attained and enhanced. Such experiences and the knowledge and sets of skills that are developed from them in turn influence individuals' particular work styles, which are developed over time and informed by a person's background, habits, attitudes and competencies (Ferdman, Deane 2013).

Individuals thus differ in the ways in which they think, concentrate, solve problems and perform their work assignments. Awareness of this remains important considering the fact that we are often asked to work in and act as teams, and to collaborate with one another in work settings where interdependencies between colleagues and their allocated tasks and activities exist.

	Practitioners view
	With respect to information management in dynamic working environments the matter of handling large quantities of data is raised.

It is in this context that features that allow for prior insertion of sets of data and the inclusion of checklists are seen as useful (Interview 3, 7)

Pre-entered data and control lists that can readily be consulted can aid memory and recall, as well as concentration and work performance. As such they can help to relieve work load pressures.

Logging features in which data and decisions can be archived enable the tracking of information and thus are likewise considered to constitute useful system features (Interview 5, 6).

Practitioners moreover referred to information processing and management as a skill that can be trained and advanced (Interview 5).

5.2.5. Team cognition

Team cognition is a **cognitive ability** that occurs at team level (Berggren et al. 2016). Two main perspectives on team cognition exist: the shared vision perspective and the interactive team cognition perspective (Cooke et al. 2013). In order to communicate and cooperate in an effective way, a team needs to have a shared understanding of shared aims (Rosen et al. 2008). Team training to improve a shared understanding and the same understanding of the aim increases the potential of the team to cope with events (Berggren et al. 2016). Likewise, it is central to have debriefing sessions after these trainings given by the instructors (Berggren et al. 2016).

Practitioners view

From a practical point of view, a lack of collaboration represents particular challenges to successful crisis management. An absence of exchange and interaction can pose serious challenges to communication flows amongst different agencies and in collaborative team work. In order to facilitate collaboration, such as in terms of information exchange, the practitioners advocate getting to know one another prior to having to work together to manage crisis responses as crisis management involves a variety of actors, not all of whom know each other or are used to working together. Collaboration and exchange between different actors involved in crisis management also leads to greater awareness and knowledge of other actors' capabilities (Interview 1, 9 and 3).

This is particularly important in view of the different approaches to crisis management that different organisations operate under (Interview 4). It is likewise significant due to the distinctive sets of tasks to be accomplished and the different responsibilities of the various organisations involved in crisis management.

5.2.6. Decision making

The research on the making of decisions demonstrates that decision making at its core revolves around the **assessment of risk** and weighing up of probabilities. Essentially, decision making is "about how individuals, groups and self-regulating teams come to decide on patterns of action" (Furnham 2011).

The decision making process can be complex, especially when it becomes difficult for decision makers to filter information due to quantity and detail of data sets. The information that becomes available has to be used to make decisions, and thus decision making entails such processes as the identification of solutions, the ways in which solutions are chosen and evaluated, and the ways in which decisions and solutions are implemented (Furnham 2011).

How individuals make their **operational decisions** often hinges on experience and age. A study of the US Customs and Border Protection Agency revealed that, in general, younger officers with little to no operational experience tend to rely more on technology than their older, more experienced counterparts. Experienced officers, in contrast, relied more on human interaction and accumulated experience to make decisions. Lacking this, younger officers substituted experience with quantitative data and different forms of technology-based decision support systems (Mays et al. 2011).

Practitioners view

In practice, technologies are generally utilised to aid work processes, rather than employed to, or even expected to, assume decision making capabilities.

Whilst systems and their features can thus be seen to be used to enhance and support work processes, they cannot relieve system operators of the task and responsibility of decision making.

Regardless of technological advances, the process of deriving at decisions thus remains the prerogative of the human system operator (Interviews 2, 9).

5.3. User Interface Design

The advanced technologies with which humans work and interact nowadays represent systems characterised by complexity that necessitate high levels of integration in term of both design and management. As such, design integration is generally focused on the **interactions** between hardware (computer-based technology), organisations (specifically organisational structures), information systems, and people (with a view to human skills, training and expertise) (Karwowski 2005).

System design generally involves various stages such as planning, design, implementation, and evaluation, but also maintenance, redesign and continuous improvement. Importantly, the diverse stages are not necessarily sequential but rather **interdependent**, **recursive** and **dynamic**, and may affect or be affected by one another (Dul et al. 2012).

In parallel to the factor of performance – which encompasses e.g. productivity, effectiveness, quality, innovativeness, flexibility, system safety and security, reliability, and sustainability – another factor likewise ought to be considered. This is the factor of well-being which refers to such aspects as e.g. health and safety as well as pleasure and satisfaction, but also learning and personal development (Dul et al. 2012).

Notably, the aspects of performance and well-being interact: "performance can influence well-being, and well-being can influence performance, both in the short and the long-term (Dul et al. 2012). Therefore, both of these aspects have to be balanced in the context of system design (see also Pot, Koningsveld 2009).

	Practitioners view
	With respect to a system's features in the context of usability, practitioners note their preference for designs that enable instinctive use and quick familiarisation.

Noting the potential of technologies to be incredibly complex, the practitioners favour designs that are user-friendly in the sense of being characterised by both practicability and ease of use.

In the context of system design this means that ideally no or merely little training is necessary prior to use and that the system is self-explanatory and can be employed intuitively. Moreover, a request for clear and concise design is articulated: the more intuitive the solutions, the more likely it is to be used by practitioners (Interview 1, 9).

Preferably, the system should bear similarities in design and features to the system or systems that practitioners are already familiar with (Interview 6).

It is when there exists clarity about the use and benefit of a system that its chances of being used are increased (Interview 2).

With regard to designing user interfaces, it remains important to consider the ways in which technologies can best be employed to, above everything else, serve human needs. Bearing in mind the goal of improving the users' experience in their interaction with a system, one of the main challenges that presents itself can be seen to be constituted in the challenge of usability. "Too often, users must cope with frustration, fear, and failure when they encounter excessively complex menus, incomprehensible terminology, or chaotic navigation paths." (Shneiderman et al. 2018) Thus, in order to enable high quality user experiences – as represented in characteristics such as usability, universality and usefulness – the design of user interfaces ought to orientate itself around the alignment with user **needs and requirements**.

The needs and requirement of users are attained by collecting and analysing data on needs and requirements prior to system development. The design of user interfaces represents a process of convergence and development: it not only involves research and preparation, but also **testing** (both usability and acceptance), and continuous **evaluation** and **improvement** (Shneidermann et al. 2018). Challenges in interface design are posed by a variety of differences exhibited by users, such as e.g. cognitive and perceptual differences, as well as language and cultural ones.

In practice, universal design can be seen to refer to the process of making decisions for design that assure that the end product "can be used comfortably by people with a wide variety of characteristics" (Ferdmann 2013). When this is carried out and implemented successfully, then enhanced user experiences are enabled. As Shneidermann et al. put it: "When managers and designers have done their jobs well, their interfaces generate positive feelings of success, competence, and mastery among users." (Shneiderman et al. 2018).

Obstacles to the users' performance and well-being alike can be constituted in a lack of fit between human capabilities and the system environment in which they are asked to work and operate. For instance, human system operators may perform below their capabilities because other parts of the system that they are working in and with present an obstacle rather than a supporting environment, such as when there exists insufficient support, lack of time or inappropriate equipment (Dul et al. 2012).

In essence successful interface design can thus be seen to be concerned with mastery and control. This also means that interface design ought to aim for the delivery of tailored and practical solutions.

Practitioners view

Whilst users prefer systems that offer such characteristics as well organised menus and intelligible display design as well as logical arrangement of system features on display screens, the usefulness and performance of the system are considered to be more significant and valuable, i.e. of greater consequence.

Thus the aesthetics of the system are considered to be less important than the system's functionality (Interview 4).

5.4. Recommendations for the design of the MRPP

Usability

In terms of system-human compatibility, in order to achieve compatibility in the design of interactive systems in which human beings, the environment, and technological machines interrelate and interact with one another, acquired knowledge about relevant **human factors and characteristics** ought to systematically and consistently be used (Karwowski 2005).

One of the main focuses therefore ought to be the design of systems that allows for system management that satisfies user needs and demands in terms of **human compatibility requirements** (Karwowski 2005).

It is important to take into account the exceptionality of the **circumstances** for which a system like the MRPP in IN-PREP is designed. I.e. the system is developed to be better prepared in emergency situations of disasters and crisis, and in situations where time normally is scarce and stress is high. This entails that the persons and practitioners using this system have to be able to quickly **assess** necessary information – even if this information is sometimes incomplete – and to make **decisions** based on this information. The system should also enable different actors and

stakeholders to **share** information and to freely interact with one another. So the system has to be able to quickly give data to the users. Another important point is that the MRPP should be easily **usable** for the persons involved, in other words it should have a high usability. Moreover, the system as a whole should not only support collaboration and communication between users, but also allow for the creation of content that can be shared and distributed via the platform. Above all, the system ought to enable users to feel in **control** of its features, i.e. users should feel in control of the system at all times.

Information systems should be **consistent**. This means they should be using at least similar interfaces, functionalities and terminology. This reduces the stress of users to adapt to a variety of systems under stress, which reduces their ability to use the systems efficiently and can sometimes even lead to them not using the systems at all or work around them in order to maintain their operational procedures (Mays et al. 2011). Stress can also be reduced by focussing on operational tasks so the MRPP should enable users to do so.

As human beings are better equipped to process **visual information** than processing information through the other senses, this should be taken into account when providing information and data in the MRPP. The quantity of information that can be transmitted in complex technological environments can pose as an impediment on human perception. Of course, practitioners are used to this and better at it than other human beings, this ought to be kept in mind when designing the system.

To overcome the schism between **experience-based** and **technology-based** decision making and therefore making the platform useful to practitioners from both ends of this spectrum, the IN-PREP platform should allow for both kinds of information. Incorporating both technology-based and humans and their assessments, and clearly marking them, makes the system interesting and useful to both kinds of users.

The system should also not only be based on quantitative data because it is not always possible to fit decisions into this kind of number matrix.

When face-to-face interaction gives way to interactions via screen-to-screen in virtual environments, then the users' **mastery of technological systems** becomes paramount. Arguably, the acceptance and use of such technologies can be facilitated and improved through the conception of designs that permit human-computer-interactions and user experiences that are characterised by consistency and usability. As levels of experience and expertise vary among users, interface design and development has to be considerate of the diversity of users, their different backgrounds and work styles.

For interface design to be functional and fit for purpose, it ought to be specifically **customised**. In the context of this project this means that the prospective users of the system ought to be included in the design process, i.e. the development of the system ought to be characterised by participatory design processes.

Moreover, not only subsequently to the planning, design and implementation processes, but also concurrently to these processes, system design ought to include processes of continuous improvement, evaluation, redesign and maintenance.

Importantly, these processes ought to occur repeatedly and consistently, making use of on-going feedback loops to improve the system's performance and quality.

Evaluation

It is important to integrate a programme into the MRPP to address the **training and human performance** of the staff in general. This programme should be based on real-life-cases and reconstructions of crises. This programme should include individual tasks and exercises as well as group exercises. Overall the introduction of a scoring system is recommended so that the users can see if their behaviour and decisions in the trainings have been successful**.**

Cooperation

For the MRPP this means that it should also be designed in a way that trainings in teams and for the development of a mutual understanding and a team cognition can be executed. It is important that the MRPP can enhance **team cognition and teamwork**.

There is a strong interdependence and correlation of data and time – especially in crisis data has to be analysed, passed, sorted and filtered, so the MRPP should implement exercises for training these tasks.

With regard to team cognition it is important to implement exercises into the MRPP that train and improve the **shared understanding** of the users. Trainings have to be included that improve "soft" skills but also the capability to recognise and solve disturbances, this of course is strongly connected to communication, decision making and teamwork in general.

Incorporating both technology-based and humans and their assessments, and clearly marking them, can also contribute to a better understanding between colleagues and thus foster a common vision and shared experiences (see also Mays et al. 2011).

Knowledge Management

Since memorial functioning and attention spans not only vary among individuals but also have their limits, the incorporation of technologies that **assist the management of information** can enhance the ways in which working environment operate by supporting work processes. Whilst human beings are not well equipped in terms of memorising and accounting for more than a few data, technological systems have no difficulties in evaluating and calculating larger sets of data (Drenth 1998). Therefore, in order to preclude the loss of important information, such features as data logging or pre-entered checklists can be useful. Assisting the tracking of data and the recall of information, these system features can aid in information management and enable system operators to stay on top of information flows when a multitude of messages and data are received simultaneously.

6. Findings from other EU projects

The EU has in the past funded various projects aiming at enhancing crisis management capabilities within the EU (e.g. ACRIMAS, which was already referenced earlier). Many of these have defined practitioner's needs or **requirements,** which also allow the formulation of more general organisational, policy, social and human factors relevant for system development. In general, if users have requirements regarding the functionality of a tool, there is a specific reason behind it, which can often be traced back to the factors covered in this paper. In this chapter some aspects of the findings from other on-going projects will be described, to highlight interlinkages.

Project **HEIMDALL** (Multi-Hazard Cooperative Management Tool for Data Exchange, Response Planning and Scenario Building) is currently being developed alongside IN-PREP. Its aim is to enhance preparedness through improving response planning strategies and scenario building through an ICT system. As such, HEIMDALL is also dealing with user requirements and factors relevant for system development. In addressing those, it partly relies on findings of EU project PHAROS, funded under FP7 (Barth 2017).

While detailing the user requirements for the HEIMDALL system, a lot of them fall into the categories described in this deliverable as pertaining to **adaptability** and **usability**. Allowing individual users and organisations to **tailor** the platform to their specific requirements and preferences is mentioned in various aspects, e.g. by suggesting organisations can tweak the user interface with their own colour codes and symbols to allow seamless integration into their workflow. Other suggestions, also relevant to IN-PREP, include the possibility to **integrate** the system into existing frameworks, easy **up-scaling** (e.g. through new functions or new users), and the use of **standardised data formats** to allow quick and easy integration and sharing of data (Barth 2017). Regarding social acceptance, HEIMDALL also highlights the need for **transparency**. It should, they write, be possible to trace decision-making and recognise responsibility structures. They also point out the need to handle **information** carefully, since the system might expose weaknesses in existing crisis management systems, thus also exposing the authorities concerned and decrease their willingness to buy or implement it. HEIMDALL also highlights the need to uphold a high standard in **data security** in order not to alleviate support by the public and/or participating or interested organisations (Baur 2017).

Project **DARWIN**, while aiming at formulating European resilience management guidelines, has also stipulated user requirements which have some relevance for IN-PREP. While not an ICT system, the topic is closely related to IN-PREP. Furthermore, DARWIN is also developed with end-users in mind. Consequently, factors making the future use of the results more likely are also relevant to this project.

A key aspect highlighted is the need for the guidelines to be easily accessible and understandable, taking different target audiences into account. Issues of **terminology**, **standardisation**, different **role competencies** and **responsibilities** of actors involved, and different understanding of concepts are also mentioned, which should be addressed during system development. **Adaptability** of the product (e.g. the flexibility to react to unforeseen events, scalability of disaster events trained for, use of the guidelines in different organisations and contexts), **evaluation, neutrality,** and **compliance** are also highlighted as important aspects (Woltjer 2016). Indeed, similar to IN-PREP, the search for a common ground and the subsequent design of the product to serve that end can be seen as an overarching goal (Branlat 2017).

In summary, both HEIMDALL and DARWIN encounter similar issues like as IN-PREP. This concerns mainly questions of **standardisation** (e.g. of planning procedures, data formats, terminology), data **security,** and **adaptability** and **usability** of the final product. Liaising with the partners to discuss common solutions to these shared problems could

yield added benefit to all problems. Some of the guidelines developed by DARWIN could be taken into account for specific aspects of the IN-PREP platform, e.g. on communication.

The **DRIVER+** project also identified factors relevant to IN-PREP, highlighting for example the issue of **computer-literacy** among staff (stating that younger employees usually adapt better to novel IT solutions than older employees, and that senior officials usually do not have too much exposure with to such systems). Another aspect highlighted was the need for a commonly agreed upon and scientifically sound methodology to collect data from exercises which can be used for **evaluation** and **debriefing** (Bähr 2017).

7. Recommendations for system development

The previous chapters took a closer look at the organisational, policy, social and human factors, which are relevant to the development of the IN-PREP platform. During the analysis, some reoccurring themes could be identified, which we propose as **guiding principles for system development**. These guiding principles will be outlined in this chapter, accompanied by specific recommendations that support and specify the principles, and which should be adhered to especially. For ease of reference, we have listed Features (concrete functionalities the MRPP should have) and Guidelines (along which the system should be developed) separately.

The recommendations listed here under the eight guiding principles are based on the single recommendations as identified at the end of each sub-chapter in chapters 2-5. They were condensed and joined where appropriate. Please note that the order of both the guiding principles and the recommendations does not reflect their importance.

The identified guiding principles, further explained in the following, are:

- Usability
- Compliance
- Interoperability & Cooperation
- Transparency
- Flexibility & Adaptability
- Neutrality
- Evaluation & Documentation
- Knowledge Management.

7.1. Usability

Based on the input received from interview partners and the literature analysed, several aspects relating to "usability" were identified that should be considered during the development of the IN-PREP MRPP. This principle unifies recommendations that aim at ensuring a smooth integration of the system in work processes of organisations. Usability also features prominently in the user requirements identified by the project HEIMDALL (Barth 2017).

In general, the system needs to reflect the user requirements identified during the end-user workshops (see D2.5). This can involve functionalities but also concerns the interface, terminology, symbols used etc.

RECOMMENDATIONS ON USABILITY
FEATURES
Include information on contact persons from participating organisations, enabling quick and easy access to information on who serves as main contact.
Include information on roles and competencies of organisations to see who is who and who can do what (e.g. by including an asset register, see chapter 7.8).
Provide the ability to define and adjust which information is displayed by the system, to ensure internal processes can be maintained. While some organisations need operational data for their work, others might need data at

tactical or strategic level, depending on their responsibilities.

Develop an easy-to-use and intuitive interface, which is important to facilitate an organisation-wide introduction and regular use of the system. The system should be accessible even to non-tech savvy users (e.g. by use of comprehensible language and avoiding technicalities). If it is not perceived as easy-to-use, the system runs the risk of not being used. As one interviewee explicitly stated, the more intuitive the solution is, the more likely it is to be used.

GUIDELINES

The system should require minimal training.

End-users should be included as much as possible during development, e.g. through feedback loops during and after exercises and implementation.

For interface design to be functional and fit for purpose, it ought to be customisable. In the context of IN-PREP this means that the prospective users of the system ought to be included in the design process, i.e. the development of the system ought to be characterised by participatory design processes.

One of the main focuses ought to be the design of systems that allows for system management that satisfies user needs and demands in terms of human compatibility requirements (Karwowski 2005).

This entails that the persons and practitioners using the system have to be able to quickly assess necessary information – even if this information is sometimes incomplete – and to make decisions based on this information. Moreover, the system as a whole should not only support collaboration and communication between users, but also allow for the creation of content that can be shared and distributed via the platform. Above all, the system ought to enable users to feel in control of its features, i.e. users should feel in control of the system at all times.

As human beings are better equipped to process visual information than processing information through other senses, this should be taken into account when providing information and data in the MRPP.

In general, different information systems used in parallel should be consistent. This means they should be using at least similar interfaces, functionalities and terminology. This reduces the pressure on users to adapt to a variety of systems under stress, which reduces their ability to use the systems efficiently and can sometimes even lead to them not using the systems at all or work around them in order to maintain their operational procedures (Mays et al. 2011). Stress can also be reduced by focussing on operational tasks, so the MRPP should enable users to do so.

To overcome the schism between experience-based and technology-based decision making and therefore making the platform useful to practitioners from both ends of this spectrum, the IN-PREP platform should allow for both kinds of information.

As levels of experience and expertise vary among users, interface design and development has to be considerate of the diversity of users, their different backgrounds and work styles.

System design ought to include processes of continuous improvement, evaluation, redesign and maintenance. Importantly, these processes ought to occur repeatedly and consistently, not only subsequently to the planning,

The principle of Usability also includes aspects of **adaptability** (which has been identified as a cross-cutting issue between the different guiding principles), in the sense of customisation to specific organisational and user requirements. It also includes scalability and expandability (which partly fall under interoperability, see sub-chapter 7.3), allowing the integration of different tools, systems and data formats into the IN-PREP MRPP. The possibility to tailor the platform to specific user needs and requirements was also identified by project HEIMDALL and is reflected in many of their user requirements (Barth 2017).

7.2. Compliance

The guiding principle of Compliance aims at ensuring the IN-PREP MRPP is in line with member state and EU laws and regulations (see D2.3). Attention should be paid to laws and regulations being adhered to, which can also be ensured by regularly gathering feedback from exercises. Since laws and regulations can change, the system should also be easily adaptable. Complementarity to existing EU initiatives, such as the Civil Protection Mechanism, would be a strong selling point for the IN-PREP MRPP and enhance its viability. This can, for example, be achieved by linking member state assets with EU CPM modules, or by including the Emergency Response Coordination Centre.

RECOMMENDATIONS ON COMPLIANCE

FEATURES

Integrate or link EU initiatives and instruments in DRM and crisis management to the platform, to enhance its attractiveness.

GUIDELINES

The IN-PREP MRPP should comply with all relevant legislation on member state and EU level.

The system should be easily adaptable to changes in legislation.

7.3. Interoperability & Cooperation

In contrast to Compliance, which focusses more on legal issues, the principle of Interoperability & Cooperation aims at technical functionality, work processes, and cooperation among actors. Like any new system, the IN-PREP MRPP should be developed with interoperability in mind. This principle can make integration into existing processes and structures easier and also mitigate political and societal concerns, e.g. concerns over costs and budgetary restrictions. If the system cannot be easily integrated this can lead to rejection not only by the people supposed to use it, but also from decision makers and, potentially, the general public.

RECOMMENDATIONS ON INTEROPERABILITY

FEATURES

Enable the system to handle the various types of data formats used by different organisations.

GUIDELINES

The system should integrate seamlessly into existing IT frameworks.

Integration of the system should also create as little friction as possible with existing organisational procedures.

The IN-PREP MRPP should be complimentary to existing work processes rather than introducing new ones. Organisations should be able to adapt the system to their workflow, not vice versa.

The requirements for successful integration of the IN-PREP MRPP should be clearly stipulated and communicated so that organisations can prepare necessary changes in advance.

The MRPP should be designed in a way that trainings in teams and for the development of a mutual understanding and team cognition can be executed.

Incorporating both technology-based and experience-based assessments, and clearly marking them, can also contribute to a better understanding between colleagues and thus foster a common vision and shared experiences (see also Mays et al. 2011).

7.4. Transparency

This guiding principle includes a variety of different aspects. Their common denominator is the need for clear structures, straightforward communication and efforts to ensure visibility of the project and its outcome. Transparency is also an important aspect identified by HEIMDALL to enhance acceptability (Baur 2017).

RECOMMENDATIONS ON TRANSPARENCY

FEATURES

Include requests for roles being clearly assigned to different organisations and individuals during training scenarios. Actions should be documented and traceable after a scenario is played. However, variations in data protection regulations need to be taken into consideration. This has three main benefits: ensuring accountability, enhancing efficiency of trainings, and furthering knowledge among partners. A module within the system on Evaluation can ensure this (see chapter on Evaluation).

Enable support for crisis management organisations to create and determine the narrative of crisis management by synthesising relevant information and providing it to responders. An Evaluation module (see chapter on Evaluation) making exercises transparent can help with visibility and showing the added benefit. It can also help increase the preparedness of the population, build trust, and help ease fears. This could also help create a shared

understanding of events between organisations.

The system needs to be transparent in itself, not just in advertising its benefits. When using the system, key stakeholders need to be easily identifiable (see also the chapter on Usability).

Undertake efforts to involve all relevant stakeholders throughout the development process (as mentioned before). This includes not only project partners but also potentially their peers, supervising organisations or ministries, or other decision makers. Who is an important stakeholder to be included in the development process should be determined together with the project partners.

The added benefit of using the IN-PREP MRPP needs to be communicated as clearly and openly as possible. This way people within an organisation sceptical of the MRPP's usefulness can be convinced to implement and use the system, and decision makers can be persuaded to invest in it.

Shortcomings, problems or other issues identified by end-users need to be addressed as quickly and openly as possible, creating an atmosphere in which end-users and developers have a shared responsibility to optimise the system.

IN-PREP as a project, but also the MRPP need to be visible within the DRM community. The finished product should be known throughout the security field. This could, for example, be achieved by promoting the platform at relevant conferences. However, positive visibility that helps exploitation relies on the system performing well, meeting end-user requirements and being accepted by project partners.

When adhering to the principle of Transparency, data protection rules and guidelines need to be considered.

7.5. Flexibility & Adaptability

Flexibility, as detailed in this chapter, is closely tied to the idea of **Adaptability,** which has been identified as a cross-cutting issue between the different guiding principles. Flexibility is something fundamental to crisis management, as situations might evolve in unforeseen ways. As such, it needs to be reflected in any ICT system used in this context.

Adaptability can ensure Usability by adjusting the interface and functionalities to individual preferences. To ensure continuous Compliance, Adaptability is needed to reflect changes in legislation. To help integrate the system into existing work processes and IT infrastructures, it needs to be adaptable to organisational requirements. Indeed, the requirement of the system to be adaptable to local contexts was highlighted as key to ensuring that it would eventually be used.

RECOMMENDATIONS ON FLEXIBILITY & ADAPTABILITY

FEATURES

Allow different users to pick and choose from the different functionalities, as they might not need certain functionalities (as mentioned under Usability). The overall workings of the system should, however, not be influenced by that.

Allow responses during the scenarios that are not part of pre-defined plans. Predetermining plans and playing the scenarios along those lines would restrict the leeway of end-users in dealing with situations.

Make the IN-PREP MRPP adaptable to different legacy systems.

GUIDELINES

The IN-PREP MRPP needs to be able to reflect different types of constellations between actors, which can also change during scenarios being played. It should also include unforeseen actors to be included on an ad-hoc basis, such as volunteers.

Given that policies and legal frameworks can change over time, the system needs to be easily adaptable to these changing circumstances.

The system should be easily scalable and expandable without requiring significant programming effort. If the system is seen as requiring little maintenance while offering long-term use by being easily changed, this can be marketed as beneficial to potential end-users and decision makers (see also the chapter on Transparency).

Since regulations on the use and protection of data vary among partners, it should be possible to determine prior to any scenario being played what kind of data is collected and who has access to it. This requires a matching of actors and actions to determine what kind of information is collected.

7.6. Neutrality

The principle of Neutrality concerns two aspects: the first relates to assumptions made about crisis management processes, the second concerns the relationship between the IN-PREP MRPP and crisis management policy.

RECOMMENDATIONS ON NEUTRALITY

GUIDELINES

Avoid built-in assumptions about governance system or work processes (as mentioned above, see chapter on Flexibility & Adaptability). It should also not rely on predefined ways scenarios "are supposed" to be played out by predefining outcomes. Thought should also be given to the terminology and symbols used in the system: it might be sensible to use terminology defined by the EU or the UN rather than by member states.

Any such assumptions or prescriptions run the risk of alienating end-users who come from a wide range of different organisations and countries, each with their own structures and processes. The system should focus on the process, i.e. focus on what actors are involved and the actions that they take.

It should not be possible to politicise results and insights about partners gained via the IN-PREP MRPP. To this end it should be absolutely transparent which data is collected, stored post training, and provided to whom. Evaluation of training activities, e.g. results for a single organisation, should only be provided to the partner in question – unless they agree otherwise. Deliverable D2.2 will cover this aspect in greater detail.

7.7. Evaluation & Documentation

During the analysis of relevant literature and the interviews with end-users, it emerged that evaluation and documentation were two key aspects deemed important for a preparedness platform. The implications of these two principles also reflect on other principles, such as Usability and Transparency.

RECOMMENDATIONS ON EVALUATION & DOCUMENTATION

FEATURES

Include a module on Evaluation and Documentation of exercises. This could be used to enhance the efficiency of trainings, provide crisis management organisations with data to underline political advocacy, further a shared understanding among different partners, and provide information for communication and educational activities. The module would need to be closely tailored to user requirements and needs.

Allow different levels of detail when disseminating training results, depending on organisational requirements by the participating organisations. Depending on their responsibilities, some organisations might require metadata about exercises, while others might need individual results of their personnel involved in exercises. This data should be interoperable with existing HR systems if existent.

Integrate a programme into the MRPP to address the training and human performance of the staff in general. This programme should be based on real-life-cases and reconstructions of crises. This should include individual tasks and exercises as well as group exercises. Overall, the introduction of a scoring system is recommended so that the users can see if their behaviour and decisions in the trainings have been successful.

Include requests for documentation of exercises that make actions taken during the exercises traceable, to provide a coherent narrative to ensure accountability. Ideally, all decisions and actions are logged in chronological order to understand developments and the chain of events.

GUIDELINES

Documentation should be compatible with EU crisis management systems as they ask participating countries to collect specific kinds of data.

Since cooperation in security-related matters is often a politically sensitive issue, data protection and accessibility to data should be handled with utmost care.

Organisations should be able to maintain ownership over the data that they provide and that is collected.

7.8. Knowledge Management

The guiding principle of Knowledge Management is closely tied to Evaluation & Documentation. However, it contains several aspects relating to how knowledge is conveyed by the IN-PREP MRPP. As such it includes topics such as standardisation and terminology.

RECOMMENDATIONS ON KNOWLEDGE MANAGEMENT

FEATURES

Include a standardised way of structuring knowledge about crisis events, such as crisis type, scope, actors involved, or actions taken. In short, a standardised template or defined formal model on reporting could help organisations gain a shared understanding of events and make decisions transparent to all parties whether they are/were directly involved or not.

Include an asset register providing the users with a quick overview on what capacities participating organisations can provide. Check with potential end-users if such a register should include only fictional information for training purposes, or also provide a real-time overview of all capacities available.

Related to the previous recommendation, when using the system, end-users should be able to quickly gather information on the status of assets (e.g. ready to deploy, deployed, in need of maintenance or fuel, etc.). This links in with the principle of Usability.

Depending on the outcome regarding the two previous recommendations: Information within the system required for playing the scenarios should be updated as quickly as possible, ideally in real-time. More general information, such as assets available or emergency plans, should be updatable by the organisations themselves without much effort, ideally by linking their existing systems with the IN-PREP MRPP (see also the chapter on Interoperability).

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8. Annexes

8.1. Annex 1: Interview questions

The following questions served as guideline for the nine interviews conducted with possible users of the IN-PREP-MRPP (covering police, fire & rescue, emergency services, and civil protection) from within and outside the project consortium.

Opening questions

1. What are your reasons to participate in IN-PREP? *(If interviewee is an IN-PREP partner)*

2. What would be opportunities for your organization when implementing the IN-PREP system? What are possible challenges?

3. Do you have any ideas on how to meet these challenges?

4. What is your experience with the introduction and use of IT systems – have they been accepted and used? Why/ why not?

Organizational factors

5. How is information management (data from trainings as well as real crisis events) currently organized? *(Relation to T2.1)*

6. What would you need from the IN-PREP platform, so that it can be integrated into the current information management processes?

7. What are hurdles in inter-organizational cooperation and communication?

8. In how far is decision-making in your organization dependent on other (governmental) organizations? (limited autonomy?)

9. What have been barriers to innovation in the past?

Policy factors

10. If you think about how crisis management is organized in your country, how do hierarchy, structures, regulations influence your decision making?

11. In your opinion, what are the most relevant challenges in transboundary cooperation?

    a. What can the IN-PREP platform do to overcome them?

12. Have external events like a crisis or political reform had any influence on your organization or work in the past?

13. How would you describe political support for crisis management in general and your organization in particular?

14. What needs to be done to make IN-PREP fit your country's overall approach to crisis management? (e.g. strategies, national response plans, etc.)

15. How important is documentation of exercises for you?

16. What are your requirements for documentation in order for it to be useful to you?

Social factors

17. How do you think public expectations have changed with the increased use of technologies?

18. What do you need from technology in general and IN-PREP in particular to help you meet these expectations?

19. How can IN-PREP help address the challenge of crisis communication with the public?

20. Speaking from your experience, what influence does data protection have on the use of technology in your organization?

21. Can you think of any other factors related to society that could hinder the successful implementation of the IN-PREP system?

22. What would be needed to overcome them?

Human factors

23. Please briefly describe your experience in command and control rooms and the technology used in that context.
24. Have you ever worked in a complex mixed-reality system like IN-PREP?

If yes:

    a. What were factors that were challenging or helpful for you?
    b. Was it easy to handle the information you got? (E.g. information overload)
    c. Was it easy to collaborate and communicate with other people?
    d. Did the system support you in your decision making? In what way?
    e. Can you think of other factors for humans that need to be considered when designing such a system?

If no:

    f. Can you think of factors that may be important for humans that need to be considered when designing such a system? If so, what would they be from your experience?

    g. What kind of demands on user interfaces do you see?
    h. Do you have any experience with systems that are used by several actors?

Closing questions

25. What could be done to mitigate the issues you highlighted?

26. Speaking from your experience, what feature of IN-PREP would be an absolute necessity for you?

8.2. Annex 2: Collection of recommendations from chapters 2-5

Annex 2 provides an overview on all recommendations as identified in chapters 2-5, structured by the guiding principles for system development. For reference the recommendations have been taken directly from each chapter and compiled into the following lists. The lists were used to derive the Recommendations (Features and Guidelines) in chapter 7.

8.2.1. Recommendations on Usability

Usability

In principal, innovation supporting measures are amongst others seen in **involving users** in innovation processes; introducing innovation incentives to staff; having an active role in innovation on management level; or tolerating trials of new ideas, no matter if successful or not (Blind et al. 2012).

Since drivers and objectives of innovation in the public sector are often not as clear as in the private sector, it will be useful to recap them both during the development of the system and when implementing the system. During development of the MRPP, the **drivers** for participating in IN-PREP (see box above), revealing main expectations towards the MRPP, **should be considered**. This means that IN-PREP partners should check if the system meets these expectations and what can be done to enhance the situation. Finally, when implementing the system, the users should reflect on their individual drivers, concentrate on making use of the MRPP's support regarding these drivers, communicate the system's benefits within their organisation, and organise respective training, if needed.

As also stated in the interviews, information flow through the IN-PREP MRPP needs to be **adjustable** to individual needs. This is not only important for the platform to be compatible to existing work processes, but also to enhance usability. If end-users can pick the information they specifically require for their operations, relevant information can be conveyed faster and more effectively (Hamrin 2012). Each end-user needs the ability to identify which information they want displayed easily and fast. If the choice which information is displayed is pre-determined there is a likelihood of practitioners not receiving what they need (Mendonça et al. 2007).

IN-PREP should focus on how to enhance information flows and **highlight the benefits** of its information management components. Users also need to highlight the benefits within their organisation and related organisations/ decision makers. This can help overcome reservations from politicians to invest in and from professionals to use them. For this to work these components have to be meticulously adapted to end-user needs – not developers' visions. If even the slightest doubt as to the usefulness of the system exist it will seriously damped its chance to be used further.

By introducing simple and unified interfaces, therefore reducing visual complexity and allowing end-users **easy access** to the functions and information they require while phasing out anything else, the IN-PREP MRPP can be used alongside existing platforms. It can also be easily integrated into existing workflows, procedures and processes if it isn't seen as burden but as added benefit to the operation. This can additionally be facilitated by allowing organisations to customise interfaces by using for example their own symbols and pictograms (Barth 2017).

However, it shall be taken into account that there is a **risk of trusting digital information blindly**, instead of avoiding misunderstandings through direct communication (Interview 7).

The general **roles** of different partners in transboundary crisis management should be clearly defined by the European Civil Protection mechanism, especially regarding mandates and assignments, which are handed out by the agency in charge. However the roles regarding the actual cooperation are related to internal structures of the participating organisations. Ideally the people filling these positions are easily **identifiable** through the platform. This would allow any crisis manager to know exactly who to contact regarding information, planning, operational

activities etc. The easier it is to know who to speak to and how, ideally directly through a communication module in the platform itself, the easier it is for organisations to coordinate. This ties in closely with inter-agency communication.

Acceptance can also be achieved by focusing not on what can be done, but what **end users need** to be done (Hallberg et al. 2012). Neglecting user needs can, in fact, lead to rejection of the system. Placing user requirements towards the system and how the system will address their needs in the centre of development can ease fears and highlight the added benefit of the IN-PREP MRPP. Thus, during the development of the system, the identified needs, especially in T2.1, T2.3, and T2.4, should be carefully considered. Also recapping the drivers, i.e. reasons for end-users to participate in IN-PREP, or to work on possibilities to create and/ or implement the IN-PREP MRPP, will support the process of change (see text box in chapter 2.2.1).

Along with this adequate and appropriate organisational and technical measures need to be taken to ensure that IN-PREP and its use will be accountable and transparent. This includes making these processes accessible (e.g. user-friendly language and descriptions).

In terms of system-human compatibility, in order to achieve compatibility in the design of interactive systems in which human beings, the environment, and technological machines interrelate and interact with one another, acquired knowledge about relevant human factors and characteristics ought to systematically and consistently be used (Karwowski 2005).

One of the main focuses therefore ought to be the design of systems that allows for system management that satisfies user needs and demands in terms of human compatibility requirements (Karwowski 2005).

It is important to take into account the exceptionality of the circumstances for which a system like the MRPP in IN-PREP is designed. I.e. the system is developed to be better prepared in emergency situations of disasters and crisis, and in situations where time normally is scarce and stress is high. This entails that the persons and practitioners using this system have to be able to quickly assess necessary information – even if this information is sometimes incomplete – and to make decisions based on this information. The system should also enable different actors and stakeholders to share information and to freely interact with one another. So the system has to be able to quickly give data to the users. Another important point is that the MRPP should be easily usable for the persons involved, in other words it should have a high usability. Moreover, the system as a whole should not only support collaboration and communication between users, but also allow for the creation of content that can be shared and distributed via the platform. Above all, the system ought to enable users to feel in control of its features, i.e. users should feel in control of the system at all times.

Information systems should be consistent. This means they should be using at least similar interfaces, functionalities and terminology. This reduces the stress of users to adapt to a variety of systems under stress, which reduces their ability to use the systems efficiently and can sometimes even lead to them not using the systems at all or work around them in order to maintain their operational procedures (Mays et al. 2011). Stress can also be reduced by focussing on operational tasks so the MRPP should enable users to do so.

As human beings are better equipped to process visual information than processing information through the other senses, this should be taken into account when providing information and data in the MRPP. The quantity of information that can be transmitted in complex technological environments can pose as an impediment on human perception. Of course, practitioners are used to this and better at it than other human beings, this ought to be kept

in mind when designing the system.

To overcome the schism between experience-based and technology-based decision making and therefore making the platform useful to practitioners from both ends of this spectrum, the IN-PREP platform should allow for both kinds of information. Incorporating both technology-based assessments and humans and their assessments, and clearly marking them, makes the system interesting and useful to both kinds of users.

The system should also not only be based on quantitative data because it is not always possible to fit decisions into this kind of number matrix.

When face-to-face interaction gives way to interactions via screen-to-screen in virtual environments, then the users' mastery of technological systems becomes paramount. Arguably, the acceptance and use of such technologies can be facilitated and improved through the conception of designs that permit human-computer-interactions and user experiences that are characterised by consistency and usability. As levels of experience and expertise vary among users, interface design and development has to be considerate of the diversity of users, their different backgrounds and work styles.

For interface design to be functional and fit for purpose, it ought to be specifically customised. In the context of this project this means that the prospective users of the system ought to be included in the design process, i.e. the development of the system ought to be characterised by participatory design processes.

Moreover, not only subsequently to the planning, design and implementation processes, but also concurrently to these processes, system design ought to include processes of continuous improvement, evaluation, redesign and maintenance.

Importantly, these processes ought to occur repeatedly and consistently, making use of on-going feedback loops to improve the system's performance and quality.

8.2.2. Recommendations on Compliance

Compliance

The IN-PREP MRPP needs to **comply with national and EU strategies** on crisis management. Otherwise political or even judicial barriers towards implementation can be hard or impossible to overcome. This adaptation can be done during development for the project partners' countries based on end-user feedback and lessons learned from the exercises and demonstrations. After the project has finished, however, the platform needs to be agile enough to **accommodate potential changes** of national strategies or the adoption of the system by partners from new countries with their own strategies. This need to comply with local provisions and to have the system be adaptable to local contexts has been mentioned by interview partners several times (Interviews 1, 2, 3, 4, 5).

IN-PREP, as an EU project, should be as **closely related to existing EU initiatives** as possible, such as the CPM and the HNS Guidelines. This avoids redundancies but can also strengthen both IN-PREPs appeal and the EU initiatives themselves. To achieve a close relation and integration of the systems and mechanism, it is important to use EU terminology and taxonomies (derived from crisis management and legal frameworks), integrate systems, exchange information and use pre-existing tools and methods of coordination and cooperation – where possible. In this sense, IN-PREP could contribute to standardisation, something several respondents mentioned during their

interviews is needed (Interviews 1, 2, 5, 6, 8).

8.2.3. Recommendations on Interoperability & Cooperation

Interoperability

A new platform, such as the IN-PREP MRPP, needs to fit as **seamlessly** as possible into existing contingency plans in order to avoid friction. If the platform requires too much adaptation from organisations, e.g. by changing established and rehearsed routines, this can lead to rejection (see also the chapter on information management). It is therefore important to strike a balance between a broad approach able to encompass as many types of preparedness planning and imposing changes on organisations to make full use of the platform

The new system should also interfere as little as possible with existing processes and procedures within the end-users' organisations. Experiences from an exercise using a newly developed common operating environment within the US Coast Guard has shown that unintended consequences can arise when a new system is tested or implemented (Benson et al. 2010). In order not to upset organisational structures the implementation of the IN-PREP MRPP needs to be **fine-tuned** to the individual organisation's operating procedures. However, there will be requirements that organisations need to fulfil, demanding a certain change within the organisation. These requirements should be identified carefully, and communicated clearly. Feedback from the different exercises shall provide guidance.

Data gathered through the IN-PREP MRPP needs to be **compatible** with systems used by different organisations. It is therefore important to know, which data types are used and weather IN-PREP supports all the different data types.

Cooperation

For the MRPP this means that it should be also designed in a way that trainings in teams and for the development of a mutual understanding and a team cognition can be executed. It is important that the MRPP can enhance team cognition and teamwork.

There is a strong interdependence and correlation of data information and time – especially in crisis data has to be analysed, passed, sorted and filtered, so the MRPP should implement exercises for training these tasks.

With regard to team cognition it is important to implement exercises into the MRPP that train and improve the shared understanding of the users. Trainings have to be included that improve a lot of "soft" skills but also the capability to recognise and solve disturbances, this of course is strongly connected to communication, decision making and teamwork in general.

Incorporating both technology-based assessments and humans and their assessments, and clearly marking them, can also contribute to a better understanding between colleagues and thus foster a common vision and shared experiences (see also Mays et al. 2011).

8.2.4. Recommendations on Transparency

Transparency
While some of the interviewed practitioners act quite autonomously, including the ability to take decisions on new tools or systems to be used (e.g. Interview 4), others depend on governmental organisations and/ or persons (Interviews 2, 6). If a user organisation and its decision-making processes are dependent on another (governmental) organisation, it is important to **involve all relevant actors** at an early stage.
The report at hand as a whole already highlights the necessity of having an **holistic view on diverse context factors** that can decide about the implementation of the IN-PREP MRPP to be successful or not. It is thus necessary to check if/ which other organisational components or processes require change.
When developing the aforementioned system for gathering structural information of buildings to inform Urban Search & Rescue decision making (see chapter 2.3.1), some key challenges faced during development were: the system needed to integrate a variety of data from different sources, which then in turn needed to be presented to end-users in a way that added a clear benefit compared to the old method of information management (spray paint). The benefits identified are saving of time, the possibility to relay more information than before and to do so more efficiently (Chen et al. 2010, pp. 2–3). When developing the IN-PREP MRPP, clear emphasis should be on the "**added benefit**". Right from the start existing problems or shortcomings identified by the end-users should be addressed, making as transparent as possible the software or technology which engages with machine learning and data aggregation so that end-users can understand the results enough to see value or concerns. By doing so end-users and decision makers can easily identify why the IN-PREP MRPP is a valuable asset. At the same time, the platform would have a real impact, as it would improve the work of crisis management organisations.
Since not all organisations will have the same resources for change and innovation processes available to them, making the platform as easily useable for end-users is highly important. The **gains** of using the IN-PREP MRPP need to be **visible** from the start while the **costs** need to be as low as possible (e.g. for internal adaption and implementation). One potential gain for organisations could be the availability of scenarios. Creating a scenario can be costly, so organisations might be reluctant to develop their own ones (Drennan et al. 2015). If, via the IN-PREP MRPP, the creation of scenarios can be shared, this might be an incentive to join and use the platform. However, this requires clear terms as to how the scenarios can be used by other organisations than the creator(s).
The system should be transparent as to clearly assign roles for the management of crises within the scenarios which can also be retraceable retrospectively. This has several benefits. 1. One key issue in transboundary crisis management is the lack of knowledge about the posts individuals from other organisations hold. Clearly assigning roles within the system thus helps their partners, greatly facilitating training efforts and making the whole system more efficient to use. That way it also increases knowledge about partners and helps create a shared understanding of crisis management. Given that several interview partners highlighted the wish to enhance their knowledge about partners from different countries and agencies, build up a network and thereby enhance efficiency, this also meets end-user's wishes (Interviews 1, 2, 3, 4, 5, 6, 7, 9). 2. Accountability is an important issue in creating legitimacy, making it also an important social factor. Development of the IN-PREP MRPP should make sure that responsibility and accountability for actions and

outcomes cannot be diffused. By logging decisions and actions within training environments, issues of accountability and responsibility can be identified.

3. By clearly assigning roles and tracing decisions and actions, organisations can also, if they desire, optimise training curricula based on individual performance evaluation. This was identified by respondents as interesting feature for the IN-PREP MRPP (Interviews 4, 5, 6).

Ideally, the scenarios should also synthesise all available information on the exercises and demonstrations, from decisions made at different levels to the impact of the actions on the ground. As a result a coherent narrative of the exercise would emerge, allowing decision makers from all levels and the practitioners on the ground to share a common view of the exercise. This not only helps creating shared experiences, it can also help answering questions of accountability. This can, for example, be achieved by providing proper documentation of exercises which clearly demarks decisions taken by all relevant parties. This aspect is closely tied to the need for a proper module for evaluation within the IN-PREP MRPP.

Under normal circumstances decision makers often refrain from investing in crisis management, especially in preparedness activities. This could have negative impacts on the implementation of IN-PREP (Interviews 2, 5). In order for the IN-PREP MRPP to become a viable choice on the market and to ensure exploitation of the project results, it is highly advisable to make the benefits of the system as clear as possible. If decision makers can easily see them, the more likely widespread implementation is.

Experiences drawn from IN-PREP should give crisis management organisations arguments for two important discussions. First, they need to clearly **communicate** what the technical measures actually allow them to do, and what not. Secondly, the reason for measures taken, whether based on technological grounds (such as simulations) or experience from field exercises, need to be clearly communicated to the public. Societal perceptions play a role here in determining the success of new crisis management technologies. This is confirmed by interview respondents (Interviews 3, 4, 5, 8). It was also highlighted that communication efforts should not stimulate fear among the public (Interview 8), or put otherwise be used to foster a climate of feeling safe (Interviews 1, 4, 7)

One of the ways to address and possibly counteract a lack of support for the investments in the project would be **Participatory Budgeting** or PB. This is a procedure to include societal actors in the budgetary decisions. Starting at the local level, PB has led to an increase of perceived legitimacy of (local) governments (Swaner 2017). By including end users in the project consortium, the project incorporates practitioners' input and feedback, increasing the acceptability of the final IN-PREP MRPP. This will increase the support of the budget by these and corresponding organisations (Sintomer et al. 2008).

The **potential benefits** of IN-PREP for the public should be made clear. An IT system can help provide the public with critical information during a crisis on the availability and use of response resources; it may also nurture trust in the ability of different actors to coordinate their efforts in a complex response network. Such information enhances transparency and allows members of the public to assess the situation themselves. This can also help create realistic expectations towards crisis management efforts (Rogstadius et al. 2013). This point was also mentioned by interviewees (Interviews 1, 2, 8).

Accountability, already mentioned in chapter 3.2, is also crucial in shaping public acceptance. If public expectations are not met it should be clear "what went wrong and where". Facilitating cooperation cannot be allowed to lead to a diffusion of responsibility. The IN-PREP MRPP should therefore be as transparent as possible, while keeping

privacy and security concerns in mind, as to who does what (roles, coordination and supporting activities).

Engagement with the public is also important to gain legitimacy and accumulate political capital to influence the political discourse in favour of one's organisation. Since the political pressures described above derive from the perception of crisis by relevant audiences, e.g. the general public, **building trust** with the public and promoting the organisation's approach to crisis management is important (Boin et al. 2009). This was also confirmed by interview respondents (Interviews 1, 3, 4, 5, 6, 7, 8).

Crisis management organisations need to make full use of all **communication** channels these days. This requires a coherent communication strategy and knowledge about these new methods. One interview respondent suggested including a (social media) communication module in the platform to train end-users on how to effectively communicate with the public (Interview 2). This could also be extended to a knowledge sharing channel on communication strategies in general and best practices in crisis communication in general.

Privacy-by-design techniques should be applied where possible to minimise the risk to data subjects. This should include building into the system informed consent process, so that it can be freely and meaningfully given, with open information about risks. Users and data subjects should be explicitly and adequately informed about the extent of the use of their data for automated decisions and other purposes.

This also suggests that the system should not run the risk of aggregating data in a way that potentially leads to loss of anonymity, privacy, or dignity or puts vulnerable individuals or communities at greater risk. Adherence to the GDPR is a pre-requisite.

8.2.5. Recommendations on Flexibility

Flexibility

Flexibility and adaptability are key aspects of modern day crisis management, since the context and nature of crises is constantly changing and evolving (Kroener et al. 2017). Consequently, there is no single best way to deal with crises and disasters (Boin et al. 2014a). It is therefore advisable, as also experiences from the EU Horizon 2020-funded iTrack project have shown, to design systems to be **reactive** and **effective**, offering end-users **choices** as to how to use them. This enhances the likelihood that the system actually reflects the environment it is used in (Kroener et al. 2017). Mendonça et al (2007) suggest ICT systems should focus on work **processes**, rather than outcomes, offering support on how to achieve goals set by the end-users rather than defining these goals. They argue that pre-defining the system for a certain set of possible conditions (e.g. pre-defined scenarios) can contradict the work practitioners do in the field. Practitioners, they state, need the flexibility to pick and choose technology to fit their needs.

Depending on organisational values and political pressure, some organisations try to adopt a lean approach to management, valuing efficiency and reducing redundancies. In crisis management this can have adverse effects, leading to a lack of adaptability and innovation and potentially produce barriers to effective crisis response (Drennan et al. 2015).

Since large-scale disaster events often play out in unforeseeable ways, **improvisation** is a big part of crisis response

(Mendonça, Wallace 2007). One example is volunteer management, which is becoming more and more important for crisis response (Bähr 2017). Practitioners need the possibility to quickly adapt to evolving situations, also acting outside the book. If the MRPP doesn't offer the flexibility to do so, practitioners might feel the need to work around the system or abandon its use. Tailoring the system to reflect only predefined responses to given scenarios can thus run counter to the experience of end-users in the field.

Giving crisis managers an information management system alone will not facilitate effective crisis response. Such a system needs to be designed with **flexibility** in mind to make it useful for the highly dynamic situation of a crisis event, in contrast to the requirements of more static organisations or environments (Hallberg et al. 2012).

A study on inter-organisational cooperation in the UK showed that there is **no single model** for cooperation. Rather, successful and effective cooperation depends on local circumstances, the modus of cooperation thus cannot be predefined (Kane 2018). The IN-PREP MRPP should thus be able to accommodate different ways of cooperation, from superficial to in-depth, giving practitioners the flexibility to find a use suitable to their needs. This would also make sure that end-users have enough leeway to cooperate in the field as they see fit, depending on the specific circumstances of the operation.

Given the fact that governance systems can change fundamentally, either due to a change in political climate, external events influencing the political climate, or sheer necessity, the IN-PREP MRPP should be flexible enough to accommodate these changes. In particular this means that changes to the IN-PREP MRPP should be easy and fast. It should not be necessary for programmers to spend hours understanding the way the system was programmed in order to make changes, since personnel working on the platform will fluctuate. At the same time the way the system is built should allow for changes to be tested quickly, without the need to conduct major tests or even taking the platform offline or inconveniencing the users otherwise. This was confirmed by interviewees (Interviews 5, 6). This links in directly with the topic of usability, which was mentioned throughout almost all interviews as a major aspect to be considered (Interviews 1, 3, 4, 5, 6, 7, 8, 9).

Since different models of governance for crises exist among the Member States, from strictly hierarchical to entirely decentralised, this needs to be taken into account by the IN-PREP MRPP. Scenarios generated through the platform need to be easily adapted to different governance structures. This could be achieved through a checklist or a short questionnaire, allowing users to quickly modify scenarios to a context. Lack of adaptability to different methods of governance has contributed to ICT failures during crisis response in the past (Mendonça et al. 2007), so this is important to improve the chances of the IN-PREP MRPP being used by different crisis management organisations. This recommendation is mirrored by the need for the IN-PREP MRPP to fit as seamlessly as possible into existing organisational structures, identified in chapter 2.2.

As mentioned above, the interviews with end-users confirmed the variety of different forms of hierarchy and influence. At the same time end-users reiterated the need for the system to fit and adequately represent their local context, referring to governance structures, with one respondent even citing the lack of adaptation of the MRPP to the local context as major challenge for implementation (Interview 2).

The implications of political incentives for system development are opaque: a disaster event can result, for example, in more or less resources for crisis management organisations, more or less deep structural reforms, or have no consequences at all. Such events will most likely result in structural changes if existing structures fail – this can be concluded from literature and interviews.

Flexibility, as an overarching theme, is thus not just required from organisations, practitioners and governance frameworks, but also from the IN-PREP MRPP. If the system is easily expandable and adaptable it can be easier to justify spending money on it.

A **tie-in** with other projects, movements or organisations developing solutions or standards in crisis management can also enhance IN-PREPs impact and make it more attractive to potential end-users. This would also help alleviate the issue of standards and harmonisation.

Since political trends aren't static, as the example of data protection shows, relevant aspects of the IN-PREP MRPP need to be highly **agile and easily adapted** to changing circumstances. This can include data protection, handling of sensitive data (where even what constitutes "sensitive" can change), organisational structures or national and EU policy frameworks.

In "selling" IN-PREP to end-users, we need to take into account **public perceptions**. We believe the IN-PREP project should fit various value constellations. But this will require a form of deliberation between potential end-users and societal stakeholders. That discussion will deliver an empirical basis for decision makers to help tailor IN-PREP to the particular context in which it must function. The importance of public perception was also mentioned during the interviews (Interviews 1, 2, 3).

Lastly, because the determination of exact **data protection needs** is situational, the training and validating scenarios and exceptional activities need to be matched in advance such that the use of data can be clearly deemed necessary for operations. One-size-fits-all solutions will struggle to find legal bases given that regulations differ from country to country.

8.2.6. Recommendations on Neutrality

Neutrality

To avoid getting caught up in political framing contests or similar issues, the IN-PREP platform should be designed with **neutrality as guiding principle**. Neither should the platform itself be based on assumptions (such as the ideal crisis response), nor should it be possible to politicise it (e.g. by using it to highlight potential shortcomings of partners). Neutrality concerns both functionality of the modules and the interfaces used by practitioners. Instead of using, for example, terminology and symbols from one particular national crisis management system, internationally agreed neutral terminology and symbols should be used.

The impact of political culture on system development itself is also very hard to assess. Some Member States are centralised, while others are characterised by decentralised or devolved decision making systems. Security policy and crisis management are seen from different perspectives, with some Member States pursuing a more interventionist approach and others being more restrained. And some Member States are federal states with, arguably, more than one political culture.

Consequently it is nearly **impossible** to speak of one prevailing political culture in Europe with a potential impact on system development. The IN-PREP MRPP should thus be as neutral as possible when it comes to assumptions on how to organise crisis management. Even the slightest normative position, e.g. on hierarchies or best practices for

crisis response, can trigger rejection.

Two interviewees mentioned the need for scenarios generated through the platform to be open, not to have a single solutions or pre-determine the outcome (Interviews 4, 5).

8.2.7. Recommendations on Evaluation & Documentation

Evaluation

To adapt to the changing (and increasingly transboundary) nature of crises, 't Hart and Sundelius (2013) call for a capacity-building process throughout all levels of governance focussed on sense-making, steering and synthesising, meaning-making, and adapting. This process should especially involve the preparedness phase of crisis management. All of these aspects aim at creating a shared understanding of tasks and ultimately a common approach.

This is mirrored by interviews responses highlighting the lack of common understanding of key elements of crisis management, such as the concept of "risk" and the lack of knowledge about partner's structures and work processes (Interviews 5, 7). The result is a juxtaposition of different approaches which ultimately have the same goal, yet differ in the way this goal is meant to be achieved.

IN-PREP can deliver vital information on these aspects, if a proper evaluation and dissemination mechanism specifically aimed at such a process is implemented. By providing data and a narrative based on training exercises among multiple partners it is possible to pinpoint areas for improvement, identify commonalities and work on creating common approaches.

Since there often is a lack of scientific data on the performance of governance in emergency services (see for example Farrell 2018), IN-PREP could provide valuable information for academics, policy makers and practitioners alike. Through an evaluation mechanism it could also be possible for national crisis management organisations to detect potential shortcomings of current institutional set-ups and identify room for improvement on the institutional level. However, since this is a very sensitive issue such a function needs to make a clear distinction between neutral meta data and more detailed information on performance. The latter data set can only be available for the organisation in question. The evaluation mechanism should also be complimentary to the mechanism used by the EC for the CPM (European Commission 2014). Indeed, security issues in handling information were also mentioned by one interview partner (Interview 1).

For assistance provided and coordinated within IN-PREP scenarios it is important the principles of subsidiarity and proportionality are adhered to. The system should thus include detailed documentation that allows ex-post evaluation of the chain of events. Such documentation would allow crisis management organisations to better assess their own capacities and when and under which circumstances help was required – and the scope thereof. By including this documentation the requirement of monitoring of emergency support provided by other Member States would be fulfilled as well (European Council).

The CPM is also intended to measure readiness for disasters by measuring "the quantity of response capacities included in the voluntary pool in relation to the capacity goals referred to in Article 11 and the number of modules registered in the CECIS" (European Parliament, Council of the EU 2013, Art. 3.2.b). The HNS Guidelines also ask

participating countries of the CPM to analyse their national risks and potential capacity gaps, as well as to identify all relevant actors (European Commission 2012). The IN-PREP MRPP could therefore lend service to this endeavour by linking it with the Common Emergency Communication and Information System (CECIS) and providing non-sensitive data to the Emergency Response Coordination Centre – should the participating organisations agree.

During development it could prove useful to specifically target existing problems in managing transboundary crises, based on input from the end-users. As mentioned the aftermath of a crisis often sees a "framing contest", involving questions of preparedness, accountability and possible shortcomings. The better equipped the IN-PREP MRPP is to identify challenges, the higher its viability for decision makers will be. Development should thus follow as closely as possible the specific requirements of the end-users and how the platform allowed for the identification of capability gaps etc. This can be facilitated by an evaluation module.

Also, if the gains of implementing and using the IN-PREP MRPP are clearly **visible** for political decision makers, they might be less averse to put their weight behind a broad roll-out throughout all government agencies involved in crisis management. For this to be successful the system needs to have demonstrated its usefulness and its functionality. This point has been confirmed by interview respondents (Interviews 1, 8).

It is important to integrate a programme into the MRPP to address the training and human performance of the staff in general. This programme should be based on real-life-cases and reconstructions of crises. This programme should include individual tasks and exercises as well as group exercises. Overall the introduction of a scoring system is recommended so that the users can see if their behaviour and decisions in the trainings have been successful**.**

Documentation

Since the effects of a crisis event on the political climate are hard to predict, practitioners are well advised to maintain their own **narrative** of their work. By being able to swiftly provide good examples of their work they can not only justify their need for resources, but also steer political discourse and reduce pressure. This is not to say that crisis management organisations should be at the forefront of political debates, but that they should be prepared to engage in them if necessary – ideally by having empirical evidence to support their cause. The IN-PREP MRPP should ideally provide meaningful documentation of the exercises and demos in an accessible and systematic way to provide this empirical evidence.

Several interview partners mentioned the need for proper documentation of training exercises to enhance both organisational and individual capabilities (Interviews 1, 2, 3, 4, 5, 6, 7, 9). This means a proper documentation capacity within the IN-PREP MRPP is required anyway, so this can be seen as potential for synergy: one functionality can serve two means.

International cooperation in security-related areas is a **sensitive** issue in most countries. The necessity to cooperate is generally acknowledged but often not translated into action. In the Indian Ocean region, following the 2004 tsunami, issue pertaining to political sensitivities as described above could by and large be overcome through coordinated support to all countries participating in the new early warning mechanism (Pattie, Dannenmann 2008).

For the IN-PREP MRPP this means that extensive documentation of the project and the platform, as well as centralised support to all organisations involved is needed. In short, the more practitioners and decision makers

know about the platform, how it works and what information is actually shared when and with whom can **ease concerns** about sensitive issues. As the tsunami early warning system shows, making an effort to incorporate a new system into existing mechanisms, policies and procedures can also strengthen acceptance.

Two interviewees highlighted the positive effects openly showcasing functionalities can have to increase acceptance (Interviews 5, 8). One interviewee especially emphasised the positive effect continued support and inclusion of users in the development had on the introduction of a new system in their organisation (Interview 5).

To **mitigate potential concerns** about sensitive data, technological solutions in general should allow organisations to "control and maintain ownership of the information they provide" and protect potentially sensitive information (Hamrin 2012). IN-PREP therefore needs to make sure that sensitive data can only be accessed by people with clearance to do so. The need to place special emphasis on this issue has been highlighted by almost all interview respondents (Interviews 1, 2, 3, 4, 5, 7, 8, 9).

Public **expectations** will vary depending on the crisis context. Ideally, public expectations are already considered during the preparation of contingency plans. And, ideally, the public is already involved in preparedness activities. IN-PREP can support this crucial task for example by providing crisis communication units with helpful data. This was explicitly mentioned by several respondents during the interviews (Interviews 4, 5, 7, 8).

Records should be maintained of personal data and processing activities in order for actions to be **traceable** and publically **liable**. In addition, records should be maintained of the decision-making schemas and actions that lead to exceptional data processing actions. Individuals should be allowed to monitor processing and automated algorithms. Along with this adequate and appropriate organisational and technical measures need to be taken to ensure that IN-PREP and its use will be accountable and transparent. This includes making these processes accessible (e.g. user-friendly language and descriptions).

8.2.8. Recommendations on Knowledge Management

Knowledge management

A common understanding of crisis events and harmonisation can be promoted through a commonly accepted way of **structuring knowledge** about crisis events. This means, in a nutshell, that when talking about a crisis event, a set of elements regarding the nature of the event is covered using a standardised way and language to describe the dimensions of the event. These elements, mutually agreed, will provide all end-users with the same information, structured in a way that leaves little to no room for ambiguities.

The IN-PREP MRPP should thus introduce a way to structure knowledge about transboundary crises along agreed-upon elements and make said knowledge available in an accessible way. Elements should cover the context of the crisis situation; the potential partners that can be mobilised and invoked; and the objectives associated with the faced situation (Bénaben 2016). It is, in other words, a way of processing the information gathered through the various technological solutions and organisations' input, using a strictly defined **formal model**. Each element is further detailed by sub-elements, which help making sense of the situation and inform decision making. The sub-elements need to be specified by the end-users to reflect their needs and make the whole process useful to them. This model of knowledge management needs to be open and continuously adapted to the circumstances and the

practitioners using it. New situations and end-users will require adaptations so the model retains its useful qualities.

Obviously **knowledge about the process** of actually managing the crisis needs to be included as well, e.g. the status of deployment of assets and their whereabouts, needs and requirements of practitioners on the ground such as personnel and materials, number and type of injuries, etc. This feeds directly into the aspects of information management and inter-organisational communication.

During the first IN-PREP end-user workshop in Leiden, the need for an **asset capacity register** was highlighted by several end-users, as explained in D2.5 (Weller 2018 (forthcoming)). In short this would entail an overview of existing assets with a description of their abilities. This description needs to be as broad as possible while being detailed enough to extract all relevant information. The exact level of detail would therefore need to be specified be end-users themselves, which constitutes a user requirement elaborated in D2.5. Such an asset capacity register within IN-PREP could be complimentary to the CECIS mentioned above by using the same terminology. A register for training purposes, providing fictive information, would for example allow training using a scenario with scarce resources. It should further be analysed if a real time register providing real information would be useful within IN-PREP, by weighing up the benefits against the additional effort for organisations that would be required to keep information up-to-date.

To effectively use the media to inform the public in times of crisis it is vital to have **information** as quickly as possible. The information management components of IN-PREP should thus have the functionality for press officers or others engaged in communication tasks to have access to important information in a simple and comprehensible way (Interviews 1, 3, 4, 5, 6, 7, 8).

Since memorial functioning and attention spans not only vary among individuals but also have their limits, the incorporation of technologies that assist the management of information can enhance the ways in which working environment operate by supporting work processes. Whilst human beings are not well equipped in terms of memorising and accounting for more than a few data, technological systems have no difficulties in evaluating and calculating larger sets of data (Drenth 1998). Therefore, in order to preclude the loss of important information, such features as data logging or pre-entered checklists can be useful. Assisting the tracking of data and the recall of information, these system features can aid in information management and enable system operators to stay on top of information flows when a multitude of messages and data are received simultaneously.