# "NOVEL INTEGRATED SOLUTION OF OPERATING A FLEET OF DRONES WITH MULTIPLE SYNCHRONIZED MISSIONS FOR DISASTER RESPONSES"

**ResponDrone**

# D15.2 Report of Field Studies

Project Deliverable Report

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Deliverable Title: Report of Field Studies
Author(s): Alen Amirkhanian, Satenik Mnatsakanyan, David Kocharov, Artur Khalatyan, Siranush Harutyunyan, Sean Reynolds
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| **Contributor(s)** | David Kocharov, Artur Khalatyan, Siranush Harutyunyan, Sean Reynolds, Alen Amirkhanian, Juan Perrela, Max Friedrich, Menelaos Hatziapostolidis, Michael Borkowski, Joonas Lieb, Richard Van Oorschot |
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| Glossary of terms and abbreviations used | |
|---|---|
| **Abbreviation / Term** | **Description** |
| AP | Access Points |
| API | Application programming interface |
| AUA | American University of Armenia |
| C2T | Command and Control Technology |
| C4I | Command, Control, Communications, Computers, and Intelligence |
| CaCo | calamities coordinator at the emergency call center |
| CBRN | Chemical, biological, radiological and nuclear hazards |
| CECIS | Communication and Information System |
| Cerberus | Software for the registration of civil protection incidents |
| CM | crises management |
| CMNC | Crisis Management National Center |
| ConOps | Concept of Operation |
| Copernicus | Copernicus Emergency Management Service |
| DJI | Da-Jiang Innovations (drones) |
| DLR | German Aerospace Center |
| DoA | Description of the Action |
| EADS | Early Assessment of Disaster Scale |
| End User | RESPONDRONE partners that represent emergency response authorities |
| EO | Earth Observation |
| EU | European Union |
| FBMN | Flying Backhaul Mesh Network |
| FIET | Fortress Incident Evolution Tool |
| FMAP | Flying MAP |
| FSB | Fortress Scenario Builder |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| GRIP | Generic Regional Deployment Procedure |

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| | |
|---|---|
| GRIP | Generic Regional Deployment Procedure or Coordinated Regional Incident-Management Procedure in the Netherlands |
| HCFDC | Haut Comité Français pour la Défense Civile |
| HFC | Home Front Command of Israel |
| HCI | Human–computer interaction |
| HRI | Human–robot interaction |
| ICT | Information and Communication Technologies |
| IMS | Information Management System |
| KW | Keyword |
| LCMS | The Netherlands National Emergency Management System |
| LTE | Long Term Evolution Network, 4G wireless communications standard |
| MAP | Mesh Access Point |
| MES | Ministry of Emergency Situations of Armenia |
| MIS | Management Information System |
| MOI | Ministry of Interior |
| MRPP | Mixed Reality Preparedness Platform |
| MS | Medical Service |
| MSSAS | Multi-Stakeholder Situational Awareness System |
| NAA | National Aviation Authorities |
| NCER | National Center for Emergency Response |
| NEMA | National Emergency Management Authority |
| NEXSIS | New Interoperable System Reform (France) |
| PC | Personal Computer |
| PETRA | Petropole staner, radio network system developed by Airbus (France) |
| PMR | National Radio System used in France |
| PoS | Development of A Portfolio of Solutions |
| RAV | Regional Administration of Varna |
| RCM | Region of Central Macedonia |
| RQ | Research Question |
| RWM | Region of Western Macedonia |

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| | |
|---|---|
| SESAR | Single European Sky ATM Research |
| SFRS | State Fire and Rescue Service of Latvia |
| SGSP | Main School of Fire Service |
| SIS2B | Fire Fighter Department of Corsica |
| SOA | Service-oriented Architecture |
| SOP | Standard Operating Procedures |
| SORA | Specific Operations Risk Assessment |
| SRH | Safety Region Haaglanden |
| SUAV | SUAV-based mesh networks |
| UAS | Unmanned Aerial Systems |
| UAV | Unmanned Aerial Vehicle |
| UCN | U-space Community Network |
| UCPM | Union Civil Protection Mechanism - Finland |
| US | United States of America |
| USAR | Urban Search and Rescue |
| UTM | UAV Traffic Management |
| VLL | Very Low Level |
| VRH | Netherlands - VRH - Safety Region Haaglanden |
| WP | Work Package |
| WSN | wireless sensor network |

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# 1. Executive Summary

The Field Studies Report presents the results of the following research items:

- A thorough review of state-of-the-art operational concepts and technological solutions currently utilized in emergency management worldwide, as well as lessons learned from previously completed and ongoing national and international research projects, datasets, statistics, current legislation, and scientific literature.
- A complete stakeholder map which includes actors in first response activities as well as their related services and dependencies.
- Targeted interviews and workshops with end users of the proposed system.

The data derived and presented as Key Findings in the report is presented in sections that are related to the following phases of disaster management:

- Preparation
- Assessment & Coordination
- Response and Recovery

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## 2. Introduction

The research team has studied thoroughly a large number of resources that have value in describing state of operations in emergency management systems, technologies used for operations and increased efficiency in responding to disasters, as well as use of unmanned aerial vehicles and systems to better inform decision makers and assist first responders in all phases of preparation, assessment and response to crisis.

The research team had a privilege to work closely and consult with all members of the consortium, many of whom greatly contributed not only with information on their own operations, but also with a variety of resources, projects, data and case studies.

Our major goal was to collect and aggregate information from past projects, scientific articles, and case studies, then compile those with our findings from field studies with end users. Throughout the project the major focus was both on our research questions, but also on answers to the questions that will be of great interest to system requirements designers and developers of testing scenarios.

The following document provides information about the following RESPONDRONE DoA requirements:

- State-of-the-Art: Learn from the past
- Stakeholder mapping
- Field studies

The structure of the document in sections is the following:

**Literature and Existing Projects Review, Cases Studies**

Research activities were conducted in the following three areas:

- Review of scientific and technical literature
- Review of existing EU projects
- Case studies

**End User Stakeholder Mapping**

A questionnaire that includes stakeholder mapping questions at all levels of emergency response (national, regional and local) was compiled and distributed among all end users.

**End User Interviews**

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Interviews have been conducted with all end user partners of the consortium according to the following three Emergency Management stages, which were defined together with all end users:

- Preparation
- Assessment and coordination
- Response and recovery

## 2.1. Methodology

The research team used the Soft Systems Methodology for developing the questionnaires for the end users. The Methodology allows for a clear distinction between structural aspects of end user operation in terms of power hierarchy, reporting and communication patterns, as well as process aspects, such as decisions to do certain activities, executing them and monitoring the results. The Soft Systems Methodology has been developed about 40 years ago by Peter Checkland and has since been widely used in technology management consultancy, predominantly for technology driven organizational change management analysis and implementation, including requirement gathering for new information and communication technology. [56]

The research team completed the Field Studies in the following steps:

- Development of questionnaires to gather information about the stakeholders involved in Disaster management operations in end user cases.
- Semi-structured Interviews with the end user partners to gather information about their current operations in the following stages of Disaster management:
    - Preparation
    - Assessment and coordination
    - Response and recovery
- Review of relevant EU projects
- Review of technical and scientific literature in the domain of disaster management
- Analysis of relevant disaster events through thorough case studies

The results of these research activities are:

- First responder operational concepts
- Technological solutions
- Stakeholder map

The results were then included in the following Reports:

- Field studies / Current state of emergency management
- Set of scenarios and simulation data

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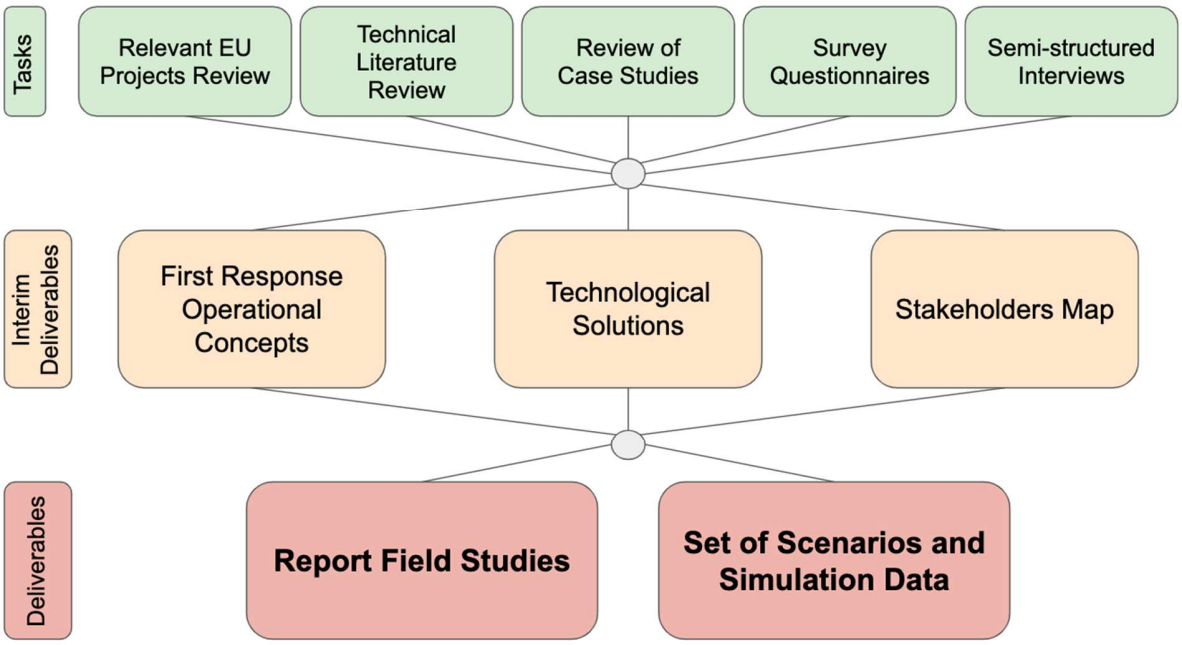
During all research activities, information about Disaster scenarios was also derived to be included in WP15 D15.3. Below is a flow chart of the described research:

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# 3. Literature and Existing Projects Review, Case Studies

In order to generate a comprehensive set of requirements, the current research strategy employed a three-pronged approach. First, a review of scientific and technical literature was conducted, which provides technical and engineering context by providing current and next-generation approaches to disaster management both with and without UAVs. The review of existing EU projects shows technologies and approaches in implementation while providing valuable feedback on how new strategies can be implemented in the field. Finally, a review of relevant disaster cases by review of after-action reports and related literature presents documented disaster management successes and pitfalls in real world scenarios.

## 3.1. Literature Review

### 3.1.1. Methodology

The use of scientific and technical literature for requirements gathering was set forth by RESPONDRONE team members to gather scientific and revised insight into positive and negative outcomes in emergency response. The scientific/revised inputs are crucial in order to augment end user interviews with officially documented lessons learned.

The list of the articles and papers were selected based on available, reliable sources with preference given to those that are most relevant to the main issues that RESPONDRONE is addressing.

A set of research questions were developed to make the review process more structured and for the retrieved information to be easier to use. These questions reflected five main themes - relevance to the RESPONDRONE goals, relevance to the RESPONDRONE system requirements definition, relevance as disaster scenario source, relevance as stakeholder mapping source, relevance to the research methodologies/frameworks.

A set of keywords have been used to make the “relevance of the article/document to the RESPONDRONE project” measurable. Projects and sources were given one point for each mentioned keyword.

**Keywords** to measure the relevance

- drone, fleet of drones, multi-drone, UAV, unmanned technology, helicopter (1 point)
- disaster (1 point)
- rescue, evacuation (1 point)
- emergency management, disaster management (1 point)
- situation(al) awareness, disaster assessment, situational assessment (1 point)

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- command & control, Command & Control Technology (C2T) (1 point)
- first response (1 point)
- decision support (1 point)
- multi-mission (1 point)
- civil protection operations (1 point)

**Research Questions Used:**

- **RQ1-Relevance**
  - How is the article relevant to RESPONDRONE goals?
- **RQ2-System Requirements**
  - What approaches are described in the article that can be used in defining RESPONDRONE system requirements?
- **RQ3-Scenarios**
  - What examples (or case studies) does the article use that can help in defining a set of scenarios for RESPONDRONE?
  - ***Note:*** *The information derived from this RQ is included in WP15 D15.3*
- **RQ4-Stakeholder Mapping**
  - Is there anything in the article that can contribute to a better stakeholder mapping?
- **RQ5-Methodology**
  - In case the article includes field studies, are there research methodologies/frameworks that can be adopted and replicated in RESPONDRONE.

### 3.1.2. Results

The complete list of the Literature/Articles identified as relevant for review is provided in **Annex B**.
Only the most relevant and the most valuable findings are included in the report.

| Title | Reference | Date (after 2005) | KW Summary |
|---|---|---|---|
| Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters | [11] | 2017 | 8 |
| Drone Applications for Supporting Disaster Management | [13] | 2015 | 7 |
| Help from the Sky: Leveraging UAVs for Disaster Management | [18] | 2017 | 7 |

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| | | | |
|---|---|---|---|
| A Survey of Unmanned Aerial Vehicle (UAV) Usage for Imagery Collection in Disaster Research and Management | [1] | 2011 | 7 |
| Unmanned Aerial Vehicles for Disaster Management | [41] | 2019 | 7 |
| A Surveillance System Using Small Unmanned Aerial Vehicle (UAV) Related Technologies | [53] | 2014 | 6 |
| Earth Observation based Crisis Information – Emergency mapping services and recent operational developments | [14] | 2017 | 5 |
| UAV-assisted disaster management: Applications and open issues | [40] | 2016 | 5 |
| Assessment of Existing and Potential Landslide Hazards Resulting from the April 25, 2015 Gorkha, Nepal Earthquake Sequence | [6] | 2015 | 5 |
| Self-Organizing Aerial Mesh Networks for Emergency Communication | [54] | 2014 | 5 |
| Cavalry to the Rescue: Drones Fleet to Help Rescuers Operations over Disasters Scenarios | [48] | 2014 | 5 |
| An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece. | [4] | 2019 | 4 |
| Managing Information in the Disaster Coordination Centre: Lessons and Opportunities | [49] | 2007 | 4 |

*RQ1 - Relevance*

*How is the article relevant to RESPONDRONE goals?*

**Drone Applications for Supporting Disaster Management (2015)**

The paper evaluates recent experience in the field and describes initiatives using drones to support disaster management. Several images and graphics are included for better understanding of the topic. [13]

**Help from the Sky: Leveraging UAVs for Disaster Management (2017)**

The article provides a full overview of how UAVs can interact with a wireless sensor network to assist in disaster management, particularly during the response stage. It discusses the pros and cons of various UAS platforms types. [18]

**A Survey of Unmanned Aerial Vehicle (UAV) Usage for Imagery Collection in Disaster Research and Management (2011)**

According to this paper from 2011, UAVs have been utilized following ecological, meteorological, geological, hydrological and human-induced disasters. The flexibility,

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safety, ease of operation, and relatively low-cost of ownership and operation facilitate UAV implementation in disaster situations. The paper provides a valuable review of practical utilization of UAVs for imagery collection for disaster monitoring and management. It presents also a compact review of similar publications till January 2011, such as recent papers regarding data acquisition and assessment prior, during and after disaster events. [1]

**Earth Observation based Crisis Information – Emergency mapping services and recent operational developments (2017)**
The article focuses on a holistic view of earth observation (EO) and the Center for Satellite Based Crisis Information development - specifically rapid mapping workflow to provide analysis products quickly. It also discusses how aerial collected data can be integrated into existing workflows. The article describes the use of a multispectral camera mounted on a helicopter but notes that these tasks will largely be carried out by UAVs in the coming years. [14]

**UAV-assisted disaster management: Applications and open issues (2016)**
The article is, to a great extent, an overview of possible UAV missions in disaster response. While it does not provide direct insight into any single, novel advance, it does point research to other ideas. [40]

**Assessment of existing and potential landslide hazards resulting from the April 25, 2015 Gorkha, Nepal earthquake sequence (2015)**
The open-file government report describes the assessment of existing and potential landslides using multiple methods including satellite, ground based, and helicopter-based methods. In this case, the techniques used by helicopters could be applied to add to the functionality of UAVs. However, the helicopter reconnaissance was not an automated process. [6]

**An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece. (2019)**
The article describes the use of aerial photography from a UAV being used to better understand flash flood evolution and maximum water level. Research mainly focused on better understanding after the flood as opposed to live intervention. However, the integration of ground level data into flood evolution models is a relevant concept. [4]

**Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters (2017)**
The current paper includes A. Restas' former texts and main viewpoints from a similar article called "Drone Applications for Supporting Disaster Management", which was published in 2015 in the World Journal of Engineering and Technology (Nr. 3, p. 316-

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321). Both publications evaluate recent experiences and describe valuable initiatives using drones to support disaster management in case of floods, earthquakes and forest fires. As in the previous one, several images and graphics are included for better perception of the topic. UAVs can be used for disaster detection, intervention monitoring and also for post-disaster monitoring. [11]

**Unmanned Aerial Vehicles for Disaster Management (2019)**
The paper evaluates the communication and network technologies that contribute to UAV disaster management systems. It surveys the latest development of UAV-assisted disaster management applications, including early warning systems, search and rescue, data gathering, emergency communication, and logistics, and presents preliminary work to demonstrate the benefits and challenges of drone systems for emergency communication. It highlights also the characteristics and design challenges of UAV disaster management systems. [41]

**Self-Organizing Aerial Mesh Networks for Emergency Communication (2014)**
The article discusses how to enable network connectivity post-disaster. The study used aerial mesh networks with UAVs providing link with end user devices. Also discussed is a strategy for distributed charging to keep UAVs in the air for the duration of the emergency. [54]

**A Surveillance System Using Small Unmanned Aerial Vehicle (UAV) Related Technologies (2014)**
The article discusses the use of small UAVs for surveillance, in particular for assessing the initial situation immediately after a disaster happened. With the help of small motorized UAVs, the NEC Guidance and Electro-Optics Division created aerial investigation systems with optical sensors and image transmission modules, etc. which integrates a wide range of tools such as image processing, sensing, networking, etc. Authors show solutions that were used when developing this new moveable tool that can obtain images (aerial image information) very quickly in an emergency/disaster situation. [53]

**Managing Information in the Disaster Coordination Centre: Lessons and Opportunities (2007)**
The 2014 article discusses the opportunities that Information and Communication Technologies (ICT) can have in supporting disaster coordination. It examines the structures and main requirements that exist in various disaster management centers. Normally, disaster coordination centers base the information for analysis on national structures, roles and responsibilities but lack corresponding ICT system and operational infrastructure. The paper identifies how ICT can better support disaster center operations and introduces a particular Crisis Information Management System. [49]

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**Cavalry to the Rescue: Drones Fleet to Help Rescuers Operations over Disasters Scenarios (2014)**
The paper suggests a drone-based solution that can assist search and rescue operations during disaster management. It discusses the advantages that drones can have in disaster scenarios, such as the provision of a temporary communication structure, creation of maps of the disaster affected territories, ability to carry cameras or radars as well as the capability to detect signals from devices. The requirements for this kind of drone-support are its autonomy and self-organization. [48]

*RQ2 – System Requirements*
*What approaches are described in the article that can be used in defining RESPONDRONE system requirements?*

**Drone Applications for Supporting Disaster Management (2015)**
Emergency Operations Centers and equivalent management infrastructure require objective and strategically useful information. They need up-to-date and relevant information about the situation. Therefore, drone applications during various stages of disaster management are divided by the author (A. Restas, 2015) according to their strategic, operational and tactical levels. All of them support disaster management during: [13]

- Pre-Disaster Activity for Prevention/Early Detection
- Activity During Managing Disaster for Mitigation/Monitoring/Decision Support
- Post-Disaster Activity for Quick Assessment/Recovery

**Help from the Sky: Leveraging UAVs for Disaster Management (2017)**
The article introduces the key concepts: [18]

- Use of a sensor network deployed on emergency vehicles and other UASs in order to control a disaster area.
- The sensor network described in the article would act independently of the UAS network in cases where weather does not permit the use of drones.
- Use of multiple UAS types (fixed wing, copter, and quad copter) for multiple missions in the response area as well as standby UASs for gap filling.
- Use of drones for initial mapping (Ortho and 3D) of the disaster area with UASs deployed by the central system to critical monitoring areas.
- The wireless network provides environmental data that are impractical for a UAS in this system.

**A Survey of Unmanned Aerial Vehicle (UAV) Usage for Imagery Collection in Disaster Research and Management (2011)**

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The research gives an overview of several field examples that used UAVs. All the collected data was photogrammetry ready and was analysed to produce various geospatial products that can be used in disaster management. The collected data was effective for detecting building failures, investigating, and validating existing models. It also showed how valuable pre-disaster collected imagery can be for comparison. [1]

**Earth Observation based Crisis Information – Emergency mapping services and recent operational developments (2017)**
The research presents the integration (and generation in real time) of rapid mapping results from recently acquired satellite imagery pre-event combined with existing infrastructure data from local GIS. Specifically, it focuses on rapid-mapping techniques to quickly create products for decision makers. Data was derived through real time processing of aerial imagery to generate 3D maps and fly-through derived from a multispectral camera (RGB and Near Infrared) onboard a helicopter. [14]

**UAV-assisted disaster management: Applications and open issues (2016)**
The following were applications identified in the article which provided an overview - situation monitoring, aerial damage assessment algorithms, standalone communication systems, and pings from mobile devices as a method for searching for clusters of survivors. [40]

**Assessment of existing and potential landslide hazards resulting from the April 25, 2015 Gorkha, Nepal earthquake sequence (2015)**
As the helicopter-based reconnaissance was based on expert estimations on board the helicopter as well as analysis of video and still images recorded during flights, the only system requirement defined is the ability to stream picture and video which is already likely an existing capability of the system. [6]

**An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece. (2019)**
Aerial photos were used to collect points on flood extent which were used later to analyse total flood depth. In the European context, many areas have high resolution digital elevation models which are typically available to local municipalities and rescuers. Adding flood extent areas along a surface would allow a general understanding of flood depth throughout the city. While the analysis would not be accurate enough for scientific purposes, it would allow first responders to understand critical areas where rescues might be needed. [4]

**Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters (2017)**

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Like in his previous article, the author (A. Restas, 2017) focuses mainly on operational and tactical UAV application in emergency management using a time-scaled separation of the application. Every headquarters management requires objective and strategically useful information. They need information immediately about the situation. Therefore, drone applications in managing stage are divided by the author into three groups according to their strategic, operational and tactical levels. All of them support the disaster management: [11]

- Pre-Disaster Activity for Prevention/Early Detection
- Activity During Managing Disaster for Mitigation/Monitoring/Decision Support
- Post-Disaster Activity for Quick Assessment/Recovery

**Unmanned Aerial Vehicles for Disaster Management (2019)**
Research demonstrates that old emergency management systems relied only on ground disaster response which suffered from low efficiency in information gathering and emergency assessment. Therefore, they were often slow to identify victims and delivered limited communication services based on large latency and low-bandwidth satellite communication. Following a severe disaster event, the affected area's roads and streets can be blocked by hazards or destroyed. Therefore, the most critical factor for successful disaster management is timing - how quickly can first responders access the disaster area and help the victims. Decision-makers need objective information as soon as possible. That's why drone applications in managing this stage could bring rescuers a bird's eye view of the entire area, which is critical for a comprehensive emergency management system that involves data collection, victim localization and rescue optimization. [41]

**Self-Organizing Aerial Mesh Networks for Emergency Communication (2014)**
The article proposes a mobility algorithm via which the mesh node that is SUAV-based can transform into a mesh structure and connect large numbers of devices (precisely EU). Additionally, it assesses the suggested scheme in a reality-mode (3D) environment and show the advantages of the aerial deployment as compared to a surface-based deployment when it concerns wireless link dependability and the level of coverage. [54]

**A Surveillance System Using Small Unmanned Aerial Vehicle (UAV) Related Technologies (2014)**
The system discussed in the article comprises a small UAV, a ground system which includes a control system and an image reception system, and the launcher. The system is constructed to facilitate the transport, deployment and assembly in the immediacy of the territory where the surveillance is taking place.
The program of the flight can be input in advance. The system has a capability to calculate the latitude and longitude of the objects based on the current UAV position

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and then can send the information (still image or video recording) to the recipient PC. [53]

**Managing Information in the Disaster Coordination Centre: Lessons and Opportunities (2007)**
The article states that the most important challenge of ICT support is to allow the team to successfully provide information to all the relevant stakeholders of teams that are dealing with disaster management and coordination. This means that a major feature that any crisis management system should have is the ability to effectively provide information-sharing services to a wide range of people and teams.
The article identifies key features of the system architecture that are necessary for a well-functioning Crisis Information Management System, such as (a) incident management; (b) people management; (c) resource management; (d) notification management; and (e) situational awareness management. [49]

**Cavalry to the Rescue: Drones Fleet to Help Rescuers Operations over Disasters Scenarios (2014)**
The article describes an organization structure to develop a fleet of drones with various tasks. It describes specific layers of systems needed for success including the application layer (mapping, IR sensing and device detection), a drone control layer, and a network layer for self-organizing networks. The article suggests the set of various types of drones to achieve this which include blimps, fixed wing drones, and multicopter drones. [48]

*RQ3 - Scenarios*
*What examples (or case studies) does the article use that can help in defining RESPONDRONE set of scenarios development?*

The information derived from this RQ is included in WP15 D15.3

*RQ4 - Stakeholder Mapping*
*Is there anything in the article that can contribute to a better stakeholder mapping?*

**A Survey of Unmanned Aerial Vehicle (UAV) Usage for Imagery Collection in Disaster Research and Management (2011)**
The article describes an interesting approach to condition assessment and prediction by Louisiana State University, using technology to enhance outreach. The Research and Education (CAPTURE) Lab has purchased a Mikrokopter Oktokopter XL for use in disaster-related imagery collection methodology investigation. The UAV was developed there for operation in fall 2011. This example shows that universities and other scientific institutions became a part of UAV-stakeholders.

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All other mentioned case reviews of different disasters sorted the tactical categorization of UAV activities into three distinct levels. These levels can be used for the classification of some potential stakeholders in the future, such as municipalities, fire & disaster departments, special rescue teams, medical organizations, nuclear and chemical industries, agricultural institutions, forest rangers, etc. [1]

**Earth Observation based Crisis Information – Emergency mapping services and recent operational developments (2017)**
The simulation included an assumed participation by multiple response agencies in the German context. [14]

**Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters (2017)**
No information about stakeholder mapping was found in this specific research. However, the mentioned case studies of three disasters and the tactical categorization of UAV activities into three levels by supporting disaster management could be helpful for the classification of some potential stakeholders in the future. The tactical drones, which have proven to be effective, can be made available to even the smallest rescue teams or fire brigades as first responders. [11]

**Unmanned Aerial Vehicles for Disaster Management (2019)**
The mentioned case studies of different disasters and the tactical categorization in three levels of UAV activities for supporting disaster management have already raised interest both in academia and the technical market. This can be seen as an indicator that drones can be embedded into the entire life-cycle of disaster management. The mentioned stakeholders are police departments, fire brigades, and disaster response departments. Small drones in particular can be integrated into their operations. [41]

**Managing Information in the Disaster Coordination Centre: Lessons and Opportunities (2007)**
The article discusses stakeholders in the context of sharing and cohesiveness in disaster management. The stakeholders mentioned are the teams which normally are responsible for disaster management. [49]

*RQ5 - Methodology*
*In case the article includes field studies, are there research methodologies/frameworks that can be adopted and replicated in RESPONDRONE similar tasks?*

**Drone Applications for Supporting Disaster Management (2015)**
The paper focuses mainly on operational and tactical drone application in disaster management. It uses a time-scaled separation of the application depending on the

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kinetics of an individual disaster. For example, the applications will differ in a slow-onset disaster versus a fast-onset disaster. [13]

**Help from the Sky: Leveraging UAVs for Disaster Management (2017)**
The article is a discussion of UAV applications and their relation to a WSN. While RESPONDRONE does not currently contain a WSN, the integrated use of WSNs by the RESPONDRONE system to increase range and application is of note. [18]

**Earth Observation based Crisis Information – Emergency mapping services and recent operational developments (2017)**
The described 3D model generation and rapid-processing techniques developed by the project are relevant and deserve consideration during methodology development. [14]

**An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece. (2019)**
The use of points collected by the pilot through aerial imagery and the integration of those points along with digital elevation models can provide a rough estimate of flood extent, depth, and height when combined with available digital elevation models. [4]

**Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters (2017)**
This research shows the need for the inclusion of UASs in disaster management to provide timely and quality information. An increase in the efficiency with which the UAS can provide data and its related systems can provide analysis products is of particular importance. [11]

**Unmanned Aerial Vehicles for Disaster Management (2019)**
According to the authors (C. Luo et al., 2019) drones offer the capability to revolutionize the efficiency and accuracy of disaster management. The potentials of drones have been mentioned in the prediction, management and recovery of disaster events. [41]

**Self-Organizing Aerial Mesh Networks for Emergency Communication (2014)**
In the paper, the authors (M. Di Felice et al., 2014) consider both the issues of mobility and energy in the use of SUAV-based mesh networks for ensuring communication systems in the events (scenarios) when the disaster has already happened. They examine the situation where not all end-users have their devices connected and the suggested aerial mesh tries to build the connections between them. Three methods are presented: they use the suggested algorithm in the context of SUAVs that help them to

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transform into an aerial mesh to connect the maximum number of devices on the ground. Second, they model an accurate 3D environment with shadows of the buildings and demonstrate that aerial mesh deployment is more reliable than the terrestrial one in terms of the level of coverage and altitude. And finally, they examine how to maximize the lifetime of the aerial mesh via SUAVs recharging their batteries by contact with the station on the ground. [54]

**A Surveillance System Using Small Unmanned Aerial Vehicle (UAV) Related Technologies (2014)**

The article discussed the small UAV surveillance system and its associated technologies which have the potential to acquire information via images from above as well as measure radioactivity by the relay of communication. The authors discuss the system outline, compact communication module, sensor gimbal, communication relay, system applications, associated equipment, and the different ways information is distributed. [53]

**Managing Information in the Disaster Coordination Centre: Lessons and Opportunities (2007)**

The article discusses in detail two of the system architecture requirements for a well-functioning Crisis Information Management System. In particular, it discusses the Incident Notification and Resource Messaging via showing the functionality of these two sub-systems and demonstrating the prototypical user interfaces that the authors (R. Iannella et al., 2007) have developed. [49]

**Cavalry to the Rescue: Drones Fleet to Help Rescuers Operations over Disasters Scenarios (2014)**

The article provides an overview of drone applications in disaster situations and first provides a drone architecture and detailed organization layers and then a fleet architecture, with types of drones, their main features and limitations as well as how they are used and their primary tasks. [48]

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## 3.2. Existing Related EU Projects Review

### 3.2.1. Methodology

The use of existing relevant EU Projects for requirements gathering was set forth by RESPONDRONE team members to make use of the existing research outcomes.

The list of projects was selected based on available, reliable sources with preference given to those that are most relevant to the main problems that RESPONDRONE is addressing.

A set of research questions were developed to make the review process more structured and the retrieved information easier to use. These questions reflected five main themes - relevance to the RESPONDRONE goals, relevance to the RESPONDRONE system requirements definition, relevance as disaster scenario source, relevance as stakeholder mapping source, relevance to the research methodologies/frameworks.

A set of keywords have been used to make the "relevance of the article/document to the RESPONDRONE project" measurable.

**Keywords (KW)** to measure the relevance

- drone, fleet of drones, multi-drone, UAV, Unmanned Technology, helicopter (1 point)
- disaster (1 point)
- rescue, evacuation (1 point)
- emergency management, disaster management (1 point)
- situation(al) awareness, disaster assessment, situational assessment (1 point)
- command & control, Command & Control Technology (C2T) (1 point)
- first response (1 point)
- decision support (1 point)
- multi-mission (1 point)
- civil protection operations (1 point)

**Research Questions (RQ) Used:**

1. **RQ1-Relevance**
    a. How is the project relevant to RESPONDRONE goals?
2. **RQ2-SysReq**
    a. What approaches are described in the project that can be used in defining RESPONDRONE system requirements?
3. **RQ3-Scenarios**
    a. What examples (or case studies) does the project use that can help in defining RESPONDRONE set of scenarios development?

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   b. ***Note:*** *The derived information from this RQ is included in WP15 D15.13*

4. **RQ4-Stakeholder Mapping**
   a. Is there anything in the project that can contribute to a better stakeholder mapping?
5. **RQ5-Methodology**
   a. In case the project includes field studies, are there research methodologies/frameworks that can be adopted and replicated in RESPONDRONE similar tasks?

### 3.2.2. Projects completed in the past

The complete list of the EU Projects identified as relevant for review is provided in Annex A. Only the most relevant and the most valuable findings are included in the report.

The following table contains the names and the relevance values for the projects that have been reviewed. Relevance values are calculated based on the lists of RQs and KWs defined above in Methodology section.

**RQ Sum**: the project gets 1 point for each relevant research questions (RQ), thus the RQ Sum represents the number of relevant RQs

**KW Sum:** for each keyword (KW) group the project gets 1 point if any subset of the group is found in the project description, e.g. the project gets only 1 point from the first group if both multi-drone and UAV are mentioned in the project. The KW Sum represents the number of KW groups mentioned in the project.

| PROJECT NAME | RQ Sum | KW Sum |
|---|---|---|
| DRIVER+ | 4 | 10 |
| COOPOL | 2 | 9 |
| IMATISSE - Inundation Monitoring and Alarm Technology In a System of SystEms | 3 | 9 |
| HEIDMALL | 5 | 8 |
| SWIFTERS: Safe and Rapid Evacuation Facilitated by UAV Swarms | 1 | 8 |
| IN-PREP | 5 | 7 |
| DISASTER | 4 | 7 |
| SAY-SO | 4 | 7 |
| Enhancing Assessment in Search and Rescue (EASeR) | 2 | 7 |
| SUNNY | 3 | 6 |
| ACRIMAS | 2 | 5 |

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| | | |
|---|---|---|
| SESAR CORUS | 5 | 4 |
| MULTIDRONE | 3 | 4 |
| FORTRESS | 2 | 4 |
| ESPREssO | 4 | 3 |
| EmSec. real-time information services for Maritime Security | 2 | 3 |
| SESAR AIRPASS | 2 | 2 |
| AW-DRONES | 2 | 2 |
| FCT WISE | 2 | 1 |
| UCPM SOPs - Common Standard Operational Procedures for the Union Civil Protection Mechanism Modules and Teams (UCPM SOPs) | 2 | 1 |

***Disclaimer**: The content of this section contains information that is, in part, a direct quote from the relevant project resources (websites, published documents etc.). References used by the corresponding project resources are given in the text and listed in the Bibliography section.*

### *RQ1 - Relevance*

*How is the project relevant to RESPONDRONE goals?*

**DRIVER +**

One of the major objectives of the RESPONDRONE project is to provide real time information to Crisis Management practitioners, in order to make more informed and timely decisions on resource management. Launched in May 2014, DRIVER+ project, which was funded under the 7th Framework Programme of the EC, is addressing current and future challenges of coping with natural disasters and terrorist threats that have increasingly severe consequences. DRIVER+ project looks at development and update of innovative solutions to address the needs of Crisis Management units.

One of the most relevant objectives of DRIVER+ multifaceted project to RESPONDRONE is to address the gaps reported by practitioners regarding threats, limitations in vulnerabilities assessment and insufficiencies in resource management when it comes to tackling disasters. The RESPONDRONE system design team will greatly benefit by taking a closer look at “Crisis Management Capability Gaps”, such as “Real time data and information fusion to support incident commander decision making”, or “Exchanging crisis related information among agencies and organizations”. Below is the link to the report on List of Crisis Management Gaps developed during DRIVER+ project. [12]
https://www.driver-project.eu/wp-content/uploads/2018/08/DRIVERPLUS_D922.11_List-of-CM-gaps.pdf

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The three main objectives of the project also address needs of RESPONDRONE system designers. In particular, the objective of "Creation of a pan-European Test-Bed for Crisis Management capability development", is relevant for Testing purposes, while the objective of "Development of A Portfolio of Solutions (PoS)" can be relevant as a platform for sharing data and solutions generated by the RESPONDRONE system. Finally, the objective of "Reaching a shared understanding in Crisis Management across Europe" is relevant in terms of standardisation of operations in crisis management with use of RESPONDRONE. The project aims at bringing new opportunities to understand how new socio-technical innovations, and solutions, including UAVs, will best meet their needs. [12]

**COOPOL**

The COOPOL project aims to develop a system based on the use of light aircraft controlled by an operator and whose data will be exploited by an operator sensor to inform the commandment in real-time mode. This may contribute to fulfilling RESPONDRONE's objectives specifically in the area of emergency information sharing. The system is dedicated to supporting emergency services and intervention forces in urban areas. It will be designed to evolve in a complex environment (low altitude flights, people located under the aircraft, obstacles, etc.) while ensuring the continuity of the operations. This continuity is essential: it must meet the autonomy constraints and the constraints related to the different environments in which the drones are supposed to evolve. Based on the outputs of the end-user interviews carried out in RESPONDRONE, operations in the urban areas and in low altitude are common among the emergency responders. Therefore, the results of the COOLPOL project can directly contribute to the success of RESPONDRONE's outcomes. [19]

**IMATISSE**

Relevance of the IMATISSE project to RESPONDRONE is mainly scientific research and work that was carried out in the framework of the project and the publication "Help from the Sky: Leveraging UAVs for Disaster Management", where the scientific team describes "a vision for leveraging the latest advances in WSN technology and UAVs to enhance the ability of network-assisted disaster prediction, assessment, and response".

The main benefit for the RESPONDRONE system designers is twofold. First the project's aim is to "create a System of Systems that combines the capabilities of sensor and robot networks with human participation through mobile crowdsensing to constantly monitor rivers and streams, alarm and describe potential danger situations, facilitate rapid response by lifeguards by providing real-time communications." Hence integration possibilities of RESPONDRONE with information generated in such networks can be researched further. [45]

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Secondly the publication mentioned above provides a well-structured list of possible capabilities of UAVs that can be used during various phases and types of disasters, both with and possibly without integration with WSNs.

The project website describes the main scientific objective of IMATISSE to be: “the definition of the emerging behaviours of each subsystem composing the system of systems. In fact, in IMATISSE, the project team will mathematically model the desired collective emergent behaviour to determine the sequence of individual steps, interactions, and information exchanges that induce such emergent behaviour. In addition, for each of the subsystems involved, the project will define the scientific and technological challenges to be overcome to allow the development of the proposed architecture”. [45]

The article linked below has great methodological value on structuring emergency management phases and usage of UAVs based on type of disaster.
http://krc.coe.neu.edu/sites/krc.coe.neu.edu/files/papers/07807176.pdf

**HEIMDALL**
The HEIMDALL project aims at improving preparedness of societies to cope with complex crisis situations by providing a flexible platform for multi-hazard emergency planning and management. [17]

With the aim of successfully achieving this overall purpose, HEIMDALL will address the following key aspects: (i) improved data and information access and sharing among the involved stakeholders, including the population and first responders on the field; (ii) better understanding of the situation by using advanced multi-hazard methods to develop realistic multi-disciplinary scenarios (which RESPONDRONE potentially can make use of), risk and vulnerability assessment, information sharing and emergency response; (iii) recognising the value of information by advanced data fusion, situation assessment and decision support tools. The combination of these aspects will be integrated in a modular and highly flexible platform which will make use of a federated architecture to provide user-tailored interfaces and foster information sharing among the involved stakeholders. Additionally, the platform will provide citizens at risk and first responders on the field with valuable incident-related information, increasing population awareness. The accuracy and reliability of information during the first stages of emergency management was identified as a primary need among the end-users of RESPONDRONE. [17]

HEIMDALL will develop and demonstrate a modular, flexible and scalable architecture that provides key stakeholders with relevant tools to process the available data and

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improve preparedness of societies in relation to emergency management, thus enhancing response capacity of society as a whole. [17]

**SWIFTERS**

The SWIFTERS project capitalizes on UAV swarms to study, design, develop, and test UAV cooperation strategies to better coordinate the tasks of mapping, tracking, and delivering help-aid kits or providing a temporary infrastructure in order to help first responders improve their response efficiency and reduce evacuation times. SWIFTERS will enhance existing capabilities by developing algorithms and software to assist operators effectively deploy UAV swarms in emergencies, train personnel in using swarms (each with a specific role in the mission) and transfer new knowledge to the community. [55]

**IN-PREP**

The IN-PREP project aims at establishing a training system that will allow first responders to train, plan coordination activities and collaborate to be better prepared for proper disaster and crisis management operations. [27]

One of the project's final deliverables will be an IT training platform called Mixed Reality Preparedness Platform/MRPP which will combine situational awareness with real-time information and decision support mechanisms with visualization, real-time information, etc. It will also have training modules to test the effectiveness of coordination between different agencies. [27]

It is relevant to RESPONDRONE goals since it is directly addressed to the first responders, it will help better coordinate necessary resources, and it aims at improving both collaborative response planning and communication of relevant information in real time.

Furthermore, considering that RESPONDRONE will be fully integrated within the current process of emergency agencies inter alia through training, the MRPP can later provide an interactive visualization of the crisis environment with both simulated and real data, decision support tools with embedded situational awareness, resource allocation in real time, remote sensing for better response actions, extensive evacuation imitation, etc. D2.1 of the project, which outlines the success and failure factors in responding to crises can later be examined when developing the RESPONDRONE system.

The link to the D2.1 is below:
https://www.in-prep.eu/wp-content/uploads/2018/05/IN-PREP-D-2.1-Success-and-Failure-Factors_v1.00.pdf

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**DISASTER**
The DISASTER project will develop an integrative and modular ontology for establishing a common knowledge structure between all the first responders for a better interaction and sharing of information. The final product should comply with international data formats used in the European Union and embedded within current SOA-based Emergency Management Systems. [50]

The final product is relevant to the RESPONDRONE system as it is directly addressed to the first responders involved in the emergency management and coordination and will deal with the issue of data interoperability. It tackles the problems of how to provide a quick and integrated response considering diverse systems of command, control and communication of different stakeholders, language diversity (including, for example, different measurement systems and colour codes), different legal regulations, and sometimes incompatible data formats and models. [50]

The final product will have two main components: a common and modular ontology with consideration of all cultural and sematic difference called EMERGEL; and a Service Oriented Architecture which will provide mediation algorithms that will comply with existing data formats and solutions. [50]

**SAY-SO**
The SAY-SO project aims to address the shortcomings related to interoperability, data management and processing, decision-making, standardisation and procurement in crisis management coordination across several borders, within and between states. The project paves the way for a possible development of European standardised Situational Awareness Systems for Multiple Stakeholders by describing the “scenery” of present Situational Awareness Systems as well as the requirements for future systems. [51]

**EASeR**
The EASeR project aims at handling a specific aspect of search and rescue (SAR) assessment called the “barrier effect,” which refers to a wide range of obstacles, such as heavy snow, huge traffic, or road interruptions that can occur during an emergency or a disaster - in particular, for example, during or after an earthquake. [14]

Its findings can be very useful to consider in relation to RESPONDRONE as it tackles the issues of non-coherent management of information and lack of basic necessary information. It intends to provide practical ways to carry more effectively the assessment in SAR and minimize the time of operations related to the rescue of the victims. [14]

**SUNNY**

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The SUNNY project aims to develop and integrate novel and comprehensive solutions for intelligent surveillance of borders (land and sea) for detecting crossing and illegal entry using a heterogeneous network of sensors carried by Unmanned Aerial Vehicles (UAVs). The developed SUNNY system will provide both large and focused capability for effective border surveillance: that is, to be able to monitor a large maritime or terrestrial border area and to detect and track targets and intended incursions. Potentially, the fleets of drones executed by RESPONDRONE can also carry similar networks of sensors and operate in the border areas.

The project proposes to develop and integrate airborne sensors to form a two-tier sensor network. The first-tier sensors, carried by vertical take-off and landing autonomous UAVs, are used to patrol large border areas to detect suspicious targets and provide global situation awareness. Fed with the information collected by the first-tier sensors, the second-tier sensors will be deployed to provide more focused surveillance capability by tracking the targets and collecting further evidence for more accurate target recognition and threat evaluation. The second-tier sensors have the capability to track, recognise and identify suspicious targets. The second tier can operate following two concepts: the first implies an autonomous coordination among the small UAVs, equipped with similar sensors, focused to optimise area coverage. The second is based on coordinated sensing, where the exploitation of data collected by different sensors carried by the UAV enables to improve the monitoring effectiveness without requiring the use of several sensors on the same UAV. [37]

**ACRIMAS**

The ACRIMAS project tackles the issue of enhancing the coordinated response from the decision makers and professionals directly involved in crisis management and first responders. It is relevant to RESPONDRONE goals as it will highlight the important issues and areas with respect to the existing crises management (CM) “system of systems,” which is considered to be highly diversified, and will suggest a more consistent version of the “system of systems”. [52]

It has a set of well-formulated reports, accessible at http://web.archive.org/web/20161201072343/http://www.acrimas.eu/index.php/deliverables, such as a Report on Misfits (where special attention is given to the assessment of the institutional, legal and political vulnerabilities of the existing CM framework), a report on the threat/hazard map for EU CM, etc. [52]

**SESAR CORUS**

The SESAR CORUS project is part of the European SESAR program (Single European Sky ATM Research). The aim of the CORUS project is to develop a broad concept which will

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define how unmanned aviation systems should be operated and guided in the Very Low Level (VLL) airspace. [35]

The experts of the CORUS project consortium team will generate a concept of operations for U-Space, the European system for traffic management of drones, including the airspace surrounding airports. The concept will include detailed definitions of the services necessary for VLL drone operations trying to balance the needs of the drone sector with society's needs or concerns to come up with safe and efficient drone operations. The project will also develop an initial architecture. [35]

The project is relevant to RESPONDRONE goals in terms of generating a concept of operations and developing well-defined use cases for regular scenarios and describing how threat and losses of safety in non-regular circumstances (e.g. incidents, emergency situations, etc.) can be mitigated or minimized. [35]

Furthermore, its value for RESPONDRONE is in its addressing drones' operations in uncontrolled airspace and in and around protected air territory (e.g. airfields). In addition, its outputs can be valuable for RESPONDRONE since it will outline the ways of safely connecting with all different classes of airspace users, taking into account possible emergencies and the volumes of traffic. [35]

**MULTIDRONE**

The MULTIDRONE project's aim is to develop an innovative, smart, multi-drone platform for media production to use for outdoor events. The 4-10 drone team is supposed to have enhanced decisional autonomy and improved robustness, security and protection mechanisms, which will allow it to also function in unfavourable conditions. [30]

It is not directly related to emergency management but is relevant to RESPONDRONE in that it includes the research on multiple drone planning, control and robust communications, in order to achieve intelligent behaviour and increased safety and autonomy for the multiple drone team. It can be useful for emergency management systems in that it also aims at tracking separate targets (or their groups) in real-time as well as analysis of the data or other semantic information about humans from the received multi-view data. [30]

It will develop tools for high-level mission planning, multiple drone formation control, mechanisms to ensure drone safety, robustness and autonomy, as well as come up with an overall efficient drone communication infrastructure all of which can be later examined when developing the RESPONDRONE system of systems. [30]

**FORTRESS**

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The relevance of FORTRESS (Foresight Tools for Responding to cascading effects in a crisis) to RESPONDRONE system designers is that the FORTRESS will use state of the art information collection and modelling tools to assist stakeholders in evaluating what information is significant, relevant and of greater priority so that they can adjust their actions accordingly. It is "Using evidence-based information from historical crisis case studies, as well as comprehensive analysis of the different relationships between systems, and systems of systems along with sensitivity information from current crisis management contexts, which can also involve information from fleet of drones, and practices in four system simulations". [43]

Just like RESPONDRONE, FORTRESS also seeks to understand and map different relations (e.g. legal, communication) between critical infrastructure nodes across sectors. Mapping and modelling these interdependencies are a prerequisite of any foresight and risk models of cascading effects. [43]

"FORTRESS will seek to intervene in current crisis response practices by bridging the gap between the over-reliance on unstructured information collection on one side and a lack of attention to structural, communication and management elements of cross-border and cascading crisis situations on the other." Water Dams, Electric Networks, Transport Infrastructure that were not explicitly reported to be significant stakeholders of the RESPONDRONE end users, may deserve a closer look and require integration with existing information systems to account for cascading effects of a crisis. [43]

**EMSec real-time information services for Maritime Security**

The EMSec project results are relevant to RESPONDRONE as the technology and tools used for spotting and saving a man overboard of a ship can be also used for finding and rescuing people in floods or other emergency situations. Also, the system is used to complement satellite information; hence the integration information can also be of great value to RESPONDRONE.

As described on the project website "EMSec is a Federal Ministry of Research and Education of Germany funded project, aiming to demonstrate the utility and value of integrating information derived by earth observation data with conventional data streams for improved maritime control and maritime situation awareness. DLR contributes by providing research aircraft D-CODE as an RPAS-Demonstrator (equipped with an optical camera) to fill the gaps in satellite surveillance in maritime scenarios (e.g. ship loss, water pollution, flooding)". [28]

**SESAR AIRPASS**

The SESAR AIRPASS project is mainly concerned with well-ordered simultaneous operation of multiple drones, a capability that RESPONDRONE also aims to build.

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The project is concerned with broader use of drones as described in the project website: "The emerging technology of drones is expected to boost industrial competitiveness, promote entrepreneurship and create new businesses in order to generate economic and social growth. This could mean that in the next few years we may see many drones flying in the air at low altitude. Drones will offer a valuable contribution to the improvement of communication and quality of life. A well-ordered operation of drones is a must in order to prevent people and the social security from danger and reduce risks. The use of drones is likewise relevant to Emergency Management, Monitoring, Traffic information". [3]

Relevance to RESPONDRONE is basically consideration of system technical requirements, and usage of "U3 – U-space (European version of the American Unmanned Traffic Management) Advanced Services", such as Dynamic Geofencing, Collaborative Interface with ATC, and Dynamic Capacity Management. [3]

The project presentation provides a broader list of UAV capabilities that RESPONDRONE technical design team may greatly benefit from.

**AW Drones**

The AW Drones project is relevant to RESPONDRONE goals in that it will contribute to harmonizing the EU drone regulation and standards, supporting the rulemaking to define those regulations, technical standards and procedures for civilian drones that will allow for safe and reliable drone operations in the European Union. The project will have a database of "best practices" and a set of technical standards for operations applicable to all relevant types of drones. The project will focus on "open" and "specific" categories of UAS operation as they represent the major part of mass market applications. [20]

**FCT WISE**

Since one of the envisioned functionalities of the fleet of drones in RESPONDRONE is recovering or creating a network for mobile communication, the FCT WISE project is discovering such opportunities, aiming to develop a new communications solution based on Flying Backhaul Mesh Network (FBMN).

As the project website describes, "at the core of the FBMN concept is the usage of Unmanned Aerial Vehicles (UAV), more specifically Quadrotors, which will carry onboard Mesh Access Points (MAPs) and will form a mobile and physically reconfigurable wireless backhaul mesh network composed of Flying MAP (FMAP). This network will be self-organised and the FMAPs will position themselves according to the data traffic generated by the mobile terminals and the need to relay the traffic towards the Internet. The project is expected to produce not only relevant scientific results but also

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a solution that may have a significant economic value, thanks to the involvement of the TEKEVER company". [44]

**UCPM SOPs**
The UCPM SOPs project is relevant to RESPONDRONE, as it can provide a more standardized mapping of stakeholders and responsibilities and develop more robust operational procedures for use of drones in emergency situations.

The RESPONDRONE system design team may benefit from looking at the recommendations to improve the standard operating procedures (SOPs) of modules and teams in the UCPM (Union Civil Protection Mechanism- Finland) Communication and Information System (CECIS). The project website describes its aim: "harmonize the existing SOPs by improving the already existing SOP guidance document, promoting it, and creating a common SOP template that enables the introduction of consistent, relevant and appropriate SOPs for all UCPM modules and teams."
The RESPONDRONE system design team may also benefit from looking at the template developed by the project that aims to facilitate the writing of SOPs and will lead to coordinated and higher quality SOPs. "Consistent SOPs improve cooperation in exercises and missions. The project thus contributes to the improved functioning of the Mechanism and the Union's ability to efficiently respond to future disasters". [46]

*RQ2 - SysReq*
*What approaches are described in the project that can be used in defining RESPONDRONE system requirements?*

**DRIVER +**
There are no direct system requirements described; however, the guidance received from the Trial Guidance Methodology and Crisis Management Gaps can greatly inform the system requirements.

**IMATISSE**
Although little is described on the project website, the publications resulting from the IMATISSE project have some value as it was envisioned the project should mathematically model the desired collective emergent behaviour to determine the sequence of steps, interactions and exchange of individual information that induce the emergent behaviour in the system. In addition, for each of the subsystems involved, the project will define the scientific and technological challenges to tackle in order to develop the proposed architecture. [45]

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The approaches on phases of crisis management and various capabilities of drones that can be used during different types of disasters can greatly inform the system requirements design for the RESPONDRONE system.

**HEIMDALL**

The HEIMDALL project has developed and published the first version of the user and system requirements and the system and technical requirements and their maintenance during the project duration. Both documents can be useful in formulating RESPONDRONE system requirements. They can be accessed here:

D2.6 HEIMDALL Requirements Report – Issue 1:
http://heimdall-h2020.eu/wp-content/uploads/2018/01/HEIMDALL_D2.6.DLR_.v1.0.F.pdf

D2.7 HEIMDALL Requirements Report – Issue 2:
http://heimdall-h2020.eu/wp-content/uploads/2019/03/HEIMDALL_D2.7.DLR_.v1.0.F.pdf

**IN-PREP**

In order to come up with an efficient way of developing the Mixed Reality Preparedness (training) Platform, the IN-PREP project's system development process included analysis of different factors, such as organizational, policy, social and human. [27]

The project has a number of reports that can be examined when defining RESPONDRONE system requirements. In particular, the report "Recommendations on relevant organizational, policy, social and human factors relevant for system developments" (D2.4) can be useful to get knowledge on the aspects that need to be examined when developing an emergency management system and when implementing the system, such as usability, compliance, interoperability, flexibility, etc. The report is available at:
https://www.in-prep.eu/wp-content/uploads/2018/05/IN-PREP_D2.4_Recommendations_on_relevant_organisational-policy-social_and_human_factors_relevant_for_system_developments_V1.00.pdf

The "User requirements" report, available via the link below, can be consulted to get knowledge on transboundary crises and about usage of innovative tools to support transboundary training and preparedness with a broad stakeholder engagement.

https://www.in-prep.eu/wp-content/uploads/2018/09/D2.6-User-Requirements-v0.2-CPLAN.pdf

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It can also be valuable to consult the report "C2 Definitions and Functions" which presents the design principals and capabilities of a regular C2 system (Command & Control Systems), since the C2 system supports agencies' operations related to preparedness, mitigation, response and recovery of the disaster management and response process. The report is
available at: https://www.in-prep.eu/wp-content/uploads/2019/05/Executive-Summary-3.3.docx.

**DISASTER**
In the DISASTER project, the information that should form the basis of the common and cross-domain knowledge of stakeholders with cultural and linguistic issues was based on collecting the requirements related to the emergency management from the end users. [50]

The development of the integrative ontology in the framework of the DISASTER project can be valuable for RESPONDRONE insomuch as the problems arising out of the language diversity, different measurement systems and colour codes, incompatible data formats and models can pose serious problems to any emergency management system and, therefore, must be taken into consideration.

In the project, incorporation within existing SOA-based Emergency Management Systems was done through developing technical mediation components able to adjust European data formats to the subsequent data model. Afterwards, those facilitation components were transformed to be integrated in legacy SOA-based Emergency Management through a software that acted as a bridge for connecting those legacy systems with the mediating common ontology. [50]

**SESAR CORUS**
SESAR CORUS project, which aims at developing a U-space Concept of Operation (ConOps), via an iterative process, has a number of reports that can be recommended for examination when detailing RESPONDRONE system requirements. [35]

The reports are available at https://cordis.europa.eu/project/rcn/211096/results/en and include studies on:

- Initial Societal & Institutional Impact - outlines the preliminary studies on the key markers of societal and institutional acceptance and state-of-the art as well as the initial proposals for a UTM regulatory environment.
- Initial CONOPS - initial version of the CONOPS.
- Initial Architecture & Solutions - includes state-of-the-art; preliminary architecture and solution description.

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- Initial Contingency & Constraints - includes methods of quantification for safety, security and risks; initial list of non-nominal events; initial mitigations using existing contingency plans and UTM services; initial suggestions for incident/accident examination and reporting.
- Initial Operations & UTM Requirements - outlines the state-of-the art use cases and initial use cases for Remote piloted Aircraft System (RPAS). [35]

**SAY-SO**

The SAY-SO project deals with the practitioners' requirements and the information needed by civil protection practitioners and emergency responders concerning Situational Awareness and Situational Awareness Systems in deliverable "D2.2 – INVENTORY OF PRACTITIONERS' REQUIREMENTS". The Situational Awareness requirements from the civil protection practitioners and emergency responders are the basis and point of leverage to describe and define the further specifications of the targeted Multi-Stakeholder Situational Awareness System (MSSAS). The mainly targeted civil protection practitioners and emergency responders are located in the field of firefighters, technical relief, paramedics, and police. [51]

The report on deliverable "D3.1 - INPUT- AND OUTPUT DATA FORMATS USED BY EU CRISIS RESPONSE ORGANISATIONS" addresses data formats commonly used by current EU crisis management and related standards, but also with a view towards other existing and emerging format technologies [51]

**SUNNY**

The SUNNY project addresses the development of an integrated solution for UAV on-board data processing. A report produced in SUNNY describes on-board data processing system based on the specific functional sub-system architecture and requirements for the data acquisition of on-board data processing of the SUNNY system. [37]

The report can be accessed here:
http://www.sunnyproject.eu/media/1011/sunny-d41-on-board-data-processing_fv.pdf

It covers the following topics: some related work on each individual sensor processing and known subsystem modules. It addresses how the SUNNY on-board data processing complies with the requirements imposed by the users and also by the global SUNNY system architecture. Based on these requirements, the project designs an on-board data processing architecture capable of coping with the SUNNY system objectives and specifying each individual module. Individual sensor integration and performance is analysed, and the data flow between on-board and ground system is defined. Results of the real-time image processing of electro/optical cameras, infrared cameras and hyperspectral cameras are also presented. Finally, the report also contains a section

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detailing the dataset campaigns, including flights performed and data collection payload used. [37]

**MULTIDRONE**

The complete MULTIDRONE system, which can be useful to examine when formulating RESPONDRONE's system requirements, includes: (a) multiple drones, (b) ground infrastructure, and (c) a logistics truck which provides recharging for drones. The software will consist of such modules, as multiple drone mission planning, flight control and drone security/autonomy services, semantic world modelling, multiple drone localization, target identification (locating) and its tracking, visual data analysis as well as multi-drone HRI/HCI software at the ground station. [30]

Project reports that can be useful to consult for RESPONDRONE are available at https://multidrone.eu/deliverables.

Specifically, "Drone Platform Implementation Report" and "Design of the Human-in-the-loop HCI/HRI Tools" reports can be further explored to get knowledge on implementation process of the drone platform and the high-level design of the human-in-the-loop HCI/HRI tools. [30]

**FORTRESS**

Although FORTRESS project is developing two tools, Fortress Scenario Builder (FSB) and Fortress Incident Evolution Tool (FIET), to be used for knowledge gathering in the preparation phase as well as for simulation and during crisis, the RESPONDRONE system designer team can get valuable insight on system requirements, in particular the information collection and modelling tools that help evaluating the what information is significant, relevant and of greater priority. This may give new ideas on capabilities that the fleet of drones should have.

As described on the project website "The project team consists of an interdisciplinary consortium from eight European countries, including social scientists, practitioners in the field of crisis management and IT-specialists", which makes it extremely valuable for socio-technological aspects of the design. [43]

"FIET can be used as a foresight tool to assist decision-makers in understanding the potential effects of their decisions in training environments." This information can be of great value for testing purposes obviously, but also for "reverse engineering" of information needs and decision-making patterns that need to inform system requirements.
"The tools developed can help crisis managers and infrastructure providers from different sectors to analyse their mutual dependencies, to develop a common

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understanding of risks of cascading effects and to plan joint and coordinated information exchange and response during crises". [43]

**SESAR AIRPASS**

As the project website states: "The AIRPASS project has the goal of making a contribution to the organized use of drones, supporting their integration in the urban and suburban environments particularly through the definition of an on-board system concept". [3]

Below are several examples of solutions or on-board drone capabilities out of dozens presented in the catalogue of SESAR solutions (link below) that RESPONDRONE technology design team can consider for system and add to requirements. https://www.sesarju.eu/sites/default/files/documents/reports/SESAR_Solutions_Catalogue_2019_web.pdf

*Tactical Geofencing*

Tactical geofencing Compared to U1 pre-tactical geofencing, tactical geofencing brings the possibility to update the operator with geofencing information even during the flight.

*Tracking*

This refers to the service provider using cooperative and non-cooperative surveillance data to maintain track identity of individual drones. The capability includes ground and air surveillance systems, as well as surveillance data processing systems. The performance requirements of the capability will vary in accordance with the specific requirements of each application.

*Flight planning management*

This service covers the receipt of a flight notification or a flight plan and provides the appropriate answer according to the characteristics of the mission and applicable regulations This service will be available for any drone operator/user with different levels of requirements.

*Strategic deconfliction*

The service provides deconfliction assistance to a drone operator at strategic level (when the flight plan is submitted, it is compared to other known flight plans, and a deconfliction in time or route could be proposed). This service could be mandatory or optional according to the operating environment. [3]

**FCT WISE**

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Below is the description of problem for big events that can be considered by RESPONDRONE system designers for emergency management situations, particularly for the capability of drones to provide broadband internet.

"Cellular networks consisting of large cells do not have enough capacity to provide broadband Internet in areas with high density of users. WiFi Access Points (AP) are a potential solution for this problem but each AP is unable to cover a large area or to serve a large number of users. A WiFi based solution may require the temporary deployment of tens of APs to provide adequate capacity, but there are problems related to the deployment of this number of APs".
Although the project describes a situation with musical festival and a difficulty to deploy APs in the middle of the crowd, the same challenge can be faced by disaster responders, for example in cases where people get crowded in particular places because of floods.
"In addition, APs may have low workload during a period and excess of users during other periods making the cost of the infrastructure very high if we consider the average or maximum capacity requirements. Moreover, a fixed AP cannot follow the random movement of the crowd when considering mobile users". [44]

Hence the RESPONDRONE technology design team may want to look at the new communication solution based on Flying Backhaul Mesh Network (FBMN).

### *RQ3 - Scenarios*

*What examples (or case studies) does the project use that can help in defining RESPONDRONE set of scenarios development?*

The derived information from this RQ is included in WP15 D15.3.

### *RQ4 - Stakeholder Mapping*

*Is there anything in the project that can contribute to a better stakeholder mapping?*

**DRIVER+**
There is no stakeholder mapping made for the DRIVER+ projects but the main stakeholders are listed in the descriptions of the Trials. These participants should be considered by RESPONDRONE, and communication among them as well as the decision-making hierarchy can greatly inform the system design. More detailed information on carried-out trials is available via the following link:
https://www.driver-project.eu/events/trials/
The following participants were present at the trial events: firefighters, aerial reinforcements and terrestrial units from a neighbouring country, environmental protection agencies, medical services organizations, and decision makers and authorities. [3]

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**HEIMDALL**
In the HEIMDALL project, the Work Package 3 focuses on stakeholder and knowledge management, supported by the identification of the use cases and the definition and performance of the demonstration scenarios. The organisation and performance of the HEIMDALL demonstrations is also part of WP3. HEIMDALL will organise three intermediate demonstrations, aligned with the three first system releases, to validate the system with the involved first responders. Additionally, the final demonstration shall demonstrate the system capabilities in an operational environment.

The deliverable 2.11 describes the HEIMDALL service concept relevant actors and the possible use cases.

D2.11 Service Concept Specification: http://heimdall-h2020.eu/wp-content/uploads/2018/05/HEIMDALL_D2.11.DLR_.v1.0.F.pdf

**IN-PREP**
In the IN-PREP project, during the stakeholder mapping and engagement, nine interviews were conducted with stakeholders/potential users of the Mixed Reality Preparedness Platform.
The interview participants were of different professions related to crisis management, namely from the police, fire and rescue, emergency services, and civil protection. The project highlighted the importance to involve all relevant stakeholders throughout the development process to alleviate concerns about possible vulnerabilities or weaknesses or privacy and information security issues. The relevance of a comprehensive stakeholder engagement was emphasized, especially with regard to the development of the technological tools of the project which will directly impact the end users and broad stakeholder communities. [27]

Reference: https://www.in-prep.eu/wp-content/uploads/2018/05/IN-PREP_D2.4_Recommendations_on_relevant_organisational-policy-social_and_human_factors_relevant_for_system_developments_V1.00

**SESAR CORUS**
The SESAR CORUS project involves a comprehensive consultation with stakeholders throughout the process. The project is guided by an Advisory Board of 22 members, and a ‘U-space Community Network’ (UCN) of stakeholders. It also collaborates with other drone-related projects. The stakeholder engagement was done through three workshops attended by experts from the drone community, representatives from drone operators, airspace users, manufacturers, research centers, authorities, airports and insurance companies, etc. [35]

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**DISASTER**
In the DISASTER project, the stakeholder engagement was done through collecting feedback from users and stakeholders and its further analysis. [50]

**ACRIMAS**
ACRIMAS project also involved considerable stakeholder mapping and engagement through active involvement of a wide range of stakeholders, such as first responders, authorities and governmental bodies as well as the supply side, throughout the whole project process, in the capacity of full partners or support groups/experts. They supplemented and verified the scenario analysis by explaining their needs and requirements concerning the distinguishing appropriate CM topics, which should be addressed by further project activities, and the demonstration concept. [52]

**FORTRESS**
Because the FORTRESS project is dedicated to understanding cascading effects in emergency situations, it gives an interesting perspective on potential stakeholders that can become part of the emergency management group with their information needs and operational standards. It can give RESPONDRONE system designers an alternative view to who are the stakeholders apart from the regular stakeholders envisioned by standard emergency response operations.

On the one hand, the 'FORTRESS model builder' (FMB) can model cross-system or cross-stakeholder dependencies in crisis scenarios. It identifies entities that may become relevant or affected during a crisis and defines the relations between these entities. "Experts from different organisations log into the platform and indicate their dependency relations with other organisations. Different features and assessments trigger communication, which makes the tool unique especially for prevention". [43]

The 'FORTRESS incident evolution tool' (FIET) then provides users with a wide range of instruments to analyse how crises are likely to evolve or consider the consequences of entity failure while mitigation measures are not available.

Two main innovations for inter-sectoral risk management can be expected from FORTRESS and can be useful for RESPONDRONE system designers, for better mapping of involved stakeholders.

- "First, understanding the interconnectedness of infrastructure systems and the necessity to map these connections in a proper way is at the center of FORTRESS' approach.

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- Second, FORTRESS assumes that the practitioners themselves (CI operators, crisis managers) will readily indicate their relevant sub-systems, objects, criticalities and relations". [43]

Triggers of cascading effect described in the FORTRESS project (also listed below) provide an interesting perspective on crisis management situations, for envisioning occurrence of potential stakeholders, which can be used to better map stakeholders.

- **Spatial proximity** - A spatial cascade may occur between geospatially related entities.
- **Time** - A system is dependent on resources or services provided by another system that is affected by an incident. A cascading effect occurs when the recovery time of the affected system lasts longer than the buffer time of the dependent system.
- **Failed resource allocation** - The resources of an affected system are running short (e.g. diesel). Although there are sufficient resources available in the infrastructure network, crisis managers fail to distribute them properly.
- **Escalation** - An incident causes a cascading effect (e.g. time or spatial cascade) that triggers further multiple cascading effects due to the high cascading impact of the affected system on further systems.
- **Loss of overview** - Due to a limited exchange of information or an information overload, crisis managers are not aware of a critical process that is culminating in a cascading effect. [43]

### *RQ5 - Methodology*

*In case the project includes field studies, are there research methodologies/frameworks that can be adopted and replicated in RESPONDRONE similar tasks?*

**DRIVER+**

The Trial Guidance Methodology defined in the DRIVER+ project can be used by RESPONDRONE for designing scenarios. Although it has a very strong social media component, it can also add value in the way the decision makers get information for assessing situations and allocating resources, which is quite relevant to RESPONDRONE.

The project website describes the methodology in a nutshell: "Trial Guidance methodology - using a systematic approach to analyse social media and create relevant public announcements to diminish rumours spread via social media platforms

Shared platform for reporting, what improvements can be made to the software.

- collecting and presenting all information on a map allowing the actors involved to share the same, up-to-date information;

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- logging and assessing information about the crisis situation and delegating tasks to the entire team;
- setting up an integrated system that allows the dispatcher to receive all the critical information needed to manage the scene in the most efficient way;
- and processing a volume of data generated by social media allowing practitioners to be alerted to new developments as well as detecting false information". [12]

The common information space described in the DRIVER+ project is another approach that can be used for testing the system of RESPONDRONE.

"TEST BED - Common information space - that can collect and make accessible photos from drones, as well as, where is the ambulance and other services, and have some input from social media.
Common simulation space, scenario management tool, observer tool, after action review tool. There are a number of videos on test bed that can provide better insight on scenarios". [47]

There is also a List of Crisis Management Gaps that can prove valuable for embedding functionalities in RESPONDRONE fleet system. In particular, the list of CM gaps covers issues in the functional domains of decision support; information sharing, situational awareness and coordination; engaging the population (warning, crowdsourcing, crowd-tasking, volunteers); resources planning and logistics; and casualty management. [47]

**IMATISSE**
Under the project the group of scientists made a comprehensive study and created a unique framework for use of various types of UAVs in different types of disaster. The RESPONDRONE system design team can use the framework for discussing capabilities for various stages of the crisis management life cycle. [45][18]

The life cycle comprises three stages:
1. Pre-disaster preparedness — UAVs survey related events that precede the disaster, offer static WSN-based threshold sensing, and set up an EWS.
2. Disaster assessment — UAVs provide situational awareness during the disaster in real time and complete damage studies for logistical planning.
3. Disaster response and recovery — UAVs support SAR missions, forming the communications backbone, and they provide insurance-related field surveys.

Authors argue that a single optimized but static network for all three stages is no longer sustainable; rather, the network must continuously evolve in topology and capability. [45][18]

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The RESPONDRONE system design team may also want to consider the recommendations for UAV use (with or without WSN), as well as types of UAVs and their capabilities.

**HEIMDALL**

The HEIMDALL project has published 2 documents on project demonstrations which are considered relevant and useful for the purpose of this report:

D3.4 HEIMDALL Demonstrations – Issue 1
Date of publishing: November 29, 2017
http://heimdall-h2020.eu/wp-content/uploads/2018/01/HEIMDALL_D3.4.PCF_.v1.0.F.pdf

D3.5 HEIMDALL Demonstrations – Issue 2
Date of publishing: December 19, 2018
http://heimdall-h2020.eu/wp-content/uploads/2019/03/HEIMDALL_D3.5.PCF_.v.1.0.F.pdf

**IN-PREP**

The methodology of the IN-PREP project used for developing the final deliverable (an emergency preparedness training platform), first involved a literature review that was later complemented by expert interviews based on a previously developed interview guideline. The guideline was structured with consideration of the five crisis management tasks: “situation assessment”, “decision making”, “coordination, command and control”, “supply of basic services to enable CM and logistics”, and “communication with the public”. [27]
The methodology is recommended in order to achieve the goals of RESPONDRONE.

**SESAR CORUS**

The SESAR CORUS project, which aims at defining a concept of operations for unmanned aircraft systems operating in the very low level, has been methodologically structured along the seven key elements, which can be useful to consider when developing the RESPONDRONE system. The main methodological keystones are (a) “management and ethics”, (b) “operations and UTM requirements”, (c) “contingency and constraints”, (d) “societal and institutional impacts”, (e) “architecture and solutions”, (f) “CONOPS integration”, and (g) “communications and dissemination”.
Furthermore, the project’s methodology aims to conform to three main principles worth considering in terms of RESPONDRONE goals, namely (a) different causes of risks, (b) safety assessment of a separate UAS mission, (c) allowing for the general assessment of various UAS missions within an airspace system. [35]

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Detailed project reports are available at:
https://cordis.europa.eu/project/rcn/211096/results/en.

**MULTIDRONE**
In the MULTIDRONE project, the methodology used for the development of requirements was based on the analysis of the current state of the art in drone cinematography aiming to define some fundamental multi-drone setups. It can be valuable for RESPONDRONE in that it is based on three cornerstones: project objective, the process that helps to achieve the objective and the necessary infrastructure that enables the process. In case of the MULTIDRONE project, the key aspects/layers of analysis were the usage scenarios, media production process and system platform or the infrastructure that supports the production process. A subsequent breakdown examination was conducted to classify domains and subdomains, each of which conforms to a particular group of requirements. [30]

One of the reports mentions SORA methodology, which can be examined for RESPONDRONE goals. It is a mechanism to assess ground and aerial risks, which gives guidelines for technical and operational barriers implementation as well as improvement/mitigation. This methodology is developed by JARUS, which is a group of experts from the National Aviation Authorities (NAAs) and regional aviation safety organisations, and promoted as a methodology that can improve the assessment of risks and mitigation of drone operations. [30]

**DISASTER**
In the DISASTER project, the methodology consisted of four phases: data acquisition, data alignment definition, data alignment execution and data exploitation. Resulting requirements (which were generated based on an input from a wide range of domain experts) for the final product were evaluated and rated from 1 (optional, nice-to-have) to 5 (highest priority). This assessment and rating of the requirements provided the foundation for the technical development of the final product – the ontology [50]. This methodology can be enhanced and replicated for RESPONDRONE system development as its multi-stakeholder and consultative nature has the potential of creating results which are in line with actual practice. Furthermore, an online survey was conducted with the aim of getting insight into stakeholders' (people directly involved in emergency response) actual requirements and ensuring that stakeholders accept the DISASTER project's solution. [50]

**AW-Drones**
The methodology that the AW-Drones projects adopts for supporting the EU drone regulatory process includes collecting existing technical rules, procedures and standards

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for the commercial use of drones and subsequently performing an assessment of all collected data to identify a best practices, gaps and bottlenecks. [20]
The final product relevant for RESPONDRONE as a project concerned with drones will be an open repository with technical rules, procedures and standards for drones globally.

**EASeR**
Since the EASeR project targets a particular issue of search and rescue assessment called the "barrier effect," the project methodology consists of (a) analysis of the current state of the art, (b) identification of operational tools and development of guidelines to be spread globally, (c) finding new technologies in support of the assessment and (d) covering via procedures the use/deployment of helicopters of other corps, all of which are important for RESPONDRONE's ultimate product. The developed procedures and new technologies are evaluated and tested during a small testing exercise where assessment teams deal with the "barrier effect". [14]

**FORTRESS**
The methodology used in FORTRESS for "Reconstruction of Crisis and Decision Processes" can be valuable for RESPONDRONE test designers as well as designers of the information system that should be used with drones.

With the overall objective to identify, understand and structure major challenges in decision making during crises, the methodology also provides a framework for stakeholder mapping, considering cascading effects and studying the consequences of decisions. The results of the tests reveal a variety of systemic challenges causing cascading effects which can be related to planning, pre-crisis conditions, and communication systems (something that can be of interest to the RESPONDRONE design team), as well as human error. [43]

The systems analysis and centrality concepts also provide a potentially valuable framework that RESPONDRONE system designers can use to better map stakeholders that are not directly related to crisis management. Usages of the framework include connecting various sectors and infrastructure systems with each other, both within the narrow first responders' circle and beyond. The concepts of "outdegree" and "betweenness" centrality reveal nodes that are prone to impact or transmission of the crisis through them, which can also be studied by the RESPONDRONE design team, to get a better layout of communication patterns. [43]

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### 3.2.3. Ongoing/Upcoming Projects

The following ongoing and/or upcoming EU projects have been identified as highly relevant to RESPONDRONE activities and goals. The relevance is measured mostly based on the Objectives and the List of partners.

Due to the limited available information, the Research Questions are not currently applicable for these Projects.

| Name | Program | Website |
|---|---|---|
| **LitterDrone** | ICT and research program | http://litterdrone.eu/?lang=en |
| **Drone in Humanitarian Action** | DG ECHO | https://drones.fsd.ch/en/homepage/ |
| **DREAMS** | European Union's Horizon 2020 Research and Innovation Programme | https://www.u-spacedreams.eu |
| **ASSISTANCE** | H2020: Adapted Situation Awareness Tools and Tailored Training Scenarios for Increasing Capabilities and Enhancing the Protection of First Responders | https://cordis.europa.eu/project/rcn/222583/en |
| **CURSOR** | H2020: Coordinated Use of miniaturized Robotic equipment and advanced Sensors for search and rescue Operations | https://cordis.europa.eu/project/rcn/222585/factsheet/en |
| **FASTER** | H2020: First responder Advanced technologies for Safe and Efficient Emergency Response | https://cordis.europa.eu/project/rcn/222619/en |
| **INGENIOUS** | H2020: The First Responder (FR) of the Future: a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, increasing protection and augmenting operational capacity | https://cordis.europa.eu/project/rcn/222613/factsheet/en |

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## 3.3. Case Studies

### 3.3.1. Methodology

The use of case studies for requirements gathering was set forth by RESPONDRONE team members to gather objective, real world, insight into positive and negative outcomes in emergency response. These real-world inputs are an important input to augment end user interviews with officially-documented lessons learned.

Case studies were selected based on available, reliable sources with preference given to cases where official after-action reports were available from one or more responding agencies. Additionally, a goal of the research was to investigate a broad range of response scenarios both in terms of the nature of the hazard as well as the overall scale of the incident. The studies were not limited to natural hazards, but also included man-made hazards including the increasing issue of terrorist attack. Naturally, the case studies also span a number of different geographies, countries, and response strategies. The comparison of different agencies and local response strategies will assist in writing requirements based on this official feedback.

As the case studies have varied scales and hazard origins, research questions were developed to allow for easier comparison. These questions reflected two main themes - response strategy and UAV mission refinement. Understanding the response strategy used during an incident as well as the failure points naturally provides best practices and suggestions for improvement in these response systems. Not all of these best practices are applicable for translation into RESPONDRONE system requirements, but many - notably situational awareness and communications support - were consistently an issue and warrant consideration as possible development.

As mentioned, research also focused on the use of drones and other air support during the response phase of each case study. With the exception of events within the last two to three years, case studies did not include UAVs as a part of the response. However, the response inefficiencies and the use of air support in older cases yielded important information for the requirements gathering effort.

**Research Questions Used:**

- **RQ1 - Systems**
  - What were the documented response issues?
- **RQ2 - Documentation**
  - What existing response systems were in place? What were the positive/negative outcomes?
- **RQ3 - Missing Information**
  - Was any critical information missing during the event? Why?

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- **RQ4 - UAVs Used**
  - Were UAVs used during Response? How?
- **RQ5 - UAV Mission**
  - Based on collected data - what are possible missions UAVs could be effective at?

**Final Case Studies Used:**

| Case Study | Year | Disaster Type | Scale |
|---|---|---|---|
| Hurricane Michael | 2018 | Meteorological | Large |
| Winter Storm France | 1999 | Meteorological | Large |
| Forest Fire Portugal | 2017 | Climatological | Small |
| Draguignan Flooding | 2010 | Hydrological | Small |
| Nepal Earthquake | 2015 | Geophysical | Large |
| UK Flooding | 2007 | Hydrological | Large |
| Boston Marathon Bombing | 2013 | Manmade | Small |
| Buncefield Oil Explosion | 2005 | Manmade | Small |

### 3.3.2. Results

*RQ1 - Systems*

*What existing response systems were in place? Were there positive outcomes from these systems?*

The response systems in each locality varied slightly, but strategies were in place for each case study. A common theme among all the case studies was the integration of response strategy between multiple levels of government. The most positive outcomes were associated with integrated technical systems such as web-based emergency operations centers (WebEOCs). These WebEOCs, specifically noted during the Boston Marathon Bombing and Hurricane Michael, act as an information exchange at all levels of the response effort: from self-reporting citizens to national level decision-makers [2]. In some cases, most notably the Draguignan Flood, such systems were available, but could not be accessed by local authorities due to communications outages in the disaster zone. [34]

Related to the WebEOC in nature is the concept of a national shared transmission infrastructure, noted in several instances but most specifically by Rouzeau, Martin and Pauc in 2010 [34]. The communications transmission system, using radio repeaters and other forms, was successful in keeping local communication to the disaster site. The issue in this case was that local government officials and in some cases first responders did not have access to these devices.

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Another critical component of existing response systems was integrated and live updating GIS maps. These maps integrated not only response data from multiple government levels, but also weather data in the case of meteorological and hydrological events. Earlier event reports noted that GIS maps would have been useful in response but were not available to first responders or local municipalities. [7][28]

In all observed cases, air support was an integrated part of the response strategy. The variation in this air support was naturally derived based on the scale and nature of the incident. Integrated and centralized command and control of various air resources resulted in their successful use or the inability of the responders to utilize air resources. Tapster [7] and Bersani, et al [15] noted specifically that lack of command and control of the area via air resources inhibited response efforts for the Buncefield oil explosion and Winter Storm Xynthia respectively.

To summarize, in all cases, a strong response infrastructure was already in place. Some form of electronic and/or GIS integrated response system or WebEOC was noted as key in saving lives and better coordinating response efforts. There were issues in each response specifically noted in the literature that will be discussed in the next section.

### *RQ2 - Documentation and RQ3 - Missing Information*

*What were the documented response issues?*
*Was any critical information missing during the event?*

There will be documented challenges for any incident. To some extent, the issues with a specific event can be attributed to unique aspects that every disaster presents. With this in mind, this discussion of response issues will focus on common themes throughout the cases studies as well as specific examples of those themes. The response issue discussion has been narrowed to focus on issues that current project scope and feasibility allows. During report synthesis, it also became clear that RQ2 and RQ3 are inherently best discussed together, as in most cases a lack of critical information from decision makers stemmed from a flaw in the response system itself.

***Compromised Cellular Infrastructure***

In earlier case studies (2010 and before) the interruption of communication in the response area was a major theme. The lack of cellular communication limited communication with not only local authorities, but also victims in need of rescue. The root cause of these failures was typically due to the overall fragility of cellular infrastructure. However, the critical nature of this resource caused response issues both pre- and post-disaster throughout the case studies.

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Of particular note in these cases are disasters with rapid onset with continually evolving threats. In the cases of Winter Storm Xynthia [15], the 2017 Portugal Wildfires [32], and the Draguignan Floods [34] local municipalities and citizens were in certain cases unaware of the threat due to interruption in cellular communication. The Draguignan floods were in this case the most instructive as local municipal authorities lost complete communication with actors at the regional and national level.

In the case of the Boston Marathon Bombing, cellular infrastructure was still available, but flooding of local cellular networks by victims and bystanders completely interrupted cellular networks in the first critical moments following the event. Particularly for emergencies in dense, urban areas, this jamming of cellular networks even without damage is an issue. The after-action report for the Boston Bombing heavily suggested an increase in high priority channels (HPCs) and easier access to these channels by first responders. [2]

***Air and Heavy Mobile Support Coordination***

Related to the issue of local communication was the dispatch of heavy air support and mobile response resources due to limited or poor information. Bersani et al. [15] noted that nautical and air assets were poorly coordinated due to not only the scale of the incident, but also due to a lack in communication link between air and ground support. Lock [22] described similar issues during Hurricane Michael, where again the regional nature of the event complicated the authorization and prioritization of air asset deployment. The severe meteorological nature of both Winter Storm Xynthia and Hurricane Michael further complicated air and ground support.

In the case of the Portugal wildfires, air assets were available, but had been dispatched to other, more historically fire prone regions. In this case, what began as a small fire was responded to according to standard protocols grew out of control due to adverse weather conditions. Of specific note in the after-action report was that in the future, air resources should be deployed based on better, more objective data [32].

During the Buncefield Oil Depot explosion, a police helicopter was able to survey the site soon after the explosion, but due to its lack of live connection with response systems, the aerial site assessment was not received for nearly two hours [6].

***Live Response Asset Tracking***

Several cases in the study mentioned the lack of asset tracking capability for improved command and control. Viegas D., Almeida, M., Ribeiro, L. [32] included the inability to understand asset location as a major efficiency throughout the event. These assets could include boats, heavy equipment, air assets, and other critical response supplies.

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During Hurricane Michael, the initial response was good, but the widespread nature of the disaster complicated responders' ability to understand where available resources were located without a unified spatial asset tracking system [21]. It is important to note that although GPS tracking has become cheaper in recent years, even disasters such as Hurricane Michael, which occurred in 2018, saw issues with this.

***Flooded or Destroyed Local EOCs***

The most instructive case regarding a destroyed EOC was the Draguignan Flooding incident in 2010. The emergency operation center in this case was flooded, rendering it unusable for the duration of the event. Beyond the loss of a primary local EOC was the hardened radios, laptops, and other devices being kept in the EOC, which were also destroyed. [34]

Similar incidents were also observed during Winter Storm Xynthia, the UK Flood of 2007, and the Nepal earthquake. [15][28][30]

***Data Compatibility***

Modern disaster management is aided in the modern era by the ability to sort and quickly analyse large amounts of data which floods into emergency operations centers during an event. However, multiple cases, most notably Hurricane Michael in 2018 and the Buncefield Oil Explosion in 2005 saw issues with incoming data incompatibility.

In the case of Hurricane Michael, damage reports coming in through both digital and analog means were not compatible with the regional EOC's data management system [21]. During the Buncefield incident, paper and GIS maps had discrepancies with complicated the response [7].

***Radio Interference***

In the response stage of the Nepal Earthquake, Pix4D - a prominent image processing company - deployed commercial drones in coordination with the rescue effort. While the drones were very effective in mapping of critical zones, their normal operating range was cut in half by increased radio interference in the aftermath of the earthquake. The post detailing the issue by Pix4D did not identify the source of the interference, but it is worth noting in any case [29].

***Rogue UAV Control***

Only one case, Hurricane Michael, cited the interference of UAVs in the response process. The after-action report noted that personal UAVs, as well as those of press agencies, complicated air rescue and survey damage caused by the storm. While the Federal Aviation Administration did administer fines after the fact, these devices represent a significant safety hazard to first responders [21].

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***Inability to Coordinate International Response***
During the Nepal earthquake, the fifty-three international search and rescue teams were responsible for only nineteen rescues. The main reason for this was simply the inability of the local response organization to integrate these teams into active missions. An important note in this case, however, is that the Nepalese military - the primary resource responsible for mass search and rescue efforts, was very effective during the response [30].

### *RQ4 - UAVs Used and RQ5 - UAV Mission*

*Were UAVs used during Response? How?*
*Based on collected data - what are possible missions UAVs could be effective at?*

Of the eight cases studied, only two mentioned the use of drones during response. In both cases, the drones were deployed by private companies and not by responders. In the first case, during the Nepal Earthquake, Pix4D made drones and their photogrammetry software available to local responders for using mapping and coordinating search and rescue efforts [29]. In the second case, Hurricane Michael, the American cellular provider AT&T deployed "Flying Cow" drones to the most affected areas to restore cell service to the area during the critical period just after the storm [23].

While drones were not used during the Boston Marathon bombing, Boston police later lamented the lack of UAVs available for the monitoring of the event and the response both for communication and situational awareness [9].

For further examples, a set of interesting Case Studies about Drone Usage in various situations including Disaster Management is available in the "Drones in Humanitarian Action" web page (URL: https://drones.fsd.ch/en/tag/case-study/).

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# 4. Field Studies

## 4.1. End User Stakeholder Mapping

### 4.1.1. Methodology

A questionnaire was prepared and distributed to the end users to prepare a complete stakeholder mapping in which all the relevant actors playing a role in first response activities, as well as their relations and dependencies, are described.

The Questionnaire had the following structure:

1. ***Policy Decision Makers***
    a. *The authorities (Organization/Legal Entity/Government Body) that define the legal framework and doctrine of civil protection response (administrative authorities)*
    b. ***Levels**: National, Regional, Local*
2. ***Operational Decision makers***
    a. *The authorities (Organization/Legal Entity/Government Body) that define and coordinate the inter-agency cooperation/collaborations (Civil protection Police - EMS response..)*
    b. ***Levels**: National, Regional, Local*
    c. ***Authority Types:** Police, Fire, EMS (Emergency Management Service), Investigations - Police/Justice, Support of Population, Medical & Hospitals, Inter-Agency Cooperation/Collaboration, etc.*
3. ***First Responders***
    a. *The authorities (Organization/Legal Entity/Government Body) that are in charge of the operational response.*
    b. ***Levels**: Regional, Local*
    c. ***Disaster cases:** Fires (Urban, industrial, Forest Bush, Wildfires), Anthropogenic, EMS, Search & Rescue, Climatic, etc.*
4. ***Operational Organization Description***
    a. *The authorities (Organization/Legal Entity/Government Body) that are in charge of the operational responses.*
    b. ***Disaster cases:** Fires (Urban, industrial, Forest Bush, Wildfires), Anthropogenic, EMS, Search & Rescue, Climatic, etc.*
    c. ***Interagency cooperation types:***
        i. *4.1. - Define in few words the Organization/Legal Entity/Government Body of the available response from the national to the local level specifying the different levels of command and interagency interactions.*

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ii. *4.2 Describe in few words the Organization/Legal Entity/Government Body of the available response from the national to the local level specifying the different levels of the organization of operations coordination.*
iii. *4.3 - Describe the Organization/Legal Entity/Government Body and means of Communication Channels/Layers between the different management levels and also between agencies during a disaster.*
iv. *4.4 Explain the Organization/Legal Entity/Government Body of the application of reinforcements and possibly specific means*
v. *4.5 - According to the 4.4, please add provide a general organizational chart of your emergency services in case of major interventions such as fire forest, flood, earthquake, terrorist attack, etc.*

5. ***Technical Questions*** *- defined by the RESPONDRONE Technological Teams.*
   a. *Is Internet usually accessible in the common disaster areas?*

#### 4.1.2. Results

The end user partners were asked to fill in the Questionnaire in Excel format. The questionnaires submitted by the end users are presented in Annex C.

Stakeholder information and different roles involved in first response operations are compiled in the Key Findings and end user Interview results sections.

### 4.2. End User Interviews

#### 4.2.1. Methodology

The end user interviews have been conducted according to the following Emergency Management stages, which were defined together with all end users:

- *Preparation*
- *Assessment & Coordination*
- *Response and Recovery*

**Note**: Informed consent was obtained from each end user.

Several targeted questions have been formulated and shared with the end users before the Interview.

***Preparation***

- *What are the main sources of information for an occurring disaster?*

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- *Where is the information physically received and registered?*
- *Who is involved with registering the information?*
- *Is the collected data stored electronically, and can it be integrated into the RESPONDRONE system if needed?*
- *Is the information classified based on the type of disaster or other categories? Can you please share with us the classification tree?*
- *Is there any Wireless Sensor Network equipment in use? What equipment is this, what type of information does it transmit, and where is this information stored?*
- *What other stakeholders can provide you with potentially valuable information (e.g. medical service, meteorological service)?*

***Policy Making***

- *What are the provisions in the policy, laws, and government decrees that potentially set standards for acquiring, registering and sharing information?*
- *What policy regulations best describe information exchange between various levels (Regional, Local) first responders and the other stakeholders involved?*
- *What policy regulations can give information on types of decisions made at various levels of emergency management bodies, along with their decision hierarchy?*

***Assessment***

***Disaster Magnitude Assessment***

- *What reconnaissance activities are involved?*
- *Who is commanding these activities?*
- *With whom is the information shared? (Please provide roles based on the type and magnitude of disaster).*
- *What are the main decisions and activities involved for assessment of the magnitude for a particular type of disaster?*
- *Are there dedicated information systems, decision making, and communication rules for various types of disasters?*

***Collecting Information***

- *What type of information will go into the disaster assessment report? (e.g. Impact on area in Square meter, type of terrain, civic and other structures involved, number of people affected/isolated, number of people in need for first responders)*
- *Who is responsible for collecting information from the field?*
- *Who are the main users of the collected information?*
- *How frequently is the information collected (e.g. once every 10 minutes, in real time, etc.)?*

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- *Do you collect any information from Social Media (e.g. pictures, text, etc.)?*
- *What are the main channels for communication of the collected information?*
- *Are there decisions made at the point of collecting information? Who is making decisions with what information?*
- *Where do you collect information coming from various sources?*
- *Is it centralised and what's the level of its integration with other types of information?*
- *Is any information system used for assessment?*
- *Does the information system have the capability to be shared among regional and local responders?*

***Assessing Magnitude and Decisions made***

- *What rules and regulations are in play that guide the Disaster Magnitude Assessment?*
- *What activities are involved in establishing search and rescue areas?*
- *What information is used by the commander to set the SAR areas?*

***Improvements, Challenges, Efficiency***

- *What are the major challenges with assessing the disaster?*
- *What improvements have been done in recent years?*
- *What are the main ways you measure efficiency of this process?*
- *What are the opportunities to improve further?*

***Involvement of with Other Stakeholders***

- *What other first responders or civic services are involved?*
- *What are their roles in this particular action?*
- *How do they get notified?*

***Response and Recovery***

- *Who makes the decision on First Response engagement?*
- *How the first responders routed to the area of disaster?*
- *What information do the first responders get before being sent to the site?*
- *What information do you update the first responders with, while on their way?*
- *Who is updating first responders? With what source of information? Through what channels?*
- *What are the instances the first responders face that require additional resources?*
- *How are these instances prioritised, if many of them occur?*
- *What are the main ways you measure efficiency of this process?*
- *What are the major challenges with assessing the disaster?*
- *What improvements have been done in recent years?*

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- *What are the opportunities to improve further?*

### 4.2.2. Results - Findings per each end user

The following data is available for each end user:

- Questionnaire
- Interview Recordings
- Interview Transcript
- Analysed Data presented below

*Armenia - MES - Ministry of Emergency Situations*

**Conducted on:** 09 July 2019
**Conducted by:** AUA

**PREPARATION**

**Sources and format of information**
The primary source of collecting information on emergency situations are rescue numbers. Both 911 and 112 are in operation. The receiving call center can transfer information and call to both police and healthcare emergency units. The MES has call centers operating in all regions, who get direct call from the region and in case of excessive number of calls the national Call Center under the CMNC (Crisis Management National Center) will handle the call.
MES is also receiving information from Hydrometeorological center, which is an NGO independent of MES. Hydromet center provides early warning weather related, as well as alerts from level of dams monitoring system. ALTER project is an EU project which upgrades dam water level monitoring system.
Yet another source of information is the seismic service that has stations in Yerevan and 3 more regions.

**Technology used (Systems software)**
The call center operator of CMNC, inside MES, it is rescue service of MES. All the received calls are voice recorded. There is no software platform to input the data, but the recordings are stored and can be sent to decision makers. The call center is planning to install an electronic call dispatching system. The call center operator has standard responses described in the instructions.

**Laws and Regulations in play**
Any kind of emergency, anything that is classified as an emergency, is regulated by the "Law on Emergency situations", including all aspects related to disaster and how the

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MES is involved. The “Law on Emergency Situation sets areas of responsibility, dependencies, major roles.
Another law “The Law on Rescue Service” provides guidance on operational level such as: the chain of operation, responsibilities of involved roles, hierarchical dependencies, by certain types and levels of disasters, as well as types of emergency situations. The law provisions are described only for post disaster situation, but it does not cover on-going risk reduction, monitoring and assessment aspects of disaster. With standard operating procedures the head of Operating Shift is granted with the right to call directly the Prime Minister, for major disasters. With major disasters at the moment only the National Security Service is granted the right for major decisions and currently amendments are being discussed to grant MES similar authority.
The tactical decisions are not regulated, depends on how the situation unfolds, and some scenarios are created for training purposes.
In addition, there are government decrees for various types of major disasters, such as major earthquake, etc.

**ASSESSMENT & COORDINATION**

**Critical Information collection, verification and communication**
The base center of MES (Ministry of Emergency Situations) for collecting information is located in Yerevan. The regional call centers pass on information right to the troops that are the nearest to the location of the emergency. The information is also communicated to health emergency and police, but the Firefighters are informed immediately.
If the emergency is big, the information is reported first of all directly to the head of rescue service.
In some cases, MES can collect information from FB, where they have their information page and citizens can write there.

The end user reports that **verification is made based on the number and frequency of calls**. The call center operator has a standard set of questions and has only one minute to make a decision on acting on the call. The **questions also help to construct the 3D image** of the location. There is an internal “Instruction 68” approved in 2018 that regulates call response process.

**Sources and Technology, Frequency (Integration, shareability - vertical, horizontal)**
As reported by end user, the MES has **information center that publishes and collects information from social media.** The information center also produce **regular daily report.** There is direct phone and digital connection with all departments in regions and the head of rescue service gets their reports through these channels.
The **information sharing is mainly done through transferring call to various services**.

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There are **alert systems tied to monitoring sensors** for earthquakes, hydromet service, reservoirs and landslides. All calls received are also considered alerts. In addition the government services such as Police, National Security Service and Health Emergency center can raise alerts to MES.
The received alerts are reported in a document. Phone conversations and other media (video, pictures) that were made available are archived. The information center can produce a summary note. For urgent cases the CMNC can activate troops in regions directly.
The information dissemination among the population is done through mobile text and sirens within a maximum of 10-minute period. Currently all alerts are sent to everyone, all citizens, but work is undergoing to make more targeted alerts via text messages.

**Roles involved (both collecting and using)**
As described by end user, roles involved in Emergency Management/response depends on the level of Emergency Situation.
For local level the MES regional department allocates the closest troops. For regional level disaster the Local Governor (Governor of Region, regional territorial units) takes the responsibility of commander and coordinates allocation of available resources and services (police, health, hydromet, personnel at natural reservoirs).
On national level the Government of Armenia forms a committee that coordinates that rescue and emergency management of other operations.
There is also psychological assistance service, both for citizens suffering from disaster and rescuers. There are also departments that provide statistics and release public information.
Another unit is doing monitoring and forecasting, risk analysis and creates simulations.
There is also unit responsible for conducting training.

The CMNC forms a committee in emergency situations where 2 people from each ministry are involved (to make sure they are present)

**Types of decisions made with information**
According to end user main information is used to make a decision on the level of disaster and involvement of various troops and services. The thresholds are set that require information in certain situations to be communicated to certain level.

**Activities (Magnitude Level)**
The end user reports that currently there are no well-developed tools and technologies to calculate the magnitude of the disaster. Most of the time it is done by emergency services attending the event. It is very critical to use technology to see the geographical spread and kinetics. Some information is provided by NGOs that have some measuring tools.

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For coordination with other services the Crisis Management Center has a special area with displays and information is shared by everyone who gets in the room and through phone, video conversations. They use various maps, including Google Maps.
The regional troops in case of regional level disasters are all getting orders from the Yerevan Center, which means they may not need that type of geographical information. First responders for their tactical operations need not only scale but also some imagery help with finding people in the area.

**RESPONSE & RECOVERY**

**Information used and exchanged (routing, other)**
At the scene, the Head of the Unit, who is in direct contact with the Head of the Operating Shift, makes decisions. Combating Units at the scene exchange information through Walkie-Talkies and the conversations are also being recorded. All rescue cars are GPS monitored.
It is the responsibility of the Head of the Operating Shift to involve other forces / ministries if needed. The Minister of Emergency Situations is the Chairman of the Emergency Situations Committee.The Emergency Situations Ministry is considered the Prime Minister's Reserve Center.

**Improvements and measuring efficiency**
The **biggest challenge in measuring the scale** is the location.
When there is an emergency, disaster with high kinetics, fast-moving, which can cause the most damage, the first important thing for the first responders is to get as accurate data as possible, and as quickly as possible. The end user would look for the following information:

1. the places of hard accessibility,
2. the places where there are no other sources of information and
3. no way to move by the car to get access to, (forest, gorges, mountains)
4. the geographical spread.

The rest of information regarding the mapping, direction, information that can be obtained from satellite, GPS or GIS, all information that is possible to get.

The Ministry of Emergency Situations once had a UAV department and has trained specialists, but due to the lack of UAVs, specialists have been involved in other special operations.

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*Bulgaria - RAV - Regional Administration of Varna*

**Conducted on:** 18 July 2019
**Conducted by:** AUA

**PREPARATION**

**Sources and format of information**
Emergency Central Phone number 112

Bulgaria uses 112 as a national rescue/emergency phone and another 668 which is part of the telephone set of the regional administration. Both are 24/7.

**River Level Monitoring Station** was installed as an information source. The end user reported about an EU program of last 5-6 years, within the framework of which most municipalities of the territory develop monitoring stations for level of sea and river. These stations record data and exchange information. These systems are coordinated by the Ministry of Environment and Water and can send alerts to first responders.

**Floods monitoring system** - sensors - the Ministry of Environment and Water collects information from sensors and they communicate with the regional governors, like the Governor of Varna region.

Maritime Administration and Port Authorities have newly built and newly equipped centers. These organizations conduct 24/7 observing and monitoring of the sea. There are a number of ports - container ports, freight ports that are being monitored 24/7. There is also a port for chemical goods, which is also constantly monitored and observed, because part of the Varna region there are many chemical factories, which is considered a potential source for disaster, too. Another unit that is being monitored 24/7 is a newly built gas terminal.

Also, the Maritime Administration has a number of vessels which are also monitoring stations. So, these are also responsible to assist and support or provide information.

Besides, the Naval Academy of Varna, has very well-equipped room for simulations and for training. For example, for petrol disaster in the sea, they have simulators for nine ships, training how to react, how to make decisions, how to operate.

**Technology used (ICT - Systems, software) - Level of integration (vertical, horizontal - e.g. other stakeholders)**
All calls to national number 112 are recorded, each communication, and these recordings are kept for some time, approximately a month.

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The end user reports that all communication is done by phone only, and there is no software-based system for registration. The information is transferred by making another call.

**Laws and regulations in play - Legal aspects of communication and decision making**
The Disaster Protection Law sets framework for planning of disasters at 3 levels:

1. Municipal
2. Regional
3. National

For implementing emergency management activities all three levels are obliged to prepare plans for protecting the society of disasters. These plans actually consist of organisational and coordination activities according to different kinds of disasters. Normally the plans will include:

a) analysis of the potential disasters
b) forecast of the results of such disasters
c) measures to decrease the risks of disasters
d) measures to protect the population
e) distribution of the responsibilities of different experts or organizations
f) observe the resources which are available or needed for fighting disasters or solving disasters and crisis
g) way of communication and coordination between different levels and different stakeholders.

The three levels in the Disaster Protection Law regulating emergency management reflect the 3 levels in Bulgaria administration:

1. Municipal
2. Regional
3. National

For example, Regional Administration of Varna is an administrative unit and it is composed of 12 municipalities in the territory. So, these municipalities will develop 12 plans and then, one regional plan together.

Throughout Bulgaria there are 28 Regions, which are grouped in 6 planning regions. Northern and Eastern Bulgaria has 4 Planning Regions and South-Western and South-Central Bulgaria has 2 Planning Regions (southeast, central east, and northeast, etc.). More on the structure of statistical Regions of Bulgaria can be found here: https://en.wikipedia.org/wiki/NUTS_statistical_regions_of_Bulgaria

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For coordination of activities during disaster normally 40 people will meet. The head of this committee is the Regional Governor, as a representative of the Prime Minister (regional governors are appointed by the Prime Minister). And all the other institutions represented by appointed person are members of this committee. They meet regularly, record memos, and attend many trainings and simulations.

As end user reports, depending on the type of the disaster they have a structure, and the institution which functionally is the closest to the topic, makes/suggests decisions and lead efforts. The Governor is responsible for making decisions and he/she is advised by experts from different agencies.

**ASSESSMENT & COORDINATION**

**Critical Information collection, verification and communication - Sources and Technology, Frequency, Integration, shareability (vertical, horizontal)**
Verification of disaster depends on the situation. If it's reachable immediately, they visit the place.
They do not use drones up to now. However, the end user reports that recently, the Ministry of Interior started using drones for cases at national level. In case of a very serious event, there are navy helicopters in the Varna navy base.

**Roles involved (both collecting and using)**
The end user reported the following agencies that can get involved during a disaster: Ministry of Interior, Ministry of Environment and Waters, Naval Academy, Maritime Administration, Regional Governors, Health Authorities

**Collaboration with other responders**
As described by the end user the national **112 call center doesn't report to governor**. It reports to the police at local level. And then, based on circumstances, they may call the governor or other service, e.g. medical service, traffic police.
Call center receiving calls on number 688 is within the regional governor's structure and operated by Governor's staff.

**Improvements and measuring efficiency**
The end user thinks that the drones can help governors get more information on the disaster, as well as RESPONDRONE can help Governors better understand the potential of drones and the system that is being used with the drones and persuade to get such fleets in all regions.

Drones can be useful for chemical industry related disaster or for gas or for petrol related disaster in the sea. The end user also thinks drones can be very helpful for

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monitoring trains transporting different chemical products, because loading is quite fast and very difficult to measure and to scale.

The end user reports that in recent years Bulgaria didn't face major disasters. There were several disasters 4-5 years ago with no major consequences. There was a flood from the rain exactly four years ago where 17 people died, in the center of the city. That was the biggest disaster the end user could recall.

When there is a flood, normally the governor or the mayor immediately go to the site, accompanied by deputy mayor who is in charge of emergency management. The governor's office will within half an hour form a "crisis shtab" (emergency management committee), which is an obligation. The shtab calls all those services, they have on their list and start to collect information to analyse and to provide decisions and actions. Information comes from different institutions, that use different maps, different data, which is collected and recorded from the monitoring system.

**RESPONSE & RECOVERY**

**Information used and exchanged (routing, other) - Roles**
Each institution has its own monitoring room. Maritime Administration have its own room with monitors. Port authority has its own room.

Normally the governor's group gathers on the site, if possible, or near the site, as well as in the governor's office.

Although, the Governor is the main responsible for Emergency Management, the Governor's office doesn't have any equipped room for monitoring; they just receive calls in the "crisis shtab" and coordinate communication among the involved institutions. But still the governor is responsible for the decision. In other words, the Governor's office is a coordinating agency. And each of those institutions who have first response duties have an operator sitting in operational room and responding and receiving calls 24/7. In case of serious situations, the governor and the "crisis shtab" members will use the most newly built well equipped room of the navy.

The Firefighters represent a separate, unit but they are part of and report to the Ministry of Interior. In addition, the end user reports that there is a separate unit for civil protection. The Civil Protection unit has special equipment, located in the city center.

**Technology**

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The firefighters do not have drones. The Ministry of Interior has Drones and Firefighters can ask to use them during crisis.
Until now the Ministry of Interior used drones for fight against criminals, or refugee-related operations but not for disasters. MOI also uses helicopters.
Up to now they use these helicopters.

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*France - HCFDC & SIS2B*

France - HCFDC - Haut Comité Français pour la Défense Civile
France - SIS2B - Fire Fighter Department of Corsica

**Conducted on:** 17 July 2019
**Conducted by:** AUA

**PREPARATION**

**Sources and format of information**
Information about the catastrophic events, climatic or civil protection events is received from several main sources. A lot of information and calls are received through the call center and most of the calls or the main calls are made through cellular network. With these calls people are mainly asking for help using rescue number 112. These are classified as emergency calls.

Other sources of information are Meteorological Center, Emergency Management Services, Law Enforcement authorities, Health Service, Ministry of Ecology and many other partners from whom the end user is getting information on prediction of events, the impact of events. Quite often information on events is received by internet. Rescue service gets alerts and can scale up response capabilities.

Population in France mainly uses 112, along with three other odd numbers, 15, 17, 18 (18 for fires, 17 for police and gendarmerie and 15 for emergency medical services), but 112 can be used for every type of emergency.

**Technology used (Systems software)**
The end user reports that at the NCER (National Center for Emergency Response) there are rooms for various purposes of communication and coordination of Emergency Management such as: Call Center; Center for Anticipating Events, where all information for prediction, forecasting of events is gathered. There is also room for interagency meetings for Big Scale Operations, (e.g. for forest fire bringing together forest service, department of Collectivity of Corsica, Law Enforcement, Emergency Management Service, etc.).

Préfecture has similar room, the state representative in Bastia, these are interactive rooms, interoperable between the headquarters of the firefighters and the room in the Préfecture with the same participants.

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The end user reported an upcoming project for the next 5 years, which will be an interagency system, having more automatic systems capability for the firefighters, as well as for EMS. As reported this new system will have new digital tools and will be interoperable, meaning that the call could be sent to another platform, which is not exactly the case today, especially between firefighting department and EMS.

**Laws and regulations in play**

As reported by end user on regulatory level, France has an operation fragmentation policy that take into account different stages. Most of this scalable system of resources begins with appropriate planning. There are different scales of planning of operation. Like any common centers, either for firefighters, or either for zone or for national level, these are scalable for 3 levels: levels 1, 2, 3, define number of people working on the crisis. Level three is a major crisis with maximum impact, Level 2 is a moderate crisis, and Level 1 a small crisis. These levels are defined, and actions and resources are put in force either through the planning, or by the decision of Emergency Crisis Managers representing different authorities, allowing to scale up the response system and command center level.

Basically the system in France is the same everywhere: there is departmental organization, the Prefect, which is acting at the interagency level, and the prefect is the head of the organization of operations in its territory, the Prefect is the real crisis manager of the system.
The Prefect is supported by all the emergency services, who have 24/7 operations services which are also reached through emergency call number 112. In 80% of the cases the 112 calls are addressed by the firefighters. Sometimes it can be addressed to the law enforcement, police or gendarmerie, which are separate systems and the Prefect serves as an interagency coordination authority.

France has division of seven zones in metropolitan areas, and in each zone there is a coordination center, which is going to support the firefighters department in case they need other services, such as law enforcement in case of disasters. These zones centers are 24/7 operational and zone prefect, which is prefect of the department or the big town, major cities, major metropolitan area in this department, is doing the interdepartmental support for all the fire agency and police and gendarmerie support for any kind of incident or disaster.

At the national level, with national resources, the activity is done on the level of the Ministry of Interior, even on the level of Prime Minister if the crisis is major.

**Regulation on flying drones**

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**T**he regulation forbids the use of drones for surveillance in full time regime. That's a big challenge for the emergency management stakeholders. In the sector, everybody is waiting for the new regulation to be able to develop new use of drones at the operational level, and not only at the tactical one.

The situation is being improved, since 1 of July the European Union brought into action new regulation, which will make things much better for first responders, although it is still limited.

**ASSESSMENT & COORDINATION**

**Critical Information collection and communication**
Verification of the information on disaster is quite straightforward, as for big operation, there are many incoming calls to the call center. In the beginning of the operation the end user reports using their own GIS, which has a lot of information regarding the area covered by the department, where it is in charge. There is a lot of information, like critical points, lands, the forest, everything. There is a lot of information integrated in the operational system, and good mapping of this type of information is available.

Most of the firefighter department got GIS system and currently few types of information can be received as live information, for instance traffic for main roads

**Use of Drones**
The end user reports that they do not have drones, but the country participated in multiple EU and international projects in this direction. With RESPONDRONE the hope is to use drones at larger scales and to be able to get some information, including mapping. Drones could fly lower than the helicopter, which is an advantage, especially in snow season when flying helicopters can be very difficult and risky.
Few fire departments in France got drones, but they are tactical drones. These existing drones are intended for very short sight to see behind the building or see it from above.

**Integration of Information**
There are 100 departments in France, each one has its own responsibility for buying its GIS, its information systems, its call center and everything, so these systems are fully independent and heterogeneous, which makes integration not an easy task. In addition, Police and Gendarmerie have their own systems, and can't share the information contained in their system outside their department.

On the national level, currently for each department there is an information logging system, which is going to be shared at a national level. Department enters the information and this information will be seen by the coordination center and at the

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national level as well. This system is called Synergy, and it can handle only typed-in information, no other media. This information is shared at the level of department, with the fire department and the department of prefect. The interagency also uses this system, but not the Gendarmerie. This system allows the interagency information sharing at the level of prefect or at the level of the zone and the national level to be linked with the fire department, who can also log in and enter information. The police and the gendarmerie enter information on this system at the level of prefect, not at the level of operation center.

**Roles involved (both collecting and using)**
The handling of the calls can be done at three levels: 1-Operator; 2-First Officer; 3-Superior Official, based on the number of calls and evaluated the impact of the emergency.
Operators at the call centers register a lot of information. There are 3 levels in the call center: 1st is the operator, who take the call for the reference. Then, there is the first officer, who is in charge of the room, and there is another higher level, that is a superior official, who can manage a big operation. These levels of responsibilities or enactment of official depends on the number of calls, area of interest, number of affected population.

**Activities (Assessing the Magnitude and deciding on Level of engagement)**
There are many indicators to evaluate the magnitude of disaster such as: number of calls, area of interest, if it is a rural area or urban area, the amount of population that could be affected by this event, the astro-meteo, day time, school period or everything counts.
Based on what the operator and the first official have evaluated they can alert the upper level to come in the room and to manage the operation and maybe activate the room to be able to get more information from other agencies.

In case of a big disaster they can have information by national fleet, where they have helicopters, or any other machines. The ability to evaluate at the beginning, before the disaster got to the national level, is very important. From this perspective there are two very important elements, (1) the plan, the planning and provision, and (2) the capability for early evaluation of the event.

There are many tools available at the local level, because some departments are investing in specific tools, such as planes or helicopters or drones. They have capabilities both on the local and national level. When there is a major forest fire, the national airplane fleet is used. The use of this fleet is activated by the coordination centers, after the department has issued a request.

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***Geopositioning system for vehicles***
In Corsica all vehicles have GPS but not all fire departments' vehicles are geo-located.

The law enforcement and gendarmerie got positioning devices. Some fire departments and fire trucks also have those devices installed.

In Corsica all vehicles are geo-located, but at the beginning of the event they have to do an evaluation of the event, based on the number of calls, the area of interest etc. There is also a good mapping of the area. The most important thing is to perform an accurate evaluation in the beginning of the operation, as soon as possible.

**Improvements and measuring efficiency**
New Interoperable System Reform NEXSIS - The end user reports that there is a big reform coming, for the next 5 years, which is going to introduce the same system for all departments and it will be under the Ministry of Interior. The new Agency, called Digital Agency was founded for the civil security, for the civil defence, for the fire fighters mainly. This Agency has developed a roadmap to introduce the new system. It will be based on the same standards and it will be fully interoperable with other external system, which is not the case today. NEXSIS reform. (e.g. if you have for instance call center, which is down for any reason, such as blackout, the new system will allow full interoperability). The system also will develop many-many **new features for the geolocation of the call**.

**RESPONSE & RECOVERY**

**Engagement, Responder and Type of equipment**
In Corsica, the system used for first response (was done to save EADS (Early Assessment of Disaster Scale?)) and the technology is based on first generation GSM. It's a very old system now, and it's not able to transfer big data.
The end user also reports that it is very difficult to speak with law enforcement responders, because there is only one channel interoperable with police and gendarmerie and it's very difficult to use it even in case of terrorist attack. The end user then needs to use another system with liaison official between common post of the police and common post of the firefighters. On the other hand, it's easier to speak with an EMS (Emergency Management System, the system with a numeric radio), as it works better.
At the operational level the end user says they have to speak using this system, and they avoid using a cellular connection. But the numeric radio system is good for urban areas and causes difficulties in the rural areas or open fields. The end user also reports that, when problems occur with the electronic system they use satellite communication, which can replace the electronic radio.

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**Information used and exchanged (routing, other) - Roles, directions of communication**
During response operations there are 4 levels of communications: there is a possibility to speak from truck to truck, from trucks to the chief and also for the chief to speak with the coordination center.

The first responders can speak with the coordination center in the beginning of the operation, then speak to his chief, and then the chief speaks with the coordination center.

At the beginning of the operation, as reported by the end user, plenty of organizational work is being done. In case of a national operation they have to define many organizational and communication sectors that are based on geographical and other criteria. Each sector has a dedicated channel to speak, and the chief of the sector can speak to the commander of coordination center.

**Technology**
There is one national radio system called PMR, which is almost the same between the police and the fire department but using different frequencies. Systems also have different names, but the technology behind is the same. It's a big network, which has been developed by Airbus and is called PETRA.

The gendarmerie has a system that is slightly different. Everything is shared on the network, which is called Shared National Radio Infrastructure. There are specific networks using this infrastructure. It's an encrypted radio network with couple of information sharing capabilities, but it's not meant for big data or files, it's mainly for voice. They can do a conference call and they can link that to GSM. It's not a smartphone technology to send an image, video.

**Improvements and measuring efficiency**
Ministry of Interior works on developing new system technology and within the next 5 to 7 years, it will be spread into the relevant forces. It's a technological revolution, and the network will be changed. Current system has been used for the last 10-15 years, and the system will remain in place for the next 5 years.

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*Greece - RCM - Region of Central Macedonia*

**Conducted on:** 17 July 2019
**Conducted by:** AUA

**PREPARATION**

**Sources and format of information**
Typically, information is received through a telephone call from Fire services or other local authority; seldom does it come from a citizen who has been affected by the disaster.

**Technology used (Systems software)**
Draft notes are kept by the staff on duty, and then the information is transferred in an official registration document. Each civil protection authority has its own procedures of collecting, disseminating and registering information concerning emergency situations.

Computers, laptops and physical archives are used to store the incoming information about the disaster. Specific techniques are used to archive this information (e.g. administrative documents, documents concerning the disasters by categories, etc.).

The information which is collected should be reliable and useful. Thus, only certified officials collect data, and they use specific procedures for the registration and treatment of the data.

Unfortunately, each organization has its own procedures. However, Cerberus software of Central Macedonia is a central point where many different users can find useful information.

**Level of integration (vertical, horizontal -e.g. other stakeholders)**
Key parties include civil protection employees with administrative duties, as well as the Heads of the departments and the administrative staff. Major meetings are typically organised and official report documents are kept.

**Laws and regulations in play, legal aspects of communication and decision making**
The national law (**Xenokratis, General Plan of Civil Protection**) specifies certain categories of disasters. There is a special appendix classifying the disaster categories along with details concerning the origin, the effects and the consequences of the disasters. The most commonly referenced disasters are: forest fires, earthquakes, floods, intensive weather phenomena and landslides/rockslides. Technological disasters

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comprise a separate category, as do other civil protection incidents such as terrorist attacks, airplane accidents, epidemics, etc.

However, there are some official guidelines suggesting the reporting the disasters (especially floods) by using specific forms and Excel files. Furthermore, Special National authorities (e.g. the General Secretary of Water Resources Management) typically monitor and register relevant data.

The national law specifies the type of information which must be reported. However, the staff involved usually collect the appropriate information needed for the effective management of and recovery from the disaster.

**Additional Stakeholders**
Voluntary organizations may play a significant role, especially because of the financial difficulties faced by the Greek economy. Additionally, the so-called “smart development” or “green economy” could be combined with investments on civil protection. Special studies are in need.

Voluntary organizations usually support the actions of the official civil protection authorities. However, there are some limitations. There is a need to train their members and supply them with appropriate accessories and tools.

They typically get notified through the main civil protection authorities who are involved in each disaster case.

**ASSESSMENT & COORDINATION**

**Magnitude Level**
When a disaster is taking place, it is difficult to assess its magnitude immediately. This is done after the end of the incident.

Typically, technical staff (engineers) employed in relevant departments conduct a detailed survey of the disaster’s effects. They usually take photos and draft estimations of the general impact. Special emphasis is given on public infrastructure and its functionality. The region is particularly sensitive to public health issues. Road infrastructures should also operate without restrictions.

**Decisions made**
When a disaster takes place, an official undertakes the coordination of the situation on the spot. The Regional Government Governor, the Vice Governors in the Regional Unities and the city Mayors are responsible for the general coordination of the situation,

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in relation to the extent of the disaster (the geographical area) and the sort of the disaster, as well as the real impact. The Head of the civil protection department works in close cooperation with other authorities (fire services, police, forestry, military), sharing certain responsibilities.

**Collaboration with other responders**
Local authorities may provide this information to regional and national authorities. In the Region of Central Macedonia, there is a specific software registering the main disasters. It is called Cerberus. However, it is not regularly updated, because of the everyday workload and other difficulties. **Sensitive data is only treated by certified officials.** The authorities are very careful about the information disseminated to the Mass Media.

**Activities**
The assigned staff goes to the affected area and monitors the situation. Information is collected via various (reliable) sources (e.g. testimonies of the Presidents or citizens of the Local Communities). A **detailed list of the impacts on the public infrastructure** is created. For example, damages to roads, bridges, buildings, rivers etc. Quantitative data, in a draft format, is kept, and then a more detailed description may be produced in the headquarters of the service involved. Photos and videos are produced, and GIS may be used.

**Disaster assessment report**
Depending on the type of the disaster, these reports typically catalogue the impact on an area in square meters, the type of terrain, the civic and other structures involved, the number of people affected/isolated, and/or the number of people in need for first responders.

The Leaders of the authorities involved take these decisions, based on the preliminary information collected on the spot. Priorities for action are specified.

**Roles for collecting information from the field**
In the field, information collection is typically performed by engineers and other technical staff. Primarily, experienced employees are used from whichever department is most relevant to the sort of disaster. Typically, the staff comes from the Department of Transportation Infrastructure or the Department of Environmental Infrastructure. The technical Division of the particular organization is typically involved.

**The main users of the collected information**
These main users include officials who need to take action for the management of the emergency restoration. Authorities' leaders and Heads of civil protection departments

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also make use of the collected data. There are specific procedures for the assignment of technical projects which are needed for the prevention or the restoration of the disaster.

**Channels of communication**
The information is communicated primarily unofficially, frequently through telephone calls, mail, or even instant messages. However, official meetings usually take place where each authority presents and shares the relevant information with others.

**Information collection frequency**
Information collection frequency depends on the sort of the emergency situation. The official on duty or the coordinator of the emergency monitors the situation and asks for updates regularly, in relation to the specific needs of the case. In most cases (e.g. a major flood), it is difficult to collect information when the disaster takes place. A few hours after the disaster, a group of experts will go on spot and start a draft assessment of the situation.

**Information transmission methods**
Mobile phones and radio communication stations are used. The radio communication system of the Fire and Police services has a recorder which records all the conversations. There are no cameras or other sort of technological solutions in use. Central civil protection authorities usually use more advanced technological solutions.

**Social Media as information source**
This sort of information is not considered as reliable. Pictures and videos are usually selective information which does not depict the whole context and impact of the emergency.

**Search and rescue**
Special groups of people are assigned for the search and rescue (SAR) activities. There is a special Service for these sorts of activities—a branch of the Fire Services called **Edomak,** the Special Group for the Management of Emergencies and (Natural) Disasters. The staff of this special group is highly trained and equipped with certain appliances, devices, gadgets and technological accessories. Trained dogs also are also used in the search for survivors.

The primary information collected on spot is typically used by the commander to coordinate SAR activities. Precautionary measures are also taken in order to avoid harm to the officials who are searching the area.

**Efficiency of SAR**

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There are no specific ways that are used in order to assess the efficiency of the process. However, because of the limits on economic and other sorts of resources, special care is taken in order to make use of the available resources as efficiently as possible.

**Challenges with assessing the disaster**
The effects of a disaster are not always well defined and understood. For example, psychological effects are complex and not easily definable. The time dimension also adds complexity to the assessment of a specific disaster. A domino effect may be considered.

**Current and planned Improvements**
Most of the officials who participate in the prevention, management and restoration processes of a disaster have enormous experience with the management of relevant situations. **Knowledge management** procedures are not very systematically implemented, although they have been scheduled. **Cerberus software** and **GIS** installed in almost every department of civil protection are significant steps towards a more effective civil protection mechanism on the local, regional and national levels.

Planned improvements will be made through the use of **modern technological innovations**, as well as through **investments on human capital, training and psychological empowerment.**

**RESPONSE & RECOVERY**

**Engagement, Responder and Type of equipment**
The nature of the disaster specifies the type of the first response engagement. If there is a forest fire, then the forest services will be involved primarily. In case of an earthquake, then technical municipal or regional authorities will be involved. Certainly, the authorities participating in the local, regional and national mechanisms of civil protection work in close cooperation. For example, the police have the responsibility for the regulation of transportation in the area affected.

**First responders' route and transportation**
Only professionals and certified staff are involved in the first response actions. Typically, public vehicles are used for these actions.

**Information available to and from the first responder**
It is very important to be sure that the information concerning the emergency situation is reliable and that complete information is available for effective response. The specific address, geographical information and the type of the disaster are requested. It is important in this phase to have reliable and specific information in order to send the

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appropriate group of people and equipment to the site. It is also crucial to know if there are human victims, in order to send ambulances or other sorts of help.

On the site there is always an official who guides all management actions. According to the nature of the emergency situation, supplementary information may be needed. For example, if there is a technological disaster, specific information is needed in order to coordinate the appropriate response actions and mobilize the appropriate staff and equipment.

Typically, there are plans and guidelines published by the General Secretary of Civil Protection which can be used. The Head of each authority involved may ask for specific types of information in order to make estimations for further actions.

**Involving other resources**
When the disaster is unusual in magnitude or sort of impacts, then specific knowledge may be needed. Experts or technical staff may be involved. Typically, experts from the Universities are called to support the management of the emergency situation. The experience from the past is not always appropriately stored and used (again a **knowledge management issue**).

There are some criteria which can be used to prioritise the disaster instances, but they do not have official approval. **Human life is the first priority** and **then the public infrastructures**. Natural and Cultural heritage are also important. Vulnerable social groups are also considered, such as hospitalized people, children, refugees, etc.

**Main ways to measure the assessment efficiency**
It is not always easy and straightforward to assess the efficiency of the emergency management actions. There are some values which cannot be measured directly. Because of the **financial difficulties** of the last few years, Greek civil protection authorities do their best in order to minimize **the economic cost** and make as much as possible with minimum resources. However, there is a need to invest on prevention rather than on the restoration after the disaster.

**Major challenges with assessing the disaster**
Global warming and Climate change are probably a reality and not an urban myth. During the summer of 2019 there was a natural phenomenon of extreme weather changes. There were a few deaths and many more injuries. Public as well as private infrastructures were destroyed. Fortunately, the emergency situation was predicted in advance, and local and regional authorities took immediate action.

**Improvements and measuring efficiency**

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There are specific plans for the improvement of human as well as technical assets of each organization involved in civil protection management. A series of meetings and discussions have shown the weaknesses and the strengths of the civil protection system in Greece. Also new legislation has been initiated, and the new government has promised that civil protection will be a significant priority of public administration reform.

The coherent implementation of the new legislation, as well as training of the staff and appropriate equipment for the organizations is needed.

Technology may play a significant role in the future. However, people are the most crucial factor considering the effective management of civil protection in the different administration levels.

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*Greece - RWM - Region of Western Macedonia*

**Conducted on:** 12 July 2019
**Conducted by:** AUA

**PREPARATION**

**Sources and format of information**
The national meteorological services provide information on expected changes in weather conditions that could endanger lives and property. This alert goes to the Civil Protection General Secretariat in Athens, and then it is spread to all regional and local civil protection authorities.

Information first goes to the General Secretariat - national authority of civil protection

Every day in the summer period, the general secretariat of civil protection provides a map about the risk for forest fires at the level of each regional entity. The Region of Western Macedonia has four regional entities, all of which get notified/alerted.

The General Secretariat cooperates with the National Observatory of Athens that is responsible for the meteorological stations network in Greece and has access to satellite images from different European networks.

For forest fires, floods, and extreme weather conditions, there is a general warning system based on sensors. But the sensors cannot make local predictions and warnings.

There are some sensors for water level that also provide information, e.g. **Sakoulevas** river in Florina in the border with North Macedonia-Skopje.

There are also a few accelerometers for landslides. Together with North Macedonia, a new measuring station for landslides in the city of Florina was installed.

**Technology used (Systems software) and Level of integration**
There is a problem with the means of the forecast. The information is being distributed to the civil protection authorities by fax, not even email or SMS. This is a big issue especially on weekends and public holidays. On those occasions the regional civil protection authorities call the mobile telephones of all the mayors or all the civil protection personnel of the municipalities to inform them about the extreme weather conditions and ask them to be prepared.

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People are not used to other technological solutions and electronic information, and that is a big challenge.

The only information that gets registered in the system at regional level is the report. When there is an emergency situation or there is a disaster, then, by law, the regional civil protection authorities have to create a report. This report is completed afterwards, after the emergency first response phase is finished. The regional authorities use this report to analyse the reasons for the disaster and the damage it caused, then it is sent back to the General Secretariat of Civil Protection. Then the General Secretariat reminds the regional and local civil protection authorities what kind of plans they should have, to be prepared for such cases of emergency.

The general public is being alerted/notified via announcements in the traditional media - television, radio, also Internet and newspapers. The announcement usually contains information about the location of the disaster and the practical steps people should take to be safe if they are close to the area.

The European 112 hotline number is not working in Greece. The number is registered, and the calls are accepted by the General Secretariat of Civil Protection, but the general public is not aware that the number exists.

In the last report of European Commission on February 2018, Greece and Malta were the only European countries that did not report to the Commission any alert system.

People usually call the police or fire brigade - whoever they believe can answer their questions. A citizen can also call the civil protection office directly - but they have to know the number. There is no unified center that receives calls by the citizens and redirects accordingly. The calls are being registered in each organization separately, and that becomes a major issue of coordination.

Police can receive a request that must be addressed by the fire brigade. There are no automatic procedures that send the requests to the most suitable entity.

**Laws and regulations in play**

**Legal aspects of communication and decision making**

The responsibility lies on the fire brigade for almost all cases of disasters.
The Civil Protection General Secretariat is more of a supporting body rather than an operational body. They have an operational center, but unlike a true operational body, they do not have their own budget.

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The civil protection plays an intermediate role trying to cover the expressed needs by the fire brigade, by the regions in order to support them in the field.

For mobilization purposes there is a law for volunteer organizations to be registered to the Civil Protection General Secretariat to be certified and used in operations. So it serves as an intermediary support body that plays a role in the prevention phase; they send guidelines (updated every year) for how to organize plans and elaborate plans for the different kinds of risks. The problem is that this is done from Athens, and the guidelines do not always cover each region's needs.
By the law the regional authorities and the municipalities have to create special plans based on a general example, provided by the General Secretariat for example the general plan **Xenokratis** for the earthquakes.

The municipal services of the city that have been damaged by the earthquake have to clear the roads, opening some roads for the fire brigade by the guidelines. But there is not a concrete plan specifying which roads need be kept open for evacuation or for sending people to the hospitals. The municipalities and the regional authorities have the obligation to make these special plans by law and send them to Athens for approval. But, in reality only a few municipalities have created these special plans. Even when they do submit such plans, the General Secretariat in Athens does not approve or disapprove or make remarks. There is a big gap between the regions and Athens, and as a result there is a general dysfunction of the system.

It is a matter of responsibility. If the plan is approved, then the responsibility lies on the General Secretariat.

**ASSESSMENT & COORDINATION**

**Critical Information collection and communication**
If the police receives a call that is related to the fire department, they will then connect the caller to the regional civil protection.

The fire brigade is in most cases in charge of the operations. The information is mostly passed to the fire brigade because they have also a lot of people in the fire brigade. Each municipality has one or, at maximum, two people with lots of obligations working on emergency management. The mayors and regional authorities in most cases do not regard civil protection as a basic service that they have to provide for their citizens and for their areas.

When the airplanes or helicopters get pictures of the disaster area, they distribute them through the platform of the entity they belong to. For example, the pictures go to the

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National Operational Center of Fire Brigade or of the coast guard if there is something in the sea. There is not a unified platform where everybody has the same operational picture in order to be able to coordinate better with the other agencies.

**Information verification - Roles involved (both collecting and using), Types of decisions made with information**

The emergency call can be taken by the civil protection, by the police, or by the fire brigade. The fire brigade is the one that mobilizes all forces that need to be involved.

The regional authorities are not allowed to establish regional emergency centers without the permission of the national state. It was assumed that the Greek government would start the procedures for establishing operational centers at the regions, at the capitals. When some regional authorities asked if they can proceed in establishing these operational centers alone with their own budget, the answer was no. So, it was again frozen, since you cannot really create the critical infrastructures of civil protection at regional level without the permission that is not given by the capital, Athens.

However, each region has 7 years for European programming periods. From 2014 to 2020 the EU budget made some allocations to the member states; some of that money goes to the ministries, while a lot of it goes to the regional authorities. This allows them to finance different activities like transportation, social services, etc. There is also a large budget for civil protection activities. Authorities do agree that regions need framework like “early warning systems, decision support tools, operational center, training, etc.’’, but the actions to create them are not defined.

A master plan of civil protection for the regions doesn’t exist. There is only one exception: the Ionian island region.

The officer in the field estimates the situation and asks for support. Then the Civil Protection can support them by approving their request to engage extra firefighters, extra vehicles or aerial means for the forest fire. In case of all the support besides the aerial means, the headquarters (either the regional ones of fire brigades or the national ones) can allocate resources and send from the neighbouring areas or even from Athens. There is a separate operational center only for aerial means because their number is limited; however, because of the information about the resources is not managed properly, they are not able to make optimal decisions when there is a need for aerial means.
The General Secretariat can support in these cases. They can communicate with the municipalities, they can mobilize some private companies that have such kind of equipment - pumps for floods or other, depending on the risk - and they can send them to support the fire brigade.

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The problem there is only that the list of the available resources (public from the municipality or private from cooperating companies), is not updated frequently. Each year by law each municipality has to send a list again by fax to the General Secretariat about their available resources, types of resources etc.
There is not an online system. This presents a problem of lacking real-time information on what is available to support the fire brigade in the operations.

There are plans to make a national electronic system but there is no defined timeline.

**Magnitude Level**
The assessment of the magnitude is done usually by planes or helicopters. If the estimation shows that it is a big event, then the support of the army can also be requested (mostly planes and helicopters to fly over the area of disaster). Fire brigade also has some aerial means (helicopters and airplanes). The General Secretariat provides equipment and/or data through the cooperation with research institutes like the National Observatory of Athens (satellite images of the area at risk etc.).

**Collaboration with other responders**
There is a different frequency for communication between the police, a different frequency for the fire brigade, a different frequency for health emergency services and so on. There has been a request for many years now, but still there is no unique frequency for emergencies, for radio communication in the field.

**RESPONSE & RECOVERY**

**Decisions made - Search and Rescue Area setup**
The fire brigade is in charge of mobilizing the forces, at the local level if it is a small event or at then regional level if it is bigger. Then the Civil Protection General Secretariat is also alerted, as well as the local or regional civil protection people. They mobilize the volunteer organizations as well.

The volunteer organizations that are certified for supporting in forest fires are usually allocated to the mountainous areas that are at risk for forest fires in order to have some patrols and some early warning from their side. In a sense they are like prevention forces. They can alert the fire brigade or also they can take a direct order from the fire brigade. They cannot do anything without direct order from the fire brigade even if they are certified by the Civil Protection General Secretariat. They also get training with the fire brigade.

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The fire brigade commander who is in charge of the operations knows where all the firefighting teams are located. There is also a GPS system and communication system in the trucks, in the vehicles, so that the commander can say in general that they know the position of the different teams. The commander can allocate the forces and ask for support from the neighbouring regional entities.

**Drone Usage**

Drones are not used. Some regional authorities started to try to use them, but it is not yet a normal situation.

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*Israel - NEMA - National Emergency Management Authority*

**Conducted on:** 24 July 2019
**Conducted by:** AUA

**PREPARATION**

**Roles and structure**
In regular time, the National Emergency Management Authority (NEMA) is responsible for writing the theory, commands, operational instructions for emergency situations, and it has to connect between the prime minister and all the organizations that need to act in emergency time.

**Types of Disasters**
Earthquakes are the most common type of disaster in Israel, followed by terror attacks. Fires and floods (mainly local by the sea or caused by the water from mountains) also happen. Snow is also an emergency since the country's infrastructure is not prepared for it. Heavy heat is also a common issue which may cause fires and issues with the electricity supply.

**Information Verification**
The call center operators are trained to verify the information received from the emergency calls. Usually the operators are women (for patience and stress-resistance reasons). The call may also be verified by comparing the sources and information from different callers.

**Information Collection**
Information is usually instantly available online, including media channels, Facebook and WhatsApp. In the future, it is planned to automate the collection and analysis of information from social media.

**Information registration and storage**
C4I is the name of the command and control system. When something happens, whether it is a citizen that reported on the form, or whether if it is a commander or a soldier who witnesses an incident, a case is opened in the system. The case is assigned a type, and details are entered into the system such as description and required resources. The case is accessible for other users.

**ASSESSMENT & COORDINATION**

**Disaster assessment**

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The biggest challenge in assessing the disaster is understanding what exactly has happened and the scale of the impact. In case of an earthquake, the responder needs to know how many buildings are down. There are 3 levels of injury: heavy, small or medium. If the building has collapsed it will be heavy, if few floors have crushed it will be medium. Knowing the level of damage is very important.

**First Responders**
Apart from NEMA other first responders include the police, firefighters, medical services and other services. In case of big disasters, the Home Front Command takes control.

**Emergency Reporting / Call Centers**
Emergency reports are received on phone number 104 (similar to 911 in the United States). The police number is 100, 101 is for the medical service, 102 is the firefighters, 103 is electric organization and 104 is Home Front Command. 911 and 112 are not used in Israel.

**RESPONSE & RECOVERY**

In emergency cases, NEMA is not physically involved. It is mainly the HFC, the Home Front Command, who acts on the ground. HFC has the units, rescue battalions, and other resources, which are deployed in the field.

**Rescue Units and Districts**
Israel is divided into 6 rescue districts:

- The Search and Rescue School (Bahad 16)
- Northern District
- Haifa District
- Dan District
- Jerusalem and Central District
- Southern District

Together the districts field 26 rescue battalions, 13 NBC-defence battalions, 14 military hospitals, 8 light infantry battalions and 6 logistic units manned mostly by reservists.

**Communication**
Communication during emergency takes place mainly through radio, which works on lower frequencies (170-200 MHz). Currently a project is in progress which will build an LTE network for such communication, and it will be completed in the next 3 years. However, LTE is not as strong as, say, in the army network and cannot be fully relied on in an emergency. LTE also connects to the citizen's network and enables the use of smartphone applications as an advantage.

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**Drones**
In civil protection in Israel, simple drones (lowest level of DJI or commercial drones) are used to take photography of the destruction site. High-altitude drones capable of automatic patrolling are used more for industrial companies, not civil protection. Courses are offered for piloting drones, taking photos using drones, making 3D models, and other functions. The photos taken by drones are fed into the C4I system for operational planning.

Drones are not currently used for enabling communication in the current radio communication protocol, but in the future LTE network there is such provision. Base stations can be put on the drones which will facilitate the communication. However, current regulations in Israel allow doing that only in case of emergency, not in regular time.

**Potential Improvements (using drones)**
Another challenge that needs to be addressed is knowing whether there are people on the disaster site (inside the collapsed buildings) who have no communication. The connectivity shall be enabled by bringing in external WiFi or cellular network facilities, or a very sensitive microphone that can amplify shots.
Drones can also drop medical packages, first aid kits, seismic sensors as well as cellular locators which can help identify injured people on the site.

Drones can also help with identifying potential traffic jams and issues on the road to the disaster site that can prevent first responders from arriving on time.

Finally, drones can also use laser pointers to guide the rescuers to the specific location on the disaster site where injured people are.

In one case that occurred three years ago, a big parking area in Israel collapsed, and three people were left under the concrete. Rescuers didn't know what had happened to them. Cellular locating was done, and it located the cellular phone of one of the three people. Drones were put on that exact point, and the rescue team went to the drones.

**Integration**
Integration of RESPONDRONE with C4I could happen in 2 ways: automatic and semi-automatic. The flying drones could stream information collected on the site. If it is structured data, such as the coordinates of the location, number of data and any other raw data that C4I can easily import, then it could happen automatically. In this case, an API or other integration interface has to be developed. Alternatively, a person could

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receive the data from the drones and enter into C4I after some processing. All information would need to be georeferenced.

Since C4I is connected to various systems, its integration with other platforms, including RESPONDRONE could be problematic (due to issues such as cybersecurity).

**Challenges**

For NEMA, the RESPONDRONE project will be critical to improving operations in big cities in Israel - that's where the challenge lies. The small places, like towns and villages, are accessible, and it is relatively easy to identify the disaster cause and scale. In big cities, even if one building collapses, it can potentially damage thousands of people.

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*Latvia - SFRS - State Fire and Rescue Service of Latvia*

**Conducted on:** 16 July 2019
**Conducted by:** AUA

**PREPARATION**

**Information sources and flow**
Depending on the type of disaster, information sources may differ. Normally, witnesses or involved citizens report the information to the emergency number 112. In case of high-risk objects (such as oil sites) industrial companies themselves report any small accident to the emergency number. For natural disasters (storms, heavy rain, extreme hot weather or extreme cold weather), the information is received from the State Meteorological and Geological Service. Forecast information is also usually provided to SFRS.

The forecast information is not in SFRS network. There are the State Meteorological and Environmental Service Servers and Smart Learning Systems for rivers, for radiological purposes, and for weather. They provide the information to SFRS in case of any hazardous level for wind, or heat, or water level. The Rescue service will disseminate this information to the media and inform the public in the country.

**Common types of disasters**
Latvia mostly has floods, which are seasonal. Big storms and forest fires are also common. Last year a forest fire happened which was the biggest in 100 years. Earthquakes, chemical or CBRN accidents are not usual, but the country has industrial sites, so it has to be prepared for emergencies (mostly chemical and oil, not radiological). But they are very rare.

**Safety Regions: National and Regional**
Latvia has five safety regions; Riga is the main one, and every region has its own call center. All of the call centers share the same 112 number. Depending on the location of the caller, the call is redirected to the closest center.

Depending on the level of the disaster, the first responders may include volunteers and municipality fire fighters located in the specific region. The State Rescue Service covers the whole country. In case of big disasters, the chief of the region from SFRS will be involved, and the information will also be provided to state level chiefs.

**ASSESSMENT & COORDINATION**

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**Assessment**
Assessment is mostly done by the first responders. SFRS is also using the Copernicus EMS. SFRS may also involve the border guard or the military if they need a helicopter to access the area.

**Information Flow - registration and validation of info, involved stakeholders**
Latvia has a centralised system within the fire rescue service, where reported emergency information is registered. The access is restricted to the fire rescue personnel only, as well as people who work within the call center or the fire houses (in the fire department, local regional centers). Every call is recorded, but not each of them gets recorded into the system as a case.

**Verification**
The call center operators are trained to verify the calls. Fake calls are still recorded but not registered as an emergency case into the accident information system. If the operator cannot decide whether the call is true or false, she can consult with the officer in charge of the regional call center. Each call center has a duty officer available 24/7.

**Mapping**
SFRS would also like to be able to easily and rapidly acquire maps of the disaster sites. It requires special software and is currently a difficult process. In case of forest fires, the map can be used to identify the location of the smoke and put the resources there. The same is true of floods; the affected area needs to be located so that the responders are sent directly to that location.

In the future, the SFRS is planning to acquire a mapping software which will show the location of every fire station, every fire truck and every firefighter.

SFRS also would like to use the maps in the preventive work - by making 3D models of higher-risk industrial sites and objects (e.g., an oil base). The 3D model may guide the first responders in their operations during the emergency by visualising the distances and altitudes and orienting them in the buildings.

**RESPONSE & RECOVERY**

**Response Operations in Regions**
SFRS has approximately 116 fire stations across the country. There is also a political decision to make a reform in the next two or three years and to reduce the number to about 40 stations. The structural reform affects all government institutions (not only the SFRS) and is aimed at lowering the number of government staff.

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**Coordination and Information Exchange**
During rescue works in a local region the fire brigade communicates with the regional call center using radios. Through radio communication they can ask for the police or the medical support. The call center operator will call the police and ask for additional support at the disaster site. But the police or the medical services do not have a direct access to the SFRC information system.

**Situation Center: Communication, Equipment and Coordination**
The information exchange at the emergency site happens mainly through radio communication. No smartphones are used; therefore, no photos or videos can be sent. On-site coordination structure also includes a minibus with IT equipment – computers, printers, some have bigger screens. In case of big disasters temporary tents can also be installed with many computers.

If the disaster escalates to the national level, a Crisis Management Council is formed. The Council has the ultimate mandate for decision-making, such as declaring a state of emergency or asking for international assistance.

On the sub-national level, there are 119 municipalities and 36 cooperating municipality territories (civil protection commission). So, there are 36 commissions in the country (3-4 municipalities in one commission). The commissions always include a representative from each stakeholder (fire, medical services, police, forest, water authority and other entities), as they are the ones on the ground having the best knowledge of the local resources to be used during an emergency.

**Drones**
SFRS is currently in the procurement procedure to acquire drones for their operations. Every fire truck will be equipped with a drone, so that every first responder can assess it. They will be basic drones, with an optical camera, and maybe also a thermal camera. The drones will be operated through remote controls using iOS or Android and can transfer photos and videos to the operational center (and potentially also do live streaming).

In the meantime, SFRS uses the drones of the local companies or the private drones in the fire service. If there is a need for a drone to assess the scene of the accident, the duty officer in the country has a list with the phone numbers of people who have drones. The problem is that they arrive a little bit too late.

SFRS has not had many problems with operating the drones and has not lost any drone in action. However, it considers the windy weather and the rain to be potential challenges for the technical operation of the drones

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The drones that SFRS is planning to acquire will be battery-powered small drones (lighter than 1.5 kilograms). The procurement will conclude this year, and before the next year SFRS plans to educate the firefighters and set internal standard operating procedures for using the drones. SFRS hopes to start using the drones early next year.

**Challenges**

One of the challenges is the airspace. 50 m is the allowed altitude for flying drones in regular time, but it is not sufficient for assessing the scene of the disaster. The procedure of accessing higher altitudes is an issue. The cooperation with responsible institutions needs to be enhanced to make standard operating procedures for such cases.

Another challenge is the human capacity for operating drones. First, the rescuers need to be trained to use the drones. But the second, bigger, challenge is the lack of human resources. Most of the time there are three or four people on the fire trucks, and they need to be involved in the response operations on the ground. The leader of the rescue troops may decide who to assign the drone operations, but because SFRS does not have much practical experience in using its own drones, it will be a challenge to train the operators. In that sense, outsourcing the drone operation to external companies is easier. The companies provide not only the equipment but also the pilots. According to European regulations all drones and pilots must be registered.

**Communication**

SFRS has previously been involved in the assessment for the regional and state communication emergencies. Driver for such disasters could be an emergency in the power grid, distribution of the power grid, or a storm where physically the tower of communication was destroyed. There is a committee of crisis emergency in charge of this kind of situations.

In case of an emergency, local telecommunication companies are called to bring portable stations to enable the communication channels. It happened once during a forest fire when such a portable tower was brought in since no communication worked (no mobile network, no radio).

SFRS sees value in using drones for enabling communication channels and would be interested to explore this possibility further.

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*Netherlands - VRH - Safety Region Haaglanden*

**Conducted on:** 11 July 2019
**Conducted by:** AUA

**PREPARATION**

The General Chain of the Public safety and public order in case of emergencies and incidents includes (day to day work):

- Fire department
- Police (maintaining public order)
- Health care (public safety)
- Public care

Emergency jurisdiction gives the mayor and the chairman special authorizations/mandate. It is only possible when the Mayor or Chairman declares a situation to be a disaster or crisis.

**ASSESSMENT & COORDINATION**

**Call Centers**
Emergencies are reported through call centers. The Netherlands has 25 call centers in total. All of them are accessible through the unified number 112. The vast majority of the Dutch population uses 112 number for emergency reporting. Over 60% of Dutch citizens also know that they can use 112 in other European countries. Responders are dispatched to the emergency site and conduct an assessment of the scale of the emergency. Cases can be classified into small, medium and big disasters. Depending on the scale, various responders can be involved. But usually the police and medical services are on the scene. For big disasters, the city mayor is also involved.

Call center for the emergency services:

- Police unit Den Haag
- Fire department Haaglanden
- Fire department Hollands Midden
- Ambulance care Haaglanden
- Ambulance care Hollands Midden

**RESPONSE & RECOVERY**

Main actions: Intake -> Front Office -> Back Office -> Dispatch

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In case of large incidents, disaster or crisis there is a Calamities Coordinator who is the first step in the process of command and control. The calamities coordinator coordinates the multidisciplinary processes (police, fire department, ambulance care).

**Generic Regional Deployment Procedure (GRIP) Level 1-4**
The Generic Regional Deployment Procedure (GRIP) on site includes the first responders on scene and so-called 'hood' meeting.


Multidisciplinary coordination on site includes On site command (CoPI) and the Leader of CoPI.

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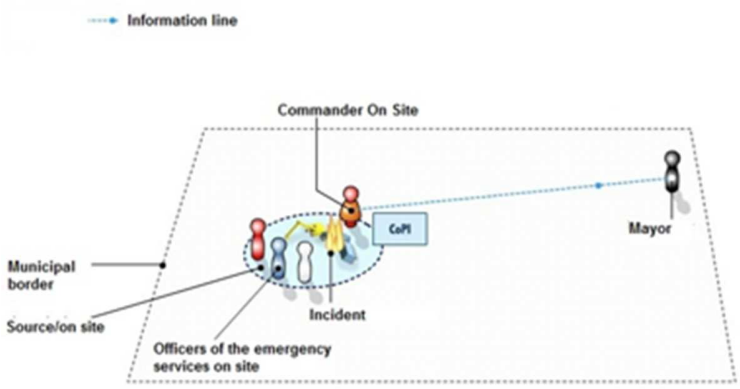
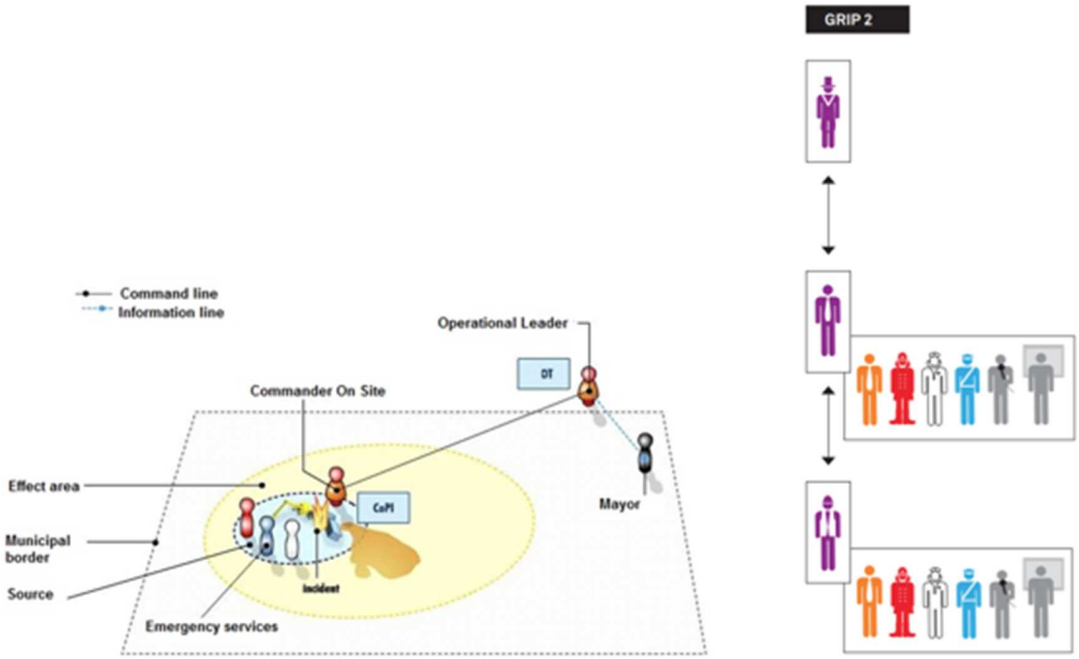



The Operational team of multidisciplinary tactic control involves:

- Operational leader (head of operations)
- Commander's emergency services
- Action centers (commander, supporting officers)




If the situation impacts multiple municipalities, is regional or nationwide and generally requires multidisciplinary and administrative coordination (by the mayor), then GRIP 3 Policy Team is involved:

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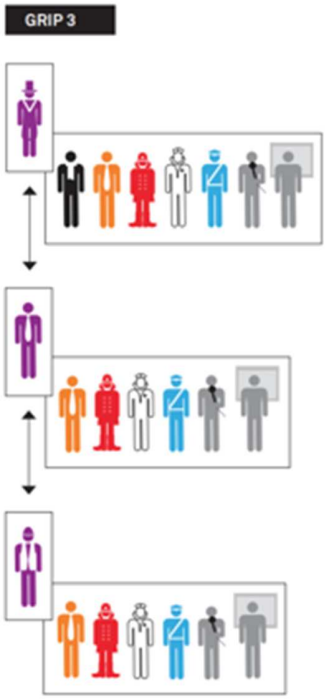


Strategic support to the Mayor is provided in making decisions, coordination of communications strategy by advisors on behalf of emergency services, the local public prosecutor, and an operational leader (at distance/video conference).


When several municipalities are affected, a Regional Policy Team is formed where strategic support to the Safety Region Chairman is provided by mayors of the involved communities, the chief public prosecutor, and the Chairman of the Water Board Council.

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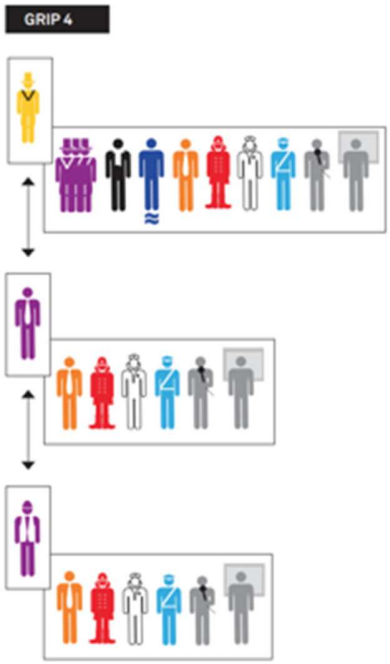


Advisors on behalf of the emergency services are normally the regional commander of the fire department (or members of the managing board), the regional commander of the public healthcare and emergency medical care), and the chief of the police unit.


Within all levels of coordination, the following functions are involved:

- Crisis communications
    - Environmental analysts

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    - Communication advisors
- Information management
    - Information managers
    - CaCo (calamities coordinator at the emergency call center)
    - Plotters
    - Information officers within the action centers
    - LCMS (information management tool)
- Resource management

**Information Management**
LCMS is a multidisciplinary tool which stores the information on emergencies and can be accessed by the fire department, police, health care and public-care services. The system can exchange information with call centers; it is not integrated but a patch can be made when required.

**Communication**
For communication, a digital portable phone (walkie-talkie) system is used called C2000. The system has 2 lines of communication: local, which covers 200-300 meters and nation-wide. However, during the recent crash of Turkish Airlines, the masts which transmit the communication info were overloaded. Currently a solution is being put in place which will dispatch the information through more masts (instead of adding more masts, the dispatching is being optimised). The optimisation seems to be successful - half a year ago a gas explosion happened in The Hague area, and no issues with communication were detected.

**Drones**
Drones are used mainly for assessing the situation and collecting information on the scale. They are not used as communication channels.

In some cases, even the military can be involved. For example, they look after and they are responsible for the channels, the rivers, and the little waterways inside the city. When there is flooding, the military is called in, and they can use very big pumps to get rid of the water and pump the water into the channel. There is a large potential number of partners that can come in during disaster response.

**National Law**
There is one common law on the safety regions, and that law explains everything about how the crisis and disaster management will be carried out. The law is national and is identical for all 25 safety regions.

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# 5. Key Findings

## 5.1. Operational state of As-Is

### 5.1.1. Stakeholders and roles involved

**EU Projects**
Responding to Cascading Effects in Crisis is another challenge that can be addressed by RESPONDRONE. FORTRESS project is studying and developing models, where information collection and modelling tools can assist stakeholders, and obviously RESPONDRONE can be part of this ecosystem. [43]

The main stakeholders listed in **DRIVER+** projects are: firefighters, aerial reinforcements and terrestrial units from a neighboring country, environmental protection agencies, medical services organizations, decision makers and authorities. [3]

FORTRESS project gives an alternative view on stakeholder mapping as it attempts to consider any infrastructure and service that is directly or indirectly can be potentially involved in crisis management. Not only does it consider geospatial, time, resource allocation, and escalation-related stakeholders, but also considers cascading effects resulting from lack of awareness of process by key decision makers. [43]

**Laws and regulations in play, legal aspects of communication and decision making**
The laws and regulations for emergency management set major roles and responsibilities, which are categorized based on the type of disaster and its level or magnitude. The laws also require planning of organization and coordination of work for assessment and rescue operations. In most of the countries where our end users operate, the government both on national and regional level serves as an interagency and coordinating unit, and the government's top official is considered to be the main commander and responsible person for managing the crisis situation.

**Field Studies**

**MES**
Laws on Emergency Situations and Law on Rescue service regulate all aspects of MES involvement, responsibilities, dependencies, operations based on types and levels of disasters. The laws also cover on-going risk reduction, monitoring and assessment of disasters. Major disasters require National Security Service decisions.
National and local administrative units play interagency role and leadership (prime minister, head of regional government take complete responsibility). Tactical decisions are not regulated.

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For regional-scale emergencies, the Local Governor takes the role of commander and coordination with other services. On the national level a committee is formed by the Government that involves all relevant ministries and agencies. For regular emergencies the MES has all services and collaborates with police, healthcare, meteorological and other services.

**RAV**

The law on Disaster Protection sets 3 levels for emergency management: 1.municipal; 2.regional; and 3. national. All levels prepare plans of organizational and coordination activities by types of disasters, including analysis of potential disaster, forecast of impact, risk reduction measures, measures to protect population, distribution of responsibilities, and allocation of resources.

Bulgaria has 28 Regions that are grouped in 6 planning regions. The regional governor serves as the Prime Minister's representative and gathers a committee from other services and government agencies, the selection of which is based on the type of disaster.

**HCFDC/SIS2B**

In France, on the regulatory level the responsibilities and operations are fragmented and appropriately planned beforehand. The regulation has provisions for three levels: small, moderate and major crisis, based on area and people affected and defines the number of people involved. Organization wise, the prefect of the region serves as an interagency coordinating unit and is leading organization of operations within the territory, hence is the real manager of the crisis, supported by various services. France has seven zones in metropolitan area, with each zone having a coordination center. For major disasters, the main responsible interagency is the Ministry of Interior and sometimes the Prime Minister.

**RCM**

On the government level, the following agencies are the decision makers in different levels:
General Secretariat for Civil Protection - national level,
Regional Governor or Vice-Governor of the Regional Unity - regional level,
Mayor, under the consultation of the "Coordinating Local Body for Civil Protection" - local level.
For the disaster situation the first responder is typically the Fire Service operating on the regional and/or local level

**RWM**

The General Secretariat for Civil Protection is the national-level decision maker.

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In all emergency cases the fire brigade is the authority having the operational response. However other governmental and regional authorities (e.g Police Headquarters, Ministry of Health & National Hellenic Center for Disease Control and Prevention, etc.) are involved in operational decision making depending on the type of the disaster.

### 5.1.2. Operational Processes

**EU Projects**
UCPM SOP project provides stakeholder mapping standardization and can prove to be useful for integrating the system with operational procedures guiding emergency response activities. [46]

The IMATISSE project working on combining capabilities of sensor and robot networks with human participation can give interesting insight into RESPONDRONE system integration possibilities. [45]

Although little is described on the project website, the publications resulting from the IMATISSE project have some value as it was envisioned the project should mathematically model the desired collective emergent behavior to determine the sequence of steps, interactions and exchange of individual information that induce the emergent behavior in the system. In addition, for each of the subsystems involved, the project will define the scientific and technological challenges to tackle in order to develop the proposed architecture. [45]

Two tools developed by FORTRESS project, Fortress Scenario Builder (FSB), and Fortress Incident Evolution Tool (FIET) are designed help crisis managers and infrastructure providers to analyse their mutual dependencies and plan joint coordinated information exchange. [43]

TEST BED gives a methodological view on various types of disasters from the perspective of information management. It features a map with layers, principles of logging and assessing information, information-driven delegation of tasks, dispatching of operations on the scene, as well as considering social media information. [12] The research group highly recommends the system designers to study carefully the Crisis Management Gaps report for more insights on information management challenges in crisis situations. [47]

DRIVER+ - Gaps regarding threat, limitations in vulnerabilities assessment, and insufficiencies in resource management when tackling disasters were studied within the framework of the DRIVER+ project, and these can greatly inform the System designers' work [47]. In addition, pan-European Test-Bed for Crisis Management capability was developed, which can prove useful for simulations of RESPONDRONE [3]

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FORTRESS project findings provide interesting insights, which can serve as a methodology for planning and testing various information needs and decision-making points. It provides systems analysis of various interdependent stakeholders in a crisis situation and develops the notions of "Outdegree and Betweenness Centralities" to describe the number of nodes and how much they are prone to pass a cascading effect of crisis through them. [43]

**Scientific Literature**

The reviewed articles suggest that in order for the proposed system (of drones, specifically) to be effective it should be autonomous and capable of self-organization, but at the same time should be able to receive instructions from a distance. Furthermore, the system of architecture should have mandatory layers/features, such as mapping, scanning, infrared sensing and device detection, etc. at drones' application level; flying control, navigation and energy and mobility management at drones' control level; and appropriate network infrastructure with information relaying, radio management and self-organization features.

Besides mapping, scanning or detecting features, autonomous drones need to be able to communicate with others and autonomously coordinate the actions to divide the tasks to be implemented. In addition, given the fact that network connectivity cannot always be guaranteed, storage and forwarding mechanisms should be a part of any fundamental communication mechanisms.

In addition, the emergency management system should be able to communicate and share information with a wide range of stakeholders, and the coordination of information, which is normally based on national frameworks that record structures, roles, and responsibilities, should be effectively supported by appropriate ICT infrastructure.

Moreover, it will be advantageous if the system has a capability to calculate the latitude and longitude of the objects based on the current UAV position and be able to later send the information to the recipient PC through a network.

Also, the issues of guaranteeing network connectivity, the problem of energy lifetime, and a scheme for a distributed charging should be taken into consideration when designing an emergency response UAV-based system.

**Field Studies**

The following list of key indicators have been used during the end user interview data analysis:

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| Question | MES | RAV | VRH | SFRS | NEMA | SIS2B/H CFDC | RCM | RWM |
|---|---|---|---|---|---|---|---|---|
| **Call Center** | | | | | | | | |
| Has Centralized National Emergency Call Center | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Is the call center aligned with EU standards - 112 | 1 | 1 | 1 | 1 | | 1 | | |
| Has regional/local Emergency Call Centers | 1 | 1 | 1 | 1 | | 1 | | |
| Is the Call Center integrated with other operational decision makers (police, medical etc.) | 1 | 1 | 1 | | | 1 | | |
| **IMS** | | | | | | | | |
| Has Information Management System (IMS, software) for capturing data on emergency reports | | | 1 | 1 | 1 | | 1 | |
| Is the data available to the first responders | | | 1 | 1 | 1 | | | |
| Is GIS available (layers should be added later by Arthur ) | 1 | 1 | | | | | 1 | |
| **Regulations/Law** | | | | | | | | |
| Has well defined policies/legislation on the emergency management | 1 | 1 | 1 | | | 1 | 1 | |
| Disaster response decision making/communication standards on tactical operational level defined and applied | 1 | 1 | 1 | | | 1 | | |
| Has a regulation on drone flights in emergency situations | | | | | | 1 | | 1 |

The following Emergency Management stages were defined and confirmed by all end users:

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- **Preparation**
- **Assessment & Coordination**
- **Response & Recovery**

**PREPARATION**

***Includes:***

- *Sources and format of information*
- *Technology used (Systems software), level of integration (vertical, horizontal -e.g. other stakeholders)*
- *Laws and regulations in play, legal aspects of communication and decision making*

**Findings**

- **Robust Information management usage is not common among all end users**
    - Some end users have a very sophisticated IMS Software with interagency integration and robust permission mechanisms, and all data related to the disaster case is available electronically.
        - However, the information is classified and cannot be shared publicly.
    - Some end users have IMS Software with limited functionality and usually accessible for one agency only.
        - The Data is again classified and cannot be shared publicly
    - Some end users are not using any kind of IMS system, and the data is kept in the form of official reports in document format (MS Word in most cases)
        - The data in these cases is classified
        - The data is not well-formatted and categorized
    - There are some cases when the official Report is kept in paper document form.

**MES**

The primary sources for emergency are calls to 911 and 112, operated on national and regional level, everything is recorded at Call Center under National Center for Crisis Management. Also, information from meteorological, seismic centers and dams is used for predicting emergency. No electronic entry is made, no software is operating, and voice recordings can be shared with decision makers.

**The National Center for Crisis Management is a** geographically distributed unit, with branches in regions having authority to deploy resources based on calls, (firefighters

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first and then police, medical emergency service). Big events are reported to the head of the rescue service.

**RAV**

Emergencies are reported through the 112 rescue call center, as well as 668 phone number used by regional administrations and report to Governor. Other sources of potential emergencies include River Level Monitoring Stations, Flood Monitoring Systems, and information reported to Port Authorities. Chemical factories, freight ports, gas terminals are constantly monitored. All calls to 112 are recorded and archived for some time. There is no software for logging and sharing information. Sharing of information is done through voice calls.

**HCFDC/SIS2B**

For emergency reporting, the population uses 112 emergency number along with 15, 17, and 19 for fire, police and medical emergency. Other sources for information include Meteorological Center, Emergency Service, Law Enforcement, Health Service and Ministry of Ecology, who provide information both for prediction of and during rescue operations.

National Center of Emergency Response has rooms for various purposes, such as a call center, a center for anticipating events, as well as a room for interagency meetings for big scale operations. Currently voice calls are the main technology used for communication and coordination, and there is a digital system where data on emergency can be logged for national level events, but without any multimedia content available for sharing. Works are underway to install an interoperable interagency system.

There are 100 fire departments in France, and each has its own GIS and Information system and call center, purchased independently. Systems are heterogeneous, and integration will be quite difficult. Also, the police and gendarmerie have their own system, information from which cannot be easily shared. The system called “Synergy” allows to type in some information on events that can be shared between fire department and Prefect. The information can be shared with police through the interagency department of Prefect, where police and gendarmerie can also input information at the level of Prefect, not from their operational centers.

**RCM/RWM**

The laws and regulations are defined in national levels and are regulated by Athens. The national law (**Xenokratis, General Plan of Civil Protection**) specifies the categories of disasters. There are official guidelines for the disaster reporting: specific forms and Excel files, types of information that should go into the report, etc.

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For mobilization purposes there is a law for volunteer organizations to be registered to the Civil Protection General Secretariat to be certified and used in operations. By the law the regional authorities and the municipalities have to create special plans for emergency response based on a general example, and the plan has to be approved by Athens.

**ASSESSMENT & COORDINATION**

***Includes:***

- *Sources and Technology, Frequency (integration, shareability - vertical, horizontal), Information verification, Roles involved (both collecting and using), Types of decisions made with information*
- *Activities: Magnitude Level, Collaboration with other responders, Decisions made, Search and Rescue Area setup*
- *Improvements and measuring efficiency*

**Findings**

- Instant verification on the validity of emergency event and its scale is done based on the number of calls.
- Next assessments of the disaster's magnitude are performed by crews of first responders.
- Accurate assessment of the magnitude and speed/direction of spreading is a key indicator for successful tackling of disaster and is reported to be one of the major expectations from RESPONDRONE.
- Some countries use well developed GIS systems with various layers, including some live information.
- Information generated during the assessment period is not easily shareable among departments and with various stakeholders, with major reliance on coordination centers and voice conversations.
- All End users consider human life impact as the first priority to measure the magnitude and the scale of the emergency.

**MES**

Verification is based on number of calls and is performed with a special questionnaire allowing to get detailed information on many aspects of the emergency. Received alerts are reported in a document, and daily and weekly reports are generated and shared with all stakeholders within MES and executive government. All phone conversations, as well as other media including video and images, are archived. The tactical information on emergency is mainly passed on through phone conversation through direct lines. Information for the population is disseminated through text messages sent to the entire population.

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According to the end user, main information describing scale, kinetics, geographical specifics, and number of affected populations is used to **make a decision on the level of disaster** and involvement of various troops and services. The thresholds are set that require information in certain situations to be communicated to certain level. A special room with monitors and GIS, with voice and video-conferencing capabilities is used for sharing information among everyone in the room and coordination activities.

**RAV**
Depending on the situation and level of disaster the assessment can be done by responding crew, navy helicopters or recently introduced drones that are operated by the Ministry of Interior. Stakeholders involved may include Ministry of Interior, Ministry of Environment and Waters, Naval Academy, Maritime Administration, Regional Governors, and Health Authorities.

**HCFDC/SIS2B**
Verification of event and initial assessment of its magnitude is done mainly through number of calls received. The SIS2B/HCFDC use their own GIS with plenty of information, such as critical points, lands, forests, live information on traffic on main roads.

The magnitude is assessed with various parameters: number of calls, urban/rural, population, time of day, etc. Based on this level the Operator and First Official can invite higher officials to handle the event and invite other services and agencies. Ability to evaluate from the very beginning is of critical importance, as is planning and provisioning. Many departments have helicopters or drones, and the national airplane fleet is used for major disasters.

**RCM**
Unfortunately, when a disaster is taking place, the magnitude is not assessed immediately. A lot of assessment is taking place after the end of the incident. Typically, technical staff (engineers) employed in relevant departments conduct a detailed survey of the disasters' effects. They usually take photos and draft estimations of the general impact. Special emphasis is given on public infrastructure and its functionality. The region is particularly sensitive to public health issues.
There are some criteria (listed below in order of high importance) which can be used to prioritise the disaster instances, but they do not have official approval.

- **Human life is the first priority**
- **Public infrastructures**
- Natural and cultural heritage
- Vulnerable social groups (hospitalized people, children, refugees, etc.)

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**RWM**
The assessment of event magnitude is done usually by planes or helicopters. In case of a large event, the support of the army can also be requested (mostly planes and helicopters to fly over the area of disaster). The fire brigade is in charge of assessing magnitude and mobilizing forces.

**RESPONSE & RECOVERY**

***Includes:***

- *Engagement, Responder and Type of equipment*
- *Information used and exchanged (routing, other): Roles, Technology, Prioritization and escalation, etc.*
- *Improvements and measuring efficiency*

**Findings**

**MES**
All emergency related information is mainly communicated using Walkie-Talkies. The head of the crew talks to the head of operating shift, who is the interagency coordinator and can involve other forces as required. All rescue vehicles are GPS-monitored.

**RAV**
In Bulgaria, stakeholders that have monitoring stations, such as Maritime Administration, have special coordination rooms with big screens and some GIS. The Governor and crisis committee use the well-equipped rooms of the Navy, or port administration.

Firefighters are part of the Ministry of Interior that has drones, which are mainly used for fighting against criminal activities.

**HCFDC/SIS2B**
In Corsica, the current communication technology used by first responders in the field is a first- generation GSM system not capable of transferring data. It is a challenge to talk to other services, so the first responder uses an official liaison to talk to police. But within the Emergency Management System, it is quite easy to communicate. Firefighters try to avoid using the cellular network, but the numeric radio that they use is good for urban areas only. Sometimes satellite communication is used instead of numeric radio.

**RWM**

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The fire brigade is usually in charge of mobilizing forces at a local and regional level. In larger scale cases, the Civil Protection General Secretariat and local or regional civil protection agencies are also alerted and mobilized.

Some volunteer organizations that are trained by the fire brigade and certified by the Civil Protection General Secretariat are also mobilized during large scale events.

There is also a GPS system and communication system in the trucks so that the fire brigade commander who is in charge of the operations knows where all the firefighting teams and other resources are located. The commander can allocate forces and ask for support from neighbouring regional entities.

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# 6. Conclusions & Next Steps

## 6.1. Summary

The conducted research on EU projects, scientific articles, case studies, as well as the field studies carried out with the end user partners, showed that the RESPONDRONE project has potential to greatly improve various aspects of emergency management operations among end users despite the level of sophistication of the current systems and operational processes already in place.

We found the information contained in the reviewed projects and case studies to generally be informative and have significant value for the RESPODRONE project. This document serves a foundation for the RESPONDRONE system requirements design.

**From Tasks to Deliverables and beyond**

The WP15 team has made an effort to connect the deliverables of the current WP with needs of other teams, which allowed us to concentrate on specific questions that can provide answers to the teams that design system requirements, as well as scenarios for testing of the RESPONDRONE system.

Crucial to the study was the selection of stakeholders and talking to people on various levels, as information exchange and decision making that RESPONDRONE seeks to improve will be happening on several levels, depending on the magnitude of the disaster.

**Current State of Operations**

Some of the key findings from end user interviews indicate that sophistication and advancement of information and communication technologies or level of detail describing operational guidelines do not necessarily speak much about the level of various departments' readiness to effectively engage in response activities. We have seen efficient and well-operating departments and units that use only voice for communication and information exchange at all levels. Planning of response activities both on operational and tactical level, proves to be one of the most important tools that system designers of RESPONDRONE can look at, as these plans on departmental, regional and national levels, as well as functional plans, can provide very good insight on communication patterns.

**Information Systems and Interoperability**

Interagency communications and information exchanges are mainly implemented by the local or national government agencies that take full responsibility for deploying resources from various stakeholders and commanding the entire operation. Most of the communication is done either through voice or by locating the representatives of various agencies in one interagency room and making centralized decisions. The system's requirements design team can greatly benefit from studying the types of technologies used

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in Interagency operational rooms and look for integration possibilities with what is being currently used for collecting information. In particular, several end users reported about using fairly advanced GIS based technologies that provide updates both with static and dynamic data.

Given the fact that end users use information systems of various sophistication, and in some countries these systems are different among many departments and stakeholders, we believe that the system design team will greatly benefiting by considering high level of modularity of RESPONDRONE information system. In a nutshell, the notion of "High Level of Modularity" of the system will allow to preserve a greater level of independence of various components of the system, which can be easily plugged on and off based on the level of sophistication of the IS currently used by a particular Emergency Responder.

**Challenges for Drone Use**

Interoperability of various information systems used for various levels of disaster as well as used by various stakeholders (firefighters, health, police emergency agencies) was called a major challenge, and many end users reported on projects being currently planned to introduce a new interoperable information system.

The field study interviews clearly demonstrate the importance of considering challenges for drone usage. Part of these challenges obviously involve technology, specifically the speed and ease of its deployment in emergency situations. An equally important part of the challenges resides in the layer between social and technological structures and processes. Major concerns include the training of crew, planning for drone use, introduction of new roles on both tactical and operational levels, information accessibility, and changing decision-making patterns. Many end users expect the new information system will address these kinds of concerns too. One obvious challenge shared by all end users is the regulation on the use of airspace that is compatible with existing regulations for manned aviation.

**Expectations towards RESPONDRONE**

One of the greatest expectations that end users have **towards** RESPONDRONE is the speed and accuracy of disaster assessment that can better support on-time decision making, helping to tackle disasters while they are small. Fast identification of scale and kinetics of disaster and ability to search for living organisms were among the highest capabilities that end users hope the RESPONDRONE project will provide. In addition, as described in the challenges section above, the new improved technological capability for sharing information among all involved stakeholders, was also mentioned to be a key expectation from the project.

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## 6.2. Additional Studies and Interviews

A comprehensive list of the projects and articles that have been identified as potentially relevant is available for reference in Annex A and Annex B. The most relevant projects and articles from this list have been included in this report. The rest can be reviewed as needed.

The content of the WP15 deliverable D15.2 will be used during the RESPONDRONE Design Thinking Workshop on November 12-13, 2019 in Thessaloniki, Greece.

The findings will also be used for the deliverables D15.4 - RESPONDRONE concept/mock-up and D15.5 - RESPONDRONE functional design document.

## 6.3. Gaps & Missing Information

Due to time and logistical restrictions, field studies were performed via conference call. Face-to-face meetings and field visits could potentially add more details to the information already gathered.

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# 8. Annexes

## 8.1. Annex A - List of EU Projects for Review

**Detailed Reviewed list of EU Projects by Research Questions**

| NAME | RQ1-Relevance | RQ2-SysReq | RQ3-Scenarios | RQ4-Stakeholders | RQ5-Methodology | RQ-Sum |
|---|---|---|---|---|---|---|
| IN-PREP | 1 | 1 | 1 | 1 | 1 | 5 |
| HEIDMALL | 1 | 1 | 1 | 1 | 1 | 5 |
| DRIVER+ | 1 | | 1 | 1 | 1 | 4 |
| ESPREssO | 1 | | 1 | 1 | 1 | 4 |
| SESAR CORUS | 1 | 1 | 1 | 1 | 1 | 5 |
| SUNNY | 1 | 1 | 1 | | | 3 |
| FCT WISE | 1 | 1 | | | | 2 |
| C-BORD | | | | | | 0 |
| MULTIDRONE | 1 | 1 | | | 1 | 3 |
| COOPOL | 1 | | 1 | | | 2 |
| FORTRESS | | 1 | | 1 | | 2 |
| CRISMA. Modelling crisis management for improved action and preparedness | | | | | | 0 |
| DISASTER | 1 | 1 | 1 | | 1 | 4 |
| SAY-SO | 1 | 1 | 1 | | 1 | 4 |
| SESAR AIRPASS | 1 | 1 | | | | 2 |
| SAFEDRONE | | | | | | 0 |
| AW-DRONES | 1 | | | | 1 | 2 |
| Introducing new technologies in near border emergency combat (EMERG_TECH) | | | | | | 0 |
| EmSec. real-time information services for Maritime Security | | 1 | 1 | | | 2 |
| HazRunoff | | | | | | 0 |
| Enhancing Assessment in Search and Rescue (EASeR) | 1 | | | | 1 | 2 |
| SWIFTERS: Safe and Rapid Evacuation Facilitated by UAV Swarms | 1 | | | | | 1 |
| UCPM SOPs - Common Standard Operational Procedures for the Union Civil Protection Mechanism Modules and Teams (UCPM SOPs) | 1 | | | 1 | | 2 |
| ASPires | | | | | | 0 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Non EU. UAS Inspections of Critical Infrastructure. 2017 Resilience Challenge Grant | | | | | | 0 |
| Critical Infrastructure Reentry and Situational Awareness Project (CIRSAP). 2019 Resilience Challenge Grant Project | | | | | | 0 |
| IMATISSE - Inundation Monitoring and Alarm Technology In a System of SystEms | 1 | 1 | | | 1 | 3 |
| SUAAVE (Sensing Unmanned Autonomous Aerial VEhicles) | | | | | | 0 |
| ACRIMAS | 1 | | 1 | | | 2 |
| LitterDrone | | | | | | 0 |
| Drone in Humanitarian Action | | | | | | 0 |
| DREAMS | 1 | | 1 | | | 2 |
| ASSISTANCE | | | | | | 0 |
| CURSOR | 1 | | | | | 1 |
| FASTER | | | | | | 0 |
| INGENIOUS | 1 | | | | | 1 |

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**Detailed Reviewed list of EU Projects by KeyWords**

| NAME | Drone Fleet of Drones Multidrone UAV Unmanned Technology Helicopter, RPAS, UAS | Disaster | Rescue evacuation | Emergency Management Disaster Management | Situation(al) Awareness Disaster Assessment Situational Assessment | Command & Control Command & Control Technology (C2T) | First Response | Decision Support | Multi-mission | Civil Protection Operations | KW-Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IN-PREP | | 1 | | 1 | 1 | 1 | 1 | 1 | | 1 | 7 |
| HEIDMALL | 1 | 1 | | 1 | 1 | | 1 | 1 | 1 | 1 | 8 |
| DRIVER+ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| ESPREssO | | 1 | | 1 | 1 | | | | | | 3 |
| SESAR CORUS | 1 | | | 1 | 1 | 1 | | | | | 4 |
| SUNNY | 1 | | | | 1 | 1 | | 1 | 1 | 1 | 6 |
| FCT WISE | | 1 | | | | | | | | | 1 |
| C-BORD | | | | | | | | | | | 0 |
| MULTIDRONE | 1 | | | | 1 | 1 | | | 1 | | 4 |
| COOPOL | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 9 |
| FORTRESS | | 1 | | 1 | | | | 1 | | 1 | 4 |
| CRISMA. Modelling crisis management for improved action and preparedness | | | | | | | | | | | 0 |
| DISASTER | | 1 | | 1 | 1 | 1 | 1 | 1 | | 1 | 7 |
| SAY-SO | 1 | 1 | | | 1 | 1 | | 1 | 1 | 1 | 7 |
| SESAR AIRPASS | 1 | | | 1 | | | | | | | 2 |
| SAFEDRONE | | | | | | | | | | | 0 |
| AW-DRONES | 1 | | | | | 1 | | | | | 2 |
| Introducing new technologies in near border emergency combat (EMERG_TECH) | | | | | | | | | | | 0 |
| EmSec. real-time information services for Maritime Security | 1 | | 1 | 1 | | | | | | | 3 |
| HazRunoff | | | | | | | | | | | 0 |
| Enhancing Assessment in Search and Rescue (EASeR) | 1 | 1 | 1 | 1 | 1 | | 1 | | | 1 | 7 |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SWIFTERS: Safe and Rapid Evacuation Facilitated by UAV Swarms | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | 1 | 8 |
| UCPM SOPs - Common Standard Operational Procedures for the Union Civil Protection Mechanism Modules and Teams (UCPM SOPs) | | | | | | | | | | 1 | 1 |
| ASPires | | | | | | | | | | | 0 |
| Non EU. UAS Inspections of Critical Infrastructure. 2017 Resilience Challenge Grant | | | | | | | | | | | 0 |
| Critical Infrastructure Reentry and Situational Awareness Project (CIRSAP). 2019 Resilience Challenge Grant Project | | | | | | | | | | | 0 |
| IMATISSE - Inundation Monitoring and Alarm Technology In a System of SystEms | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 9 |
| SUAAVE (Sensing Unmanned Autonomous Aerial VEhicles) | | | | | | | | | | | 0 |
| ACRIMAS | | 1 | 1 | 1 | | | 1 | | | 1 | 5 |
| LitterDrone | | | | | | | | | | | 0 |
| Drone in Humanitarian Action | | | | | | | | | | | 0 |
| DREAMS | 1 | | | 1 | | | | | 1 | | 3 |
| ASSISTANCE | | | | | | | | | | | 0 |
| CURSOR | 1 | 1 | 1 | | | 1 | | | | | 4 |
| FASTER | | | | | | | | | | | 0 |
| INGENIOUS | | 1 | | 1 | | | 1 | 1 | | | 4 |

| NAME | Program | Agreement Number | Website |
|---|---|---|---|
| IN-PREP | H2020/2014-2020, European Union's Programme for Research and Innovation | 740627 | https://www.in-prep.eu/ |
| HEIDMALL | European Union's Horizon 2020 Research and Innovation Programme | 740689 | http://heimdall-h2020.eu/ |
| DRIVER+ | 7th Framework Programme of the European Commission | 607798 | https://www.driver-project.eu/ |

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| | | | |
|---|---|---|---|
| ESPREssO | European Union's Horizon 2020 Research and Innovation Programme | 700342 | http://www.espressoproject.eu/ |
| SESAR CORUS | SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme | 763551 | https://www.sesarju.eu/projects/corus |
| SUNNY | 7th Framework Programme of the European Commission | | http://www.sunnyproject.eu/ |
| FCT WISE | Portuguese Foundation for Science and Technology | | http://wise.inesctec.pt/?page_id=70 |
| C-BORD | European Union's Horizon 2020 Research and Innovation Programme | 653323 | https://cordis.europa.eu/project/rcn/194848/factsheet/en |
| MULTIDRONE | European Union's Horizon 2020 Research and Innovation Programme | 731667 | https://multidrone.eu/ |
| COOPOL | | | http://coopol.eurecom.fr/en |
| FORTRESS | 7th Framework Programme of the European Commission | 607579 | https://cordis.europa.eu/project/rcn/185488/factsheet/en |
| CRISMA. Modelling crisis management for improved action and preparedness | 7th Framework Programme of the European Commission | 284552 | http://www.crismaproject.eu/ |
| DISASTER | 7th Framework Programme of the European Commission | | https://www.disaster-fp7.eu/ |
| SAY-SO | European Union's Horizon 2020 Research and Innovation Programme | 740872 | https://www.sayso-project.eu/ |
| SESAR AIRPASS | European Union's Horizon 2020 Research and Innovation Programme | 763658 | http://www.airpass-project.eu/w/ |
| SAFEDRONE | European Union's Horizon 2020 Research and Innovation Programme | 783211 | https://www.sesarju.eu/node/3199 |
| AW-DRONES | European Union's Horizon 2020 Research and Innovation Programme | 824292 | https://www.aw-drones.eu/ |
| Introducing new technologies in near border emergency combat (EMERG_TECH) | Co-funded: European Regional Development Fund and National funding (Latvia) | | https://latlit.eu/lli-267-introducing-new-technologies-in-near-border-emergency-combat-emerg_tech/ |

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| | | | |
|---|---|---|---|
| EmSec. real-time information services for Maritime Security | Research for Civil Protection' programme run by the German Federal Ministry for Education and Research (BMBF). | | https://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10081/151_read-19273/#/gallery/24278 |
| HazRunoff | European Civil Protection and Humanitarian Aid Operations | 783208 | https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/hazrunoff_en |
| Enhancing Assessment in Search and Rescue (EASeR) | European Civil Protection and Humanitarian Aid Operations | | https://www.easerproject.eu/ |
| SWIFTERS: Safe and Rapid Evacuation Facilitated by UAV Swarms | European Civil Protection and Humanitarian Aid Operations | | https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/swifters-safe-and-rapid_en |
| Common Standard Operational Procedures for the Union Civil Protection Mechanism Modules and Teams (UCPM SOPs) | European Civil Protection and Humanitarian Aid Operations | 783255 | https://ec.europa.eu/echo/funding-evaluations/financing-civil-protection-europe/selected-projects/common-standard-operational_en |
| Advanced systems for prevention & early detection of forest fires (ASPires) | European Civil Protection and Humanitarian Aid Operations | | http://www.aspires.eu/ |
| UAS Inspections of Critical Infrastructure. 2017 Resilience Challenge Grant | National Infrastructure Protection Plan (NIPP) Security and Resilience Challenge grants | | https://www.regionalresilience.org/2017-project.html |
| Critical Infrastructure Reentry and Situational Awareness Project (CIRSAP). 2019 Resilience Challenge Grant Project | National Infrastructure Protection Plan (NIPP) Security and Resilience Challenge grants | | https://www.regionalresilience.org/2019-project.html |

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| | | | |
|---|---|---|---|
| IMATISSE - Inundation Monitoring and Alarm Technology In a System of SystEms | Regional Council of Hauts-de-France | | https://imatisse.hds.utc.fr/ |
| SUAAVE (Sensing Unmanned Autonomous Aerial VEhicles) | Engineering and Physical Sciences Research Council (EPSRC) | | https://www.cs.ox.ac.uk/projects/SUAAVE/ |
| ACRIMAS | 7th Framework Programme for Research and Technological Development (FP7) | | http://web.archive.org/web/20161201072343/http://www.acrimas.eu/index.php/deliverables |
| LitterDrone | ICT and research program | | http://litterdrone.eu/?lang=en |
| Drone in Humanitarian Action | DG ECHO | | https://drones.fsd.ch/en/homepage/ |
| DREAMS | European Union's Horizon 2020 Research and Innovation Programme | 763671 | https://www.u-spacedreams.eu |
| **ASSISTANCE** | **H2020 - ADAPTED SITUATION AWARENESS TOOLS AND TAILORED TRAINING SCENARIOS FOR INCREASING CAPABILITIES AND ENHANCING THE PROTECTION OF FIRST RESPONDERS** | **832576** | https://cordis.europa.eu/project/rcn/222583/en |
| **CURSOR** | **H2020 - Coordinated Use of miniaturized Robotic equipment and advanced Sensors for search and rescue OpeRations** | **832790** | https://cordis.europa.eu/project/rcn/222585/factsheet/en |
| **FASTER** | **H2020 - First responder Advanced technologies for Safe and efficienT Emergency Response** | **833507** | https://cordis.europa.eu/project/rcn/222619/en |
| **INGENIOUS** | **H2020 - The First Responder (FR) of the Future: a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, increasing protection and augmenting operational capacity** | **833435** | https://cordis.europa.eu/project/rcn/222613/factsheet/en |

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## 8.2. Annex B - List of Scientific Articles for Review

| Title | Source (Journals, White Papers, Articles etc.) | Date (after 2005) | Links/Refs |
|---|---|---|---|
| Drone Applications for Supporting Disaster Management | World Journal of Engineering and Technology | 2015 | https://www.researchgate.net/publication/283537233_Drone_Applications_for_Supporting_Disaster_Management |
| AWARE: Platform for Autonomous self-deploying and operation of Wireless sensor-actuator networks cooperating with unmanned AeRial vehiclEs. | Proceedings of the 2007 IEEE International Workshop on Safety, Security and Rescue Robotics | 2007 | https://ieeexplore.ieee.org/document/4381259 |
| The ATHENA Project: Using Formal Concept Analysis to Facilitate the Actions of Responders in a Crisis Situation | Sheffield Hallam University Research Archive | 2013 | http://shura.shu.ac.uk/8601/ |
| Strategic approach to disaster management: lessons learned from Hurricane Katrina | Disaster Prevention and Management 15 (3): 484–494. | 2006 | https://www.emerald.com/insight/content/doi/10.1108/09653560610669945/full/html |
| Efficacy and Utilization of Unmanned Aerial System (UAS) as Operational Tools for Disaster Management in India | National Disaster Management Authority | 2018 | https://webcache.googleusercontent.com/search?q=cache:nZiU0OuTXnMJ:https://www.preprints.org/manuscript/201810.0039/v1/download+&cd=1&hl=en&ct=clnk&gl=am&client=safari |
| Help from the Sky: Leveraging UAVs for Disaster Management | IEEE Computer Society | 2017 | https://bwn.ece.gatech.edu/papers/2017/uavs.pdf |

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| | | | |
|---|---|---|---|
| Disaster Management Supported by Unmanned Aerial Systems (UAS) Focusing Especially on Natural Disasters | Zeszyty Naukowe SGSP 2017, Nr 61 (tom 2)/1/2017 | 2017 | http://yadda.icm.edu.pl/yadda/element/bwmeta1.element.baztech-58c4ae1f-0644-4dfd-b506-098ec5d5e1fd/c/Agoston_Restas_ZN_SGSPNr_61_tom_2_WKLAD_druk.pdf |
| A Survey of Unmanned Aerial Vehicle (UAV) Usage for Imagery Collection in Disaster Research and Management | Adams, S.M. & Friedland, C.J. (2011) | 2011 | https://www.researchgate.net/publication/266465037_A_Survey_of_Unmanned_Aerial_Vehicle_UAV_Usage_for_Imagery_Collection_in_Disaster_Research_and_Management |
| Disaster Monitoring And Management By The Unmanned Aerial Vehicle Technology | Technical Commission VII Symposium 2010 | 2010 | https://www.isprs.org/proceedings/xxxviii/part7/b/pdf/137_XXXVIII-part7B.pdf |
| Unmanned Aerial Vehicles for Disaster Management | Geological Disaster Monitoring Based on Sensor Networks, pp.83-107 | 2019 | https://www.researchgate.net/publication/326960048_Unmanned_Aerial_Vehicles_for_Disaster_Management |
| The use of unmanned aerial vehicles and drones in search and rescue operations – a survey | Conference: PROLOG 2018, At Hull, UK | 2018 | https://www.researchgate.net/publication/327755534_The_use_of_unmanned_aerial_vehicles_and_drones_in_search_and_rescue_operations_-_a_survey |
| Managing Information in the Disaster Coordination Centre: Lessons and Opportunities | Proceedings of the 4th International ISCRAM Conference (B. Van de Walle, P. Burghardt and C. | 2007 | https://pdfs.semanticscholar.org/a4e0/49f81a397b152883c409092d31ce43c6d435.pdf |

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| | | | |
|---|---|---|---|
| | Nieuwenhuis, eds.) Delft, the Netherlands, May 2007 | | |
| An integrated approach of ground and aerial observations in flash flood disaster investigations. The case of the 2017 Mandra flash flood in Greece. | International Journal of Disaster Risk Reduction | 2019 | https://www.sciencedirect.com/science/article/pii/S2212420918303935 |
| Earth Observation based Crisis Information – Emergency mapping services and recent operational developments | In Proceedings of International Conference on Information and Communication Technologies for Disaster Management | 2017 | https://www.driver-project.eu/wp-content/uploads/2018/01/Earth_Observation_Lechner_ICT-DM-paper.pdf |
| Trialing a Common Operational Picture in a simulated environment | In Proceedings of International Conference on Information and Communication Technologies for Disaster Management | 2017 | https://www.driver-project.eu/wp-content/uploads/2018/01/DRIVER_2017-ICT-DM-paper-on-Expe41.pdf |
| Enhancing Unmanned Flight Operations in Crisis Management with Live Aerial Images | In Proceedings of the 2016 Integrated Communications Navigation and Surveillance (ICNS) conference, Washington | 2016 | https://www.researchgate.net/publication/303886242_Enhancing_Unmanned_Flight_Operations_in_Crisis_Management_with_Live_Aerial_Images |
| Dynamic and Context Aware Reporting of Observations from the Field for Situation Assessment in Crisis Situation: An Integrated System for Information-Gathering and Sense-Making | n Information Systems for Crisis Response and Management in Mediterranean Countries - Proceedings of the Second International Conference on | 2015 | https://www.researchgate.net/publication/286923492_Dynamic_and_Context_Aware_Reporting_of_Observations_from_the_Field_for_Situation_Assessment_in_Crisis_Situation_An_Integrated_System_for_Info |

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| | | | |
|---|---|---|---|
| | Information Systems for Crisis Response and Management in Mediterranean Countries | | rmation-Gathering_and_Sense-Making |
| Communication Gaps in Disaster Management: Perceptions by Experts from Governmental and Non-Governmental Organizations | Journal of Contingencies and Crisis Management | 2012 | https://jyx.jyu.fi/bitstream/handle/123456789/44162/3/PalttalaBoanoVosLund2012_CommunicationGapsDisasterManagement.pdf |
| SESAR U-Space Projects Information Sharing Session Presentation | | 2017 | http://www.airpass-project.eu/w/wp-content/uploads/2018/09/U-Space-SESAR-projects-info-session-01.pdf |
| Disaster Risk Reduction Increasing resilience by reducing disaster risk in humanitarian action | DG ECHO Thematic Policy Document n° 5 | 2013 | https://ec.europa.eu/echo/files/policies/prevention_preparedness/DRR_thematic_policy_doc.pdf |
| UAV-assisted disaster management: Applications and open issues | International Conference on Computing, Networking and Communications (ICNC), Kauai (USA), | 2016 | https://www.archives-ouvertes.fr/hal-01305371/document |
| Help from the Sky: Leveraging Unmanned Aerial Vehicles for Disaster Management | IEEE Pervasive Computing, special issue on "Drones – Computing, Networking, Input, and Output in Mid-Air" | 2017 | http://krc.coe.neu.edu/sites/krc.coe.neu.edu/files/papers/07807176.pdf |

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| | | | |
|---|---|---|---|
| Self-Organizing Aerial Mesh Networks for Emergency Communication | In Personal, Indoor, and Mobile Radio Communication (PIMRC), 2014 IEEE 25th Annual International Symposium on, 2014 | 2014 | http://krc.coe.neu.edu/sites/krc.coe.neu.edu/files/papers/PIMRCAerial.pdf |
| ENABLING MOBILITY IN HETEROGENEOUS WIRELESS SENSOR NETWORKS COOPERATING WITH UAVS FOR MISSION-CRITICAL MANAGEMENT | Wireless Communications, IEEE, 2008 | 2008 | https://www.researchgate.net/publication/224371313_Enabling_mobility_in_heterogeneous_wireless_sensor_networks_cooperating_with_UAVs_for_mission-critical_management |
| UAV aerial imaging applications for post-disaster assessment, environmental management and infrastructure development | In Unmanned Aircraft Systems (ICUAS), 2014 International Conference on, 2014. | 2014 | https://www.researchgate.net/publication/271456098_UAV_aerial_imaging_applications_for_post-disaster_assessment_environmental_management_and_infrastructure_development |
| Using cooperative MIMO techniques and UAV relay networks to support connectivity in sparse Wireless Sensor Networks | In Computing, Management and Telecommunications (ComManTel), 2013 International Conference on, 2013. | 2013 | https://www.researchgate.net/publication/261087205_Using_cooperative_MIMO_techniques_and_UAV_relay_networks_to_support_connectivity_in_sparse_Wireless_Sensor_Networks |
| On-the-Fly Establishment of Multihop Wireless Access Networks for Disaster Recovery | Communications Magazine, IEEE, 2014. | 2014 | https://web.njit.edu/~borcea/papers/ieee-commag14.pdf |
| UAVNet: A Mobile Wireless Mesh Network Using Unmanned Aerial Vehicles | In Globecom Workshops (GC | 2012 | http://home.inf.unibe.ch/~rvs/research/p |

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| | | | |
|---|---|---|---|
| | Wkshps), 2012 IEEE, 2012. | | ub_files/MBZSA12.pdf |
| Automating Humanitarian Missions with a Heterogeneous Fleet of Vehicles | Computing in Science Engineering, 2014. | 2014 | https://www.researchgate.net/publication/269820848_Automating_humanitarian_missions_with_a_heterogeneous_fleet_of_vehicles |
| Resilient and efficient MANET aerial communications for search and rescue applications. | In Computing, Networking and Communications (ICNC), 2013 International Conference on, 2013 | 2013 | https://dl.acm.org/citation.cfm?id=2496626 |
| Design strategies of unmanned aerial vehicle-aided communication for disaster recovery | In High Capacity Optical Networks and Enabling Technologies (HONET), 2012 9th International Conference on, 2012. | 2012 | https://www.researchgate.net/publication/261468858_Design_strategies_of_unmanned_aerial_vehicle-aided_communication_for_disaster_recovery |
| Exploiting the Use of Unmanned Aerial Vehicles to Provide Resilience in Wireless Sensor Networks | Communications Magazine, IEEE, 2014. | 2014 | http://anrg.usc.edu/www/papers/Pedro-UAV-Comm-Magazine.pdf |
| A Surveillance System Using Small Unmanned Aerial Vehicle (UAV) Related Technologies | NEC Technical Journal, 2013 | 2013 | https://pdfs.semanticscholar.org/c8a8/3edc2d261b012ba0f2b36895a42a5315f438.pdf |
| Assessment of Existing and Potential Landslide Hazards Resulting from the April 25, 2015 Gorkha, Nepal Earthquake Sequence | US Geological Survey Open-File Report | 2015 | https://pubs.usgs.gov/of/2015/1142/ofr20151142_v1.1.pdf |
| Rapid and Near Real-Time Assessments of Population Displacement Using Mobile Phone Data Following Disasters: The 2015 Nepal Earthquake | PLoS Currents | 2016 | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4779046/ |

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## 8.3. Annex C - End User Stakeholder Mapping

### *Armenia - MES - Ministry of Emergency Situations*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| Prime-Minister of the Republic of Armenia | Regional (Marz) Governors | Local Self-Governing Bodies (Community Directors) |
| Ministry of Emergency Situations of the Republic of Armenia, Secretary General | Ministry of Emergency Situations of the Republic of Armenia, Secretary General | Ministry of Emergency Situations of the Republic of Armenia, Secretary General |

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | Police of the Republic of Armenia | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **Fire** | Rescue Service of the Ministry of Emergency Situations, Director of the Service | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **EMS (Emergency Management Service)** | Ministry of Emergency Situations | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **Investigations - Police/Justice** | Police of the Republic of Armenia // General Prosecutor Office | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **Support of Population** | Ministry of Emergency Situations // Ministry of Labor and Social Affairs | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **Medical & Hospitals** | Ministry of Emergency Situations // Ministry of Health | Regional Governors | Local Self-Governing Bodies (Community Directors) |
| **Inter-Agency Cooperation/Collaboration** | Ministry of Emergency Situations //Each Ministry is responsible within its liabilities | Regional Governors | Local Self-Governing Bodies (Community Directors) |

| **3. First Responders** | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |

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| | | |
|---|---|---|
| **Fires :** *Urban and industrial* | Rescue Service of the Ministry of Emergency Situations | Regional Firefighting and Rescue Teams |
| **Fires:** *Forest* *Bush, Wildfires* | Rescue Service of the MES // Ministry of Environmental Protection // Ministry of Territorial Administration and development | Regional Firefighting and Rescue Teams |
| **EMS (Emergency Management Service):** *Emergencies relief to the population* | Rescue Service of the Ministry of Emergency Situations | Regional Firefighting and Rescue Teams |
| **Anthropogenic:** *All kinds of accidents* | Rescue Service of the Ministry of Emergency Situations // Ministry of Health | Regional Firefighting and Rescue Teams |
| **Search & Rescue:** *At sea, mountain, perilous environment like Urban Collapse or other* | Rescue Service of the Ministry of Emergency Situations //Ministry of Environmental Protection | Regional Firefighting and Rescue Teams |
| **Climatic:** *Floods, landslide, storms, weather events* | Rescue Service of the Ministry of Emergency Situations | Regional Fire-fighting and Rescue Teams |
| **HAZ-MAT / C.B.R.N.E.** | Rescue Service of the Ministry of Emergency Situations | Regional Fire-fighting and Rescue Teams |
| **Terrorist attack** | National Security Service of the Republic of Armenia | National Security Service of the Republic of Armenia |

| **4. Operational Organization Des** | | | | | |
|---|---|---|---|---|---|
| **Type of disaster** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** |
| **Fires :** *Urban and industrial* | Bodies listed in the sheet 3 are responsible within their liabilities to communicate with relevant agencies. The processes are led and coordinated by the Rescue Service of MES as per the Law of the Republic of Armenia on Rescue Service | Bodies listed in the sheet 3 are responsible within their liabilities. The authorised body for Emergency Management is the Ministry of Emergency Situations. At regional to local levels the regional governments deliver directions and orders to regional | Web / Radio connection / Cellular operators | Depending on the situation the means are predefined, the reinforcement required is applied upon request | Long-term strategic decisions are made by Prime-Minister, Situations are reported by the MES, Rescue Service Director reports on the Operational Situation, |
| **Fires:** *Forest* *Bush, Wildfires* | | | | | |
| **EMS (Emergency Management Service):** *Emergency relief to the population* | | | | | |
| **Anthropogenic:** *All kinds of accidents* | | | | | |

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| | | | | | |
|---|---|---|---|---|---|
| **Search & Rescue:** *At sea, mountain, perilous environment like Urban Collapse or other* | (HO-171-N, article 5.1.1). | representations of interior affairs, national security as well as the regional governmental organizations for the relief of crisis situations, according to the Law of the Republic of Armenia on Civil Protection in Emergency Situations (HO-265, articles 13-15) | | | Regional Rescue Teams report on locations situations // Reporting/ suggestions come up to the PM who makes the final decision, gives approval |
| **Climatic:** *Floods, landslide, storms, weather events* | | | | | |
| **HAZ-MAT / C.B.R.N.E.** | | | | | |
| **Terrorist attack** | | | | | |

| **5. Technical Questions** | | | |
|---|---|---|---|
| **Technical Questions** | **No** *Please comment* | **Yes** *Please comment* | **Notes** |
| **Is Internet usually accessible in the common disaster areas?** *What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.* | | depending on the scale of the damage | |
| **Is there available data regarding topography and critical infrastructure of the disaster area?** *What format is the geographical data available and can it be accessed/used by RESPONDRONE.* | | Crisis management National Center owns the information | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | | yes | |
| **Do first responders use mobile terminals currently?** *It is important for INESC TEC to know what terminals will be used so that the network is compatible with them.* | no | | |
| **Are there any existing software/hardware solutions that you will need to integrate into the** | no | | |

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| | | | |
|---|---|---|---|
| **RESPONDRONE system?** | | | |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | no | | |

*Bulgaria - RAV - Regional Administration of Varna*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| Varna Airport, Director | Regional Administration Varna, Governor | Municipality of Aksakovo, Mayor |
| Bulgarian Navy Forces, Deputy Commander of the Head Quarter | Varna Medical University | Municipality of Avren, Mayor |
| State Company Port Infrastructure Varna | Varna Free University | Municipality of Beloslav, Mayor |
| Maritime Administration Varna | Health Emergency Center-Varna | Municipality of Byala, Mayor |
| Bulgarian Ministry of Interior | Regional Directorate Fire Protection and Civil protection ( Fire Police) | Municipality of Dalgopol |
| | Regional Administration, Governor | Municipality of Devnya, Mayor |
| | RIEW (Regional Inspectorate of Environment and Waters) | Municipality of Dolni Chiflik, Mayor |
| | Black Sea Basin Directorate | Municipality of Valchi dol, Information Security |
| | Union of Bulgarian Black Sea Local Authorities | Municipality of Varna, Deputy Mayor |
| | Varna Technical University, Deputy Rector | Municipality of Vetrino, Mayor |
| | Varna Economic University, Deputy Rector | Municipality of Provadia, Mayor |
| | | Municipality of Suvorovo, Mayor |

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | General Directorate"Fire Safety and Civil Protection" of the | Police Regional Directorate-Varna, Director | |

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| | | | |
|---|---|---|---|
| | Bulgarian Ministry of Interior, Director | | |
| **Fire** | General Directorate "Fire Safety and Civil Protection" of the Bulgarian Ministry of Interior, Director Operational Activities | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director |
| **EMS (Emergency Management Service)** | National Medical Coordination Center, tel.112 | Health Emergency Center-Varna | |
| **Investigations - Police/Justice** | National Medical Coordination Center, tel.112 | Regional Directorate Fire Safety and Civil protection ( Fire Police) | |
| **Support of Population** | National Medical Coordination Center, tel.112 | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | |
| **Medical & Hospitals** | National Medical Coordination Center, tel.112 | Varna Medical University | Health Emergency Center-Varna |
| **Inter-Agency Cooperation/Collaboration** | National Medical Coordination Center, tel.112 | | |

| **3. First Responders** | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |
| **Fires :** ***Urban and industrial*** | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | Municipality of Varna, Deputy Mayor |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | Municipality of Varna, Deputy Mayor |
| **EMS (Emergency Management Service):** ***Emergencies relief to the population*** | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | Health Emergency Center-Varna |
| **Anthropogenic:** ***All kinds of accidents*** | Regional Administration Varna, Governor | Municipality of Varna, Deputy Mayor |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Regional Administration Varna, Governor | Municipality of Varna, Deputy Mayor |
| **Climatic:** ***Floods, landslide, storms, weather events*** | Regional Administration Varna, Governor | Municipality of Varna, Deputy Mayor |

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| | | |
|---|---|---|
| **HAZ-MAT / C.B.R.N.E.** | | Municipality of Varna, Deputy Mayor |
| **Terrorist attack** | Regional Directorate Fire Safety and Civil protection ( Fire Police), Director | Municipality of Varna, Deputy Mayor |

| **4. Operational Organization Des** | | | | | |
|---|---|---|---|---|---|
| **Type of disaster** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** |
| **Fires :** ***Urban and industrial*** | All institutions listed in the sheets 2 and 3 are members of the Standing Regional Committee on Disasters and Civil Protection, and they are responsible within their liabilities to be part of the decision taking process and to communicate with relevant agencies. The processes are led and coordinated by the Governor of the Varna Regional Administration. | All institutions listed in the sheets 2 and 3 are responsible within their competences. The authorised body for Emergency Management is the General Directorate"Fire Safety and Civil Protection" of the Bulgarian Ministry of Interior. At the regional to local levels the regional governments deliver directions and orders to regional representations of interior affairs, national security as well as the regional governmental organizations for the relief of crisis situations, according to the Law of the Republic of Bulgaria on Civil Protection on Disasters and Risks. | Cellular operators Internal Security Radio transmission Web | The means are predefined depending on the situations The reinforcement required is applied upon request | Bulgarian Prime-Minister is responsible for the long-term strategic decisions. Situations are reported by the Bulgarian Minister of Interior. Director of the General Directorate"Fire Safety and Civil Protection" of the Bulgarian Ministry of Interior reports on the Operational Situation. Regional Standing Committee on Disasters and Civil Protection reports on locations situations. Reporting/ suggestions come up to the Prime-Minister, who makes the final decision and |
| **Fires:** ***Forest Bush, Wildfires*** | | | | | |
| **EMS (Emergency Management Service):** ***Emergency relief to the population*** | | | | | |
| **Anthropogenic:** ***All kinds of accidents*** | | | | | |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | | | | | |
| **Climatic:** ***Floods, landslide, storms, weather events*** | | | | | |
| **HAZ-MAT / C.B.R.N.E.** | | | | | |
| **Terrorist attack** | | | | | |
| | | | | | |

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| | | | | | |
|---|---|---|---|---|---|
| | | | | | gives approval. |

| 5. Technical Questions | | | |
|---|---|---|---|
| **Technical Questions** | **No**<br>**Please comment** | **Yes**<br>**Please comment** | **Notes** |
| **Is Internet usually accessible in the common disaster areas?**<br><br>***What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.*** | | Yes, cellular Internet connections are usually accessible in the common disaster areas | |
| **Is there available data regarding topography and critical infrastructure of the disaster area?**<br><br>***What format is the geographical data available and can it be accessed/used by RESPONDRONE.*** | | Yes, there is available GIS data regarding topography and critical infrastructure, and it can be accessed and used by RESPONDRONE | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | No, we do not have drones | | |
| **Do first responders use mobile terminals currently?**<br>*It is important for INESC TEC to know what terminals will be used so that the network is compatible with them.* | No, we use mobile phones and cellular radio-transmitters of army and border police system | | |
| **Are there any existing software/hardware solutions that you will need to integrate into the RESPONDRONE system?** | No | | |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | Use of radio frequencies requires a license. | | |

## *Greece - RCM - Region of Central Macedonia*

| 1. Policy Decision Makers | | |
|---|---|---|
| **National** | **Regional** | **Local** |

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| | | |
|---|---|---|
| Ministry of Citizen Protection (General Secretariat for Civil Protection) | 0 | 0 |
| Ministry of Interior (General Secretariat of the Ministry) | 0 | 0 |
| Ministry of Health (National Health Operation Center (EKEPY) - Directorate EKEPY) Contact: Call Center: +30213/1364000, URL:http://www.moh.gov.gr/ | 0 | 0 |

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Government** | Prime-Minister, through the Unified Operations Coordination Centre (UOCC) of General Secretariat for Civil Protection | Regional Governor or Vice-Governor of the Regional Unity, under the consultation of the "Coordinating Body for Civil Protection" (SOPP) of the Regional Unity, through the Independent Directorate for Civil Protection of the Region (Director of IDCP) | Mayor, under the consultation of the "Coordinating Local Body for Civil Protection" (STO) of the Municipality, through the Civil Protection Department or Office of the Municipality (Head of Department or Office) |
| **Civil Protection** | Minister of Citizen Protection / General Secretariat for Civil Protection (General Secretary of GSCP), Contact: URL: https://www.civilprotection.gr/en Tel.: 112 | 0 | 0 |
| **Fire** | Minister of Citizen Protection / Fire Service of Greece (General Chief of the Fire Service), Contact: URL: https://www.fireservice.gr/el, Tel.: 199 | Regional Fire Service (Regional Commander of Fire Service), Tel.: 166 | Local Fire Service (Local Commander of the Fire Service), Tel.: 199 |
| **Police** | Minister of Citizen Protection / Hellenic Police (General Chief of the Hellenic Police), Contact: URL: http://www.astynomia.gr/ind | Regional Hellenic Police (Regional Commander of Hellenic Police), Tel.: 100 | Local Hellenic Police (Local Commander of the Hellenic Police), Tel.: 100 |

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| | | | |
|---|---|---|---|
| | ex.php?option=ozo_content&perform=view&id=34&Itemid=13&lang=EN, Tel.: 100 | | |
| **Medical & Hospitals: National Health Operations Center (EKEPY)** | Ministry of Health / National Health Operations Center EKEPY (Commander of EKEPY) | Regional EKEPY (Head of Regional Unity of EKEPY) | 0 |
| **EMS (Emergency Management Service): National Emergency Center of Greece (EKAB)** | Ministry of Health / National Emergency Center EKAB (President of EKAB), through the "Crisis Management Team" (ODIK), Contact: URL: https://www.ekab.gr/, Tel.: 166 | Regional Directorate of EKAB (Director of Regional EKAB), Tel.: 166 | Local Sector of EKAB (Head of Local Sector), Tel.: 166 |
| **Army** | Hellenic Army / Hellenic Army General Staff (General Chief of the Hellenic Army), Contact: Call centr: +30210/6555911, URL: http://www.army.gr/ | Regional Commander of Hellenic Army | |

| **3. First Responders** | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |
| **Fires :** ***All kind of fires: Urban and industrial, Forest Bush, Wildfires*** | Regional Fire Service (Regional Commander of Fire Service), Tel.: 166 | Local Fire Service (Local Commander of the Fire Service), Tel.: 199 |
| **EMS (Emergency Management Service) /** ***National Emergency Center of Greece (EKAB): Emergencies relief to the population*** | Regional Directorate of EKAB (Director of Regional EKAB), Tel.: 166 | Local Sector of EKAB (Head of Local Sector), Tel.: 166 |
| **Earthquakes** | Regional Fire Service (Regional Commander of Fire Service, Tel.: 166) for fires, Regional Hellenic Police (Regional Commander of Hellenic Police, Tel.: 100) for public safety and Regional Governor / Independent Directorate for Civil Protection of the Region (Director of IDCP, Tel: depends on the area of the incident) for disaster management | Local Fire Service (Local Commander of the Fire Service, Tel.: 199) for fires, Local Hellenic Police (Local Commander of the Hellenic Police, Tel.: 100) for public safety and Mayor/Civil Protection Department or Office of the Municipality (Head of Department or Office, Tel: depends on the area of the incident) for disaster management |

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| | | |
|---|---|---|
| **Anthropogenic:** ***All kinds of accidents*** | Regional Fire Service (Regional Commander of Fire Service, Tel.: 166) for fires, Regional Hellenic Police (Regional Commander of Hellenic Police, Tel.: 100) for public safety and Regional Governor / Independent Directorate for Civil Protection of the Region (Director of IDCP, Tel: depends on the area of the incident) for disaster management | Local Fire Service (Local Commander of the Fire Service, Tel.: 199) for fires, Local Hellenic Police (Local Commander of the Hellenic Police, Tel.: 100) for public safety and Mayor/Civil Protection Department or Office of the Municipality (Head of Department or Office, Tel: depends on the area of the incident) for disaster management |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Regional Fire Service (Regional Commander of Fire Service), Tel.: 166 and Regional Hellenic Police (Regional Commander of Hellenic Police), Tel.: 100 | Local Fire Service (Local Commander of the Fire Service), Tel.: 199 and Local Hellenic Police (Local Commander of the Hellenic Police), Tel.: 100 |
| **Climatic:** ***Floods, landslide, storms, weather events*** | Regional Fire Service (Regional Commander of Fire Service, Tel.: 166) for fires, Regional Hellenic Police (Regional Commander of Hellenic Police, Tel.: 100) for public safety and Regional Governor / Independent Directorate for Civil Protection of the Region (Director of IDCP, Tel: depends on the area of the incident) for disaster management | Local Fire Service (Local Commander of the Fire Service, Tel.: 199) for fires, Local Hellenic Police (Local Commander of the Hellenic Police, Tel.: 100) for public safety and Mayor/Civil Protection Department or Office of the Municipality (Head of Department or Office, Tel: depends on the area of the incident) for disaster management |
| **HAZ-MAT / C.B.R.N.E.** | Regional Fire Service (Regional Commander of Fire Service), Tel.: 166 or/and Hellenic Army (depends on the kind of incident or the severity) | Local Fire Service (Local Commander of the Fire Service), Tel.: 199 or/and Hellenic Army (depends on the kind of incident or the severity) |
| **Terrorist attack** | Regional Fire Service (Regional Commander of Fire Service, Tel.: 166) for fires and Regional Hellenic Police (Regional Commander of Hellenic Police, Tel.: 100) for public safety and investigations | Local Fire Service (Local Commander of the Fire Service, Tel.: 199) for fires and Local Hellenic Police (Local Commander of the Hellenic Police, Tel.: 100) for public safety and investigations |

| **5. Technical Questions** | | | |
|---|---|---|---|
| **Technical Questions** | **No**<br>**Please comment** | **Yes**<br>**Please comment** | **Notes** |
| **Is Internet usually accessible in the common disaster areas?**<br><br>***What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.*** | | Cellular internet is accessible in the whole country, mobile wi-fi in a few Municipalities | |

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| | | | |
|---|---|---|---|
| **Is there available data regarding topography and critical infrastructure of the disaster area?**<br><br>***What format is the geographical data available and can it be accessed/used by RESPONDRONE.*** | | Only by Google maps | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | No, but there are a few Voluntary Teams that they have | | |
| **Do first responders use mobile terminals currently?**<br>***It is important for INESC TEC to know what terminals will be used so that the network is compatible with them.*** | | | Information unavailable |
| **Are there any existing software/hardware solutions that you will need to integrate into the RESPONDRONE system?** | No | | |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | | | Information unavailable |

## *Greece - RWM - Region of Western Macedonia*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| General Secretariat for Civil Protection | Regional Civil Protection (elected region) | Regional unity civil protection |
| Ministry of Citizens' Protection | Regional Civil Protection (decentralized region) | Municipal civil protection |
| Headquarters of Fire Brigade | Regional Fire Brigade | Regional unity fire brigade |
| National Center for Emergency Support (EKAB) | Regional Union of Municipalities | Local department of EKAB & Hospitals |
| Operational Center of Civil Protection | Police | Local Volunteers Organizations |
| Coast Guard Operational Center | Regional Department of EKAB & Health regions (for all health units) | Police |
| | | Coast Guard |
| | | |
| | | Civil Protection Stakeholders (Professional associations, Technical |

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| | | |
|---|---|---|
| | | chamber, etc.) |

**NOTE:** The Greek Civil Protection System after 2018 disasters in Attica (UWI Fire) and Flash Floods will be redesigned (decisions still pending to be announced by the new Government of July 7th elections)

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | Police Headquarters | Police Regional Administration | Police Regional Unit Administration |
| **Fire** | Fire Brigade Headquarters | Fire Brigade Regional Administration | Fire Brigade Regional Unit Administration |
| **EMS (Emergency Management Service)** | Civil Protection General Secretariat & National Operational Center | Regional Civil Protection Directorate | Municipal Civil Protection Office |
| **Investigations - Police/Justice** | Police Headquarters & Fire Brigade Headquarters & Antiterrorism Service | Police Regional Administration Special Units from Athens (antiterrorism service) | Police Regional Unit Administration Special Units from Athens (antiterrorism service) |
| **Support of Population** | Government - Ministries | Regional Governor and regional Coordination Body | Mayor and Municipal Coordination Body |
| **Medical & Hospitals** | Ministry of Health & National Hellenic Center for Disease Control and Prevention | Health Region (Responsible for all regional health units) | Health Region Health Region (Responsible for all regional health units) |
| **Inter-Agency Cooperation/Collaboration** | Interministerial Committee & General Secretariat for Civil Protection | Regional Coordination Body | Municipal Coordination Body |

| **3. First Responders** | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |
| **Fires :** ***Urban and industrial*** | Fire Brigade | Fire Brigade |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | Fire Brigade | Fire Brigade |
| **EMS (Emergency Management Service):** ***Emergency relief to the population*** | Fire Brigade | Fire Brigade |
| **Anthropogenic:** ***All kinds of accidents*** | Fire Brigade | Fire Brigade |

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| | | |
|---|---|---|
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Fire Brigade | Fire Brigade |
| **Climatic:** ***Floods, landslide, storms, weather events*** | Fire Brigade | Fire Brigade |
| **HAZ-MAT / C.B.R.N.E.** | Fire Brigade | Fire Brigade |
| **Terrorist attack** | Fire Brigade & Antiterrorism Service | Fire Brigade & Antiterrorism Service |

| **4. Operational Organization Des** | | | | | |
|---|---|---|---|---|---|
| **Type of disaster** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** |
| **Fires :** ***Urban and industrial*** | In all cases the fire brigade is the authority having the operational response. There exists a regional coordination body (and a local coordination body) where all main entities participate and any necessary entity / person can be invited that is chaired by the regional governor (mayor) to support coordination of operations and order evacuation if necessary. | The operations of fire Brigade, beside the support of regional (local) coordination bodies, are supported by the National Operational Center (in Athens, pending for over 15 years the establishment of regional operational centers) and the General Secretariat of Civil Protection (that has the role to try find the supplies/support needed by the operational authorities). Ministries also provide support (i.e. Ministry of Health. Ministry of Infrastructures and Networks) as well as the private companies that manage/ own critical infrastructures | The main communication means are through radio channels both for communication between different agencies on the field. However, each agency uses a different radio channel that makes communication difficult (still pending for years the request for a single radio channel for operations). Telephones (and mobiles) are being used for communication between the various | The General Secretariat of Civil Protection is responsible for reinforcements supporting operations. It also activates the request for Union Civil Protection Mechanism Support for specific means, equipment, forces (i.e. firefighting aircrafts, helicopters, ground forces). There is an operational center for firefighting aerial means that decides their distribution in the various forest fires that may be active at the same time). The Interministerial committee that can | There is no official general organizational chart for the Greek Civil Protection System. |
| **Fires:** ***Forest Bush, Wildfires*** | | | | | |
| **EMS (Emergency Management Service):** ***Emergency relief to the population*** | | | | | |
| **Anthropogenic:** ***All kinds of accidents*** | | | | | |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | | | | | |
| **Climatic:** ***Floods, landslide, storms, weather events*** | | | | | |
| **HAZ-MAT / C.B.R.N.E.** | | | | | |
| **Terrorist attack** | | | | | |

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| | | | | | |
|---|---|---|---|---|---|
| | | (railway, highways, power plants, telephony networks, dams, ports, airports etc.). | management level (and also between agencies). In case the mobile operational center of Fire Brigade is on the field also satellite communication can be used). | be activated and led by the prime minister can also take such supporting decisions. | |

*Israel - NEMA - National Emergency Management Authority*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| National Emergency Management Authority | NA | NA |
| http://www.rahel.mod.gov.il/English/Pages/EnglishMainPage.aspx | | |

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | Ministry of Public Security | https://www.gov.il/en/departments/israel_police | |
| **Fire** | Ministry of Public Security | https://www.gov.il/en/departments/firefighting_and_rescue_israel | |
| **EMS (Emergency Management Service)** | NOT Relevant | https://carbyne911.com/ems-case-study/ | |
| **Investigations - Police/Justice** | NOT Relevant | | |
| **Support of Population** | Home Front Command | https://www.oref.org.il/929-en/Pakar.aspx | |
| **Medical & Hospitals** | NOT Relevant | https://www.health.gov.il/English/Pages/HomePage.aspx | |
| **Inter-Agency Cooperation/Collaboration** | NOT Relevant | | |

| **3. First Responders** | | | |
|---|---|---|---|
| **Type of disaster** | **Regional** | **Local** | |

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| | | |
|---|---|---|
| **Fires :** ***Urban and industrial*** | https://www.gov.il/en/departments/firefighting_and_rescue_israel | |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | https://www.gov.il/en/departments/firefighting_and_rescue_israel | |
| **EMS (Emergency Management Service):** ***Emergencies relief to the population*** | https://carbyne911.com/ems-case-study/ | |
| **Anthropogenic:** ***All kinds of accidents*** | https://www.oref.org.il/929-en/Pakar.aspx | |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | https://www.oref.org.il/929-en/Pakar.aspx | |
| **Climatic:** ***Floods, landslide, storms, weather events*** | https://www.oref.org.il/929-en/Pakar.aspx | |
| **HAZ-MAT / C.B.R.N.E.** | https://www.oref.org.il/929-en/Pakar.aspx | |
| **Terrorist attack** | Ministry of Public Security | https://www.gov.il/en/departments/israel_police |

| **4. Operational Organization Des** | | | | | |
|---|---|---|---|---|---|
| **Type of disaster** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** |
| **Fires :** ***Urban and industrial*** | Chief of Staff<br>District Commander<br>Station commander<br>Team Commander | | UHF | | |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | | | UHF | | |
| **EMS (Emergency Management Service):** ***Emergency relief to the population*** | | | LTE+UHF | | https://www.mdais.org/en |
| **Anthropogenic:** ***All kinds of accidents*** | District Commander<br>Area Commander<br>Battalion Commander | district<br>subdistrict<br>battalion | LTE+UHF | | https://www.oref.org.il/11280-en/Pakar.aspx |

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| | | | | | |
|---|---|---|---|---|---|
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Company Commander | company | LTE+UHF | | |
| **Climatic:** ***Floods, landslide, storms, weather events*** | | | LTE+UHF | | |
| **HAZ-MAT / C.B.R.N.E.** | | | LTE+UHF | | |
| **Terrorist attack** | District Commander<br>Commander of the Sector<br>Station commander<br>Team Commander | | LTE+UHF | | |

| **5. Technical Questions** | | | |
|---|---|---|---|
| **Technical Questions** | **No**<br>**Please comment** | **Yes**<br>**Please comment** | **Notes** |
| **Is Internet usually accessible in the common disaster areas?**<br><br>*What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.* | X | | |
| **Is there available data regarding topography and critical infrastructure of the disaster area?**<br><br>*What format is the geographical data available and can it be accessed/used by RESPONDRONE.* | | V | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | | V | |
| **Do first responders use mobile terminals currently?**<br>*It is important for INESC TEC to know what terminals will be used so that the network is compatible with them.* | | V | |

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| | | | |
|---|---|---|---|
| **Are there any existing software/hardware solutions that you will need to integrate into the RESPONDRONE system?** | X | | |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | X | | |

*Latvia - SFRS - State Fire and Rescue Service of Latvia*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| Ministry of Interior<br>http://www.iem.gov.lv/eng/ | Applicable to 36 civil protection commissions of the cooperation territories | Applicable to 109 rural municipalities and 9 cities under state jurisdiction (Riga, Daugavpils, Liepaja, Ventspils, Valmiera, Rezekne, Jelgava, Jurmala and Jekabpils).<br>http://www.varam.gov.lv/lat/darbibas_veidi/pasv/kont/?doc=13066 |
| State Fire and Rescue Service of Latvia<br>https://www.vugd.gov.lv/eng/contact_us | | |
| Civil Protection Department<br>Office Number: +371 67075817 | | |

| **2. Operational Decision makers** | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | State Police National Headquarters, or Latvian State Security Service Headquarters | State Police Regional Headquarters | State Police operational field headquarters |
| **Fire** | National Disaster Working Group | Regional Disaster Working Group | State Fire and Rescue Service operational field headquarters |
| **EMS (Emergency Management Service)** | National Disaster Working Group | Regional Disaster Working Group | State Fire and Rescue Service operational field headquarters |
| **Investigations - Police/Justice** | State Police National Headquarters | State Police Regional Headquarters | State Police operational field headquarters |
| **Support of Population** | Ministries regarding type of the emergency | The civil protection commission of the cooperation territories | 109+9 Municipalities |
| **Medical & Hospitals** | State Operation Medical Commision | State Emergency Medical Service | Hospital, State Emergency Medical Service |

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| | | | |
|---|---|---|---|
| **Inter-Agency Cooperation/Collaboration** | Crisis Management Council https://likumi.lv/ta/en/en/id/224553-by-law-of-the-crisis-management-council | The civil protection commission of the cooperation territories | Operational field headquarters |

| **3. First Responders** | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |
| **Fires :** ***Urban and industrial*** | State Fire and Rescue Service | State Fire and Rescue Service |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | State Forest Service; State Fire and Rescue Service | State Forest Service; State Fire and Rescue Service |
| **EMS (Emergency Management Service):** ***Emergencies relief to the population*** | The civil protection commission of the cooperation territories; State Fire and Rescue Service | The civil protection commission of the cooperation territories; State Fire and Rescue Service |
| **Anthropogenic:** ***All kinds of accidents*** | State Fire and Rescue Service | State Fire and Rescue Service |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Latvian Coast Guard | Latvian Coast Guard |
| **Climatic:** ***Floods, landslide, storms, weather events*** | See table below | See table below |
| **HAZ-MAT / C.B.R.N.E.** | See table below | See table below |
| **Terrorist attack** | Latvian State Security Service | Latvian State Security Service |

| **4. Operational Organization Des** | | | | | |
|---|---|---|---|---|---|
| **Type of disaster** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** |
| **Fires :** ***Urban and industrial*** | State Fire and Rescue Service of Latvia is performing fire-fighting operations in all levels | State Fire and Rescue Service resources, and if necessary supported by other stakeholder resources | Mobile network, Radio communication, E-mail | | |
| **Fires:** ***Forest*** ***Bush, Wildfires*** | State Forest Service is performing forest fire-fighting operations in all levels | State Forest Service resources, and if necessary supported by other stakeholder resources | Mobile network, Radio communication, E-mail | | |

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| | | | | | |
|---|---|---|---|---|---|
| **EMS (Emergency Management Service):** ***Emergency relief to the population*** | State Fire and Rescue Service of Latvia | State Fire and Rescue Service of Latvia resources and other Organization/Legal Entity/Government Bodies resources | Mobile network, Radio communication, E-mail | | |
| **Anthropogenic:** ***All kinds of accidents*** | State Fire and Rescue Service | State Fire and Rescue Service of Latvia resources and other Organization/Legal Entity/Government Bodies resources | Mobile network, Radio communication, E-mail | | |
| **Search & Rescue:** ***At sea, mountain, perilous environment like Urban Collapse or other*** | Latvian Coast Guard | Latvian Coast Guard resources | Mobile network, Radio communication, E-mail | | |
| **Climatic:** ***Floods, landslide, storms, weather events*** | See table in sheet Nr.3 | | Mobile network, Radio communication, E-mail | | |
| **HAZ-MAT / C.B.R.N.E.** | See table in sheet Nr.3 | | Mobile network, Radio communication, E-mail | | |
| **Terrorist attack** | Latvian State Security Service | | Mobile network, Radio communication, E-mail | | |

| **5. Technical Questions** | | | |
|---|---|---|---|
| **Technical Questions** | **No** | **Yes** | **Notes** |
| **Is Internet usually accessible in the common disaster areas?** ***What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.*** | | x | Not available only if damages occur in electricity grid or internet infrastructure |

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| | | | |
|---|---|---|---|
| **Is there available data regarding topography and critical infrastructure of the disaster area?**<br><br>***What format is the geographical data available and can it be accessed/used by RESPONDRONE.*** | | x | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | x | | |
| **Do first responders use mobile terminals currently?**<br>*It is important for INESC TEC to know what terminals will be used so that the network is compatible with them.* | x | | |
| **Are there any existing software/hardware solutions that you will need to integrate into the RESPONDRONE system?** | | x | Mapping, secure on-live video streaming, vehicle and people detection and recognition system, drone tracking with visualization on map |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | | x | Data streaming has to be secured. |

## *Netherlands - VRH - Safety Region Haaglanden*

| **1. Policy Decision Makers** | | |
|---|---|---|
| **National** | **Regional** | **Local** |
| **Ministry of Justice and Safety** | **25 Safety regions** | **In the Veiligheidsregio Haaglanden are 9 municipalities** |
| https://www.rijksoverheid.nl/ministeries/ministerie-van-justitie-en-veiligheid | | https://www.vrh.nl/ |
| | https://nl.wikipedia.org/wiki/Veiligheidsregio#/media/Bestand:2019-Veiligheidsregio-1200.png | |
| | nr 15: Veiligheidsregio Haaglanden | https://nl.wikipedia.org/wiki/Veiligheidsregio_Haaglanden#/media/Bestand:2017-R15-Haaglanden.jpg |

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| 2. Operational Decision makers | | | |
|---|---|---|---|
| **Authorities** | **National** | **Regional** | **Local** |
| **Police** | National Police, Unit Haaglanden https://www.politie.nl/over-de-politie/organisatie---nationaal.html | | |
| **Fire** | non | https://www.brandweer.nl/haaglanden | |
| **EMS (Emergency Management Service)** | | | |
| **Investigations - Police/Justice** | see Police | | |
| **Support of Population** | no | 9 municipalities in the Safety Region Haaglanden https://nl.wikipedia.org/wiki/Lijst_van_Nederlandse_gemeenten#/media/Bestand:2019-NL-Gemeenten-basis-2500px.png | |
| **Medical & Hospitals** | ministerie-van-volksgezondheid-welzijn-en-sport https://www.rijksoverheid.nl/ministeries/ministerie-van-vol | GHOR Haaglanden (medical service) https://www.vrh.nl/over-de-vrh/ghor-haaglanden | |
| **Inter-Agency Cooperation/Collaboration** | | | |

Stedin (energie supplier) https://www.stedin.net/

HTM (public transport) https://www.htm.nl/

DUNEA (Drinking water) https://www.dunea.nl/

Waterschap Delfland https://www.hhdelfland.nl/

| 3. First Responders | | |
|---|---|---|
| **Type of disaster** | **Regional** | **Local** |
| **Fires :** *Urban and industrial* | Fire Brigade Haaglanden https://www.brandweer.nl/haaglanden | same |
| **Fires:** *Forest* | Fire Brigade Haaglanden | same |

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| | | |
|---|---|---|
| *Bush, Wildfires* | | |
| **EMS (Emergency Management Service):** *Emergency relief to the population* | | |
| **Anthropogenic:** *All kinds of accidents* | | |
| **Search & Rescue:** *At sea, mountain, perilous environment like Urban Collapse or other* | Veiligheidsregio Haaglanden (FB and medical) , KNRM https://www.knrm.nl/?gclid=Cj0KCQjwjMfoBRDDARIsAMUjNZr6LvtNQGQ3YC5DLMEZwHG0WqdyMjZ2OxDQF7pG-XbWafIRLRF8QX8aAoq7EALw_wcB | same |
| **Climatic:** *Floods, landslide, storms, weather events* | all emergency services (police, fire brigade, medical) municipality and water authority | same |
| **HAZ-MAT / C.B.R.N.E.** | Veiligheidsregio Haaglanden (FB and medical) and RIVM https://www.rivm.nl/ | same |
| **Terrorist attack** | National Police, Unit Haaglanden | same |
| **Flooding** | Regional water authority Delfland https://www.waterschappen.nl/ | same |

**4. Operational Organization Description**

| Type of disaster | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 |
|---|---|---|---|---|---|
| **Fires :** *Urban and industrial* | Mayor, Head officer, Officer, Enginechief | Mayor, Head officer, Officer, Enginechief | C2000 - LCMS | fire department | enclosed the crisis plan document |
| **Fires:** *Forest Bush, Wildfires* | same as above | same as above | C2000 - LCMS | fire department, army | in the figures the organisational chart in case of crises |
| **EMS (Emergency Management Service):** *Emergency relief to the population* | | | C2000 - LCMS | | |
| **Anthropogenic:** *All kinds of accidents* | | | | | |

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| | | | | | |
|---|---|---|---|---|---|
| **Search & Rescue:** *At sea, mountain, perilous environment like Urban Collapse or other* | Coast guard and fire service | Coast guard and fire service | C2000 - LCMS | coastguard, navy, fire service | |
| **Climatic:** *Floods, landslide, storms, weather events* | Mayor, Head officer, Officer, Enginechief | Mayor, Head officer, Officer, Enginechief | C2000 - LCMS | fire service, army | |
| **HAZ-MAT / C.B.R.N.E.** | Mayor, Head officer, Officer, Enginechief | Mayor, Head officer, Officer, Enginechief | C2000 - LCMS | fire service, army, water authority | |
| **Terrorist attack** | Police, Mayor, Head officer, Officer, Enginechief | Prosecutor, Police, Mayor, Head officer, Officer, Enginechief | C2000 - LCMS | fire service, police, army | |

**LCMS** = National/regional internet based system for crisis communication in the Netherlands

**C2000** = National tetra communication network

| **Technical Questions** | **No** *Please comment* | **Yes** *Please comment* | **Notes** |
|---|---|---|---|
| **Is Internet usually accessible in the common disaster areas?** *What type of Internet connection is available (if at all): cellular, fixed, or mobile wi-fi stations.* | | x | |
| **Is there available data regarding topography and critical infrastructure of the disaster area?** *What format is the geographical data available and can it be accessed/used by RESPONDRONE.* | | x | |
| **Does your organization have drones that can be used and/or integrated into the RESPONDRONE system?** | | x | |
| **Do first responders use mobile terminals currently?** *It is important for INESC TEC to know what terminals will be used so that the* | | x | |

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| | | | |
|---|---|---|---|
| *network is compatible with them.* | | | |
| **Are there any existing software/hardware solutions that you will need to integrate into the RESPONDRONE system?** | x | | |
| **Are there any software/hardware licensing requirements/restrictions you would like the technical teams to consider?** | x | | |

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