Enhancing decision support and management services in extreme weather climate events

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5.3 Universitat Pompeu Fabra (UPF)
5.4 Fraunhofer Institute of Optronics, System, Technologies and Image Exploitation (IOSB)
5.5 Finnish Meteorological Institute (FMI)
5.6 IBM Israel - Science And Technology LTD (IBM)
beAWARE (Enhancing decision support and management services in extreme weather climate events.), funded by the European Union’s H2020 research and innovation programme (GA-700475), explored the combination of innovative technologies to result in a holistic approach to the realization of crisis management framework that support all the phases in an emergency call sequence.

The main goal of the project was to rely on platforms, theories and methodologies that are already used for disaster management and add the elements that are necessary to make them working efficiently under the same objective.

beAWARE’s usability and interoperability have been stress-tested in the lifetime of the project through 3 major field testings and will undergo a permanent stress-testing (demo) environment after the official end of the project.

1.1 Overall objectives of the project and the Progress beyond the state of the art

Figure 1.1: beAWARE Concept

beAWARE project ended on 31 December 2019 and has met all its milestones. The project made a clear contribution to its main target: improving situational awareness and command and control (C2) systems. As a whole, beAWARE integrated platform encompasses high-end technologies and machine learning capabilities for obtaining information from text messages, social media and voice calls; a classification mechanism to process weather and other
1.1. Overall objectives of the project and the Progress beyond the state of the art

multimodal data and to generate early warnings and real-time alerts; deep learning techniques to detect crisis events in visual content; automatic drone routing and piloting for receiving valuable information from aerial imagery; case-based reasoning and de-cision support algorithms for crisis management; and automatic generation of multi-lingual reports to transform all the above into linguistic information to the authorities creating a usable system for performing in real case scenarios.

beAWARE project proposed a novel approach for disaster management, that manages the different events and information retrieved all along the disaster management process. The project overall development approach was iterative and organised in three main cycles, each one involving integration, prototype building and evaluation phases. In this context, the work focused on the following innovative objectives: 1) Research study on the requirements for emergency services, 2) multilingual speech and written content extraction, 3) aggregation of multimodal information from sensors, social media, meteorological data etc. 4) visual context analysis, 5) semantic integration for reasoning and decision support, 6) multilingual generation of reports for summarization, 7) research and development of a Main Safety Answering Point (PSAP), 8) Design and Execution of three large pilots.

The main objectives and its final results are enumerated below.

Obj.1 – Perform a research study on the requirements for emergency services given the current digital landscape (i.e. end user in emergency need, PSAP operator, first responder).

The aim of this objective was to identify the needs for emergency services within the current accessible digital landscape. The research tried to find the gaps in e.g. the present warning technologies and propose improvements with the aim of filling the gaps. In order to achieve this objective a spiral process (requirements elicitation process) was established throughout the entire project, where every iteration was based on the outcomes of the previous. The members of the consortium with weekly teleconferences, plenary meetings and Workshops managed to organize and formulate a a lists of approximately 100 user requirements which corresponds to the three relevant use cases of the project: Fire, Flood, Heatwave.

Obj.2 – Multilingual speech and written communication analysis in emergency calls

The capability to grasp the content of any message transmitted by a citizen in danger during an emergency was very crucial in the context of beAWARE. To fulfill this objective beAWARE designed and developed the following components:

Social media analysis tool which continuously collects tweets from the twitter and classify them as relevant or not. Automatic speech recognition module which is used
to transcribe voice messages in 4 supported languages. In order to showcase the ability of the platform to integrate with existing tools, the component was adjusted in order to communicate and transcribe calls coming either from the beAWARE mobile application or from existing call centers.

Transcribed and written communication analysis: In order to extract concepts and conceptual relations from textual material (texts, social media postings, and transcribed spoken language) a multimedia text analysis module was developed. beAWARE extended the knowledge extraction techniques to detect from multilingual text a wide range of incidents and impacted objects, as well as locations and states associated with incidents.

**Obj.3 – Aggregate multimodal information from sensor networks, meteorological stations, etc. and social media for decision support and validation purposes and issue early warnings.**

beAWARE has designed and developed the procedures and the infrastructure to support the aggregation of multimodal information. The system collects information from the following sources:

- Meteorological and Hydrological data (forecasting weather data and real-time weather observations)
- Flood risk maps from and fire hazard maps from EFFIS and EFAS
- Videos and Images (from the beAWARE mobile application, static cameras and Drones)
- Audio messages (from the beAWARE mobile application and Call Centers)
- Social media data relevant to a specific crisis (from Twitter)

The sensing data (forecasts and observations for river water level and weather parameters) are stored to the SensorThings Server API (FROST), a standard-based sensor data store. The main module developed to process this data is the Crisis Classification (CRCL) module which consumes all stored data from the different sources and estimates the crisis level of an event. CRCL consists of two components, the Early Warning to provide provisional alerts and the Real-Time Monitoring component responsible for monitoring the evolution of the crisis.
1.1. Overall objectives of the project and the Progress beyond the state of the art

Obj.4 – Visual context analysis during emergency calls.

This objective pointed at understanding the visual context received to the system. The term ‘call’, in a wider sense, refers to the reporting of a person for an emergency situation by using all the available multimedia context that beAWARE provides via the mobile application.

To enable the above, beAWARE designed and developed and finalised the Image and Video analysis components to extract high-level information such as type of the crisis (flood, fire), detect impacted people, animals, cars, indoor/outdoor, city landscape/deserted area by extracting low-level features from visual data and translate them into high-level concepts based on supervised machine learning techniques. The extracted visual concepts lead primarily to real-time detection and assessment of occurring events and their type, as well as a global understanding of the situation in the affected area (people impacted, traffic conditions etc.)

Moreover, crisis event detection in multimedia collections has been also explored following the temporal dimension of a flood or fire dynamic texture in. In addition beAWARE has proposed novel methods for combining multi-modal information in early and late fusion schemes that deploy multi-modal stacked autoencoders along with dimensionality reduction algorithms.

Figure 1.4: Visual context analysis in emergency events
Obj.5 – Semantic integration of multimodal information from the emergency calls, M2M/IoT platforms and social media for decision support and generation of early warnings.

The key direction of this objective was to research and develop technologies for semantic integration of the diverse multimodal content to enable reasoning for decision support and for the generation of early warnings.

There is a number of tools developed within the project to enable the reasoning support. The backbone of the reasoning mechanisms consists in the use of a beAWARE ontology for the mapping of the input. Based on this ontological framework beAWARE is able to estimate the severity level of an incident, to cluster relevant incidents, to link the heterogeneous digital information and reveal semantic hidden relations.

Moreover, a two-layer validation mechanism, both at the component level and at the Knowledge Base level, was integrated to validate the incoming data and filter conflicting or irrelevant information.

Obj.6 - Multilingual report generation from aggregated emergency data.

The report generation aims in the development of techniques for the generation of multilingual written information that derives from the previous ontological representations.

The output of the analysis from all the beAWARE analysis components is used as input to the report generation component that processes the information and automatically determines which contents need to be forwarded to linguistic generation so as to provide written reports to the authorities.

Two types of multilingual reports can be issued by the system, situational and summary reports covering the occurrence of incidents in chronological order. Entities and concepts beyond those modelled by the ontology can be verbalised, thus facilitating the portability of the developed components to new emergency scenarios.

Similarly to the Text analysis component, the Report Generator can generate reports in all 4 supported languages (English, Italian, Spanish and Greek).
1.1. Overall objectives of the project and the Progress beyond the state of the art

Obj.7 – Research and development of Main Public Safety Answering Point (PSAP) for emergency multimedia enriched calls Develop a PSAP

In the context of beAWARE a main public safety answering point (PSAP) was designed and developed in order to provide a platform for integration of multiple unconnected security applications and devices and control them through one unified user interface. This involves visualisation and interaction techniques for enhanced situational awareness, including situational assessment, GIS analysis and mapping. The public safety answering point consists of a Map and a Dashboard. The Map is used to display the position of the incidents, the results of the analysis components and the reports that are automatically generated as well as to present the location of the FRs and their status. Also map layers can be used to filter out data and avoid user of being overwhelmed by the amount of information. The Dashboard is used to display the metrics generated by system but moreover for other actions such as the generation of public alerts or the management and the assignment of tasks to the FRs.

![Main Public Safety Answering Point of beAWARE](image)

Figure 1.6: Main Public Safety Answering Point of beAWARE
Chapter 1. Overall objectives of the project and the final conclusions

Obj.8–Design and execute 3 large scale pilots.

To demonstrate and evaluate beAWARE solution there were selected three demonstration scenarios for flood, fire, heatwave to be implemented respectively in Vicenza, Valencia and Thessaloniki respectively. The locations were selected based on the frequency of the occurrence of those event. Overall, three large scale pilots successfully carried out involving in total more than 600 participants.

Figure 1.7: Participants performing tasks during the Vicenza Pilot

1st Pilot - Heatwave in Thessaloniki The beAWARE 1st Pilot was executed on the 20th of November of 2018 in Thessaloniki, Greece, with the aim to test the 1st prototype along with the heatwave scenario.

2nd Pilot - Flood in Vicenza The second beAWARE pilot took place on the 7th of March in Vicenza, Italy from 8:00 CET to 14:00 CET at the presence of more than 90 participants.

3rd Pilot - Fire in Valencia The third beAWARE pilot was executed on the 14th of November in Valencia, Spain, with the aim to test the final version of the beAWARE system applied to the fire scenario. This pilot involved more than 500 participants.

More information and videos of the pilots can be found on the website: https://beaware-project.eu/results/beaware-pilots/

Figure 1.8: Command Center in Vicenza and in Valencia Pilot
2. Overview of the results and their exploitation and dissemination

### 2.1 beAWARE Exploitable Solutions

beAWARE is more than a crisis management platform that will help authorities, first responders and citizens in extreme weather events. Instead, the platform can be seen as a combination of different components offering a variety of tools and functionalities, some of which represent promising innovations to the current State of Art technologies.

Table 2.1: beAWARE System tools

<table>
<thead>
<tr>
<th>#</th>
<th>beAWARE System tools</th>
<th>Relevant Objective %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Multilingual Text Analysis Module</td>
<td>Objective 2</td>
</tr>
<tr>
<td>2</td>
<td>Automatic Speech Recognition Module</td>
<td>Objective 2</td>
</tr>
<tr>
<td>3</td>
<td>Crisis Classification: Early Warnings &amp; Real Time Monitoring</td>
<td>Objective 3</td>
</tr>
<tr>
<td>4</td>
<td>FROST-Server, geoServer</td>
<td>Objective 3</td>
</tr>
<tr>
<td>5</td>
<td>Drones Platform</td>
<td>Objective 3</td>
</tr>
<tr>
<td>6</td>
<td>Social Media Analysis Module</td>
<td>Objective 3</td>
</tr>
<tr>
<td>7</td>
<td>Visual analysis module</td>
<td>Objective 4</td>
</tr>
<tr>
<td>8</td>
<td>Knowledge base</td>
<td>Objective 5</td>
</tr>
<tr>
<td>9</td>
<td>KB Service for Semantic Integration &amp; Reasoning</td>
<td>Objective 5</td>
</tr>
<tr>
<td>10</td>
<td>Multilingual Report Generator Module</td>
<td>Objective 6</td>
</tr>
<tr>
<td>11</td>
<td>Main Public Safety Answering Point</td>
<td>Objective 7</td>
</tr>
<tr>
<td>12</td>
<td>Mobile Application</td>
<td>Objective 7</td>
</tr>
<tr>
<td>13</td>
<td>UIs for KB, Drones Dashboard, Analysis Workbench</td>
<td>Objective 3, 5, 7</td>
</tr>
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</table>

beAWARE system integrates several independent components creating a usable platform for performing in real case scenarios. The software components involved are put together and subsequently deployed with the principal aim to facilitate the development and operability of the platform. In order to achieve that goal, the beAWARE system is providing detailed enumeration, specification, and means of validation. In such way, each of the components meets other beAWARE platform components or specific user needs.

During the three years of the project’s lifetime, several tools and applications were de-
developed, to support project’s objectives and to address the three use cases considered in beAWARE.

In the last year of the project, the consortium worked towards the identification of the final exploitable solutions. Finally, 5 separate individually exploitable solutions are identified and presented below in addition to the complete integrated beAWARE system.

2.1.1 FROST Server

Crisis Management Systems of the future will integrate many sensor data retrieved via Internet of Things (IoT) solutions. The SensorThings API (Application Programming Interface) is a standard that allows this data to be collected and processed in a uniform way despite the enormous variety of devices and their heterogeneous nature. It builds on long OGC experience in the field of sensor data management and takes into account modern requirements for performant and easy to master interfaces.

The FROST server is one of the first fully compliant implementations of the SensorThingsAPI standard that implements all optional features, such as MultiDatastreams and Batch Requests. It offers a REST-based interface to store and retrieve sensor data with powerful queries, as well as MQTT support to publish data and to subscribe for entity inserts and changes. Therefore, the integration into existing Crisis Management and Early Warning systems can be done with a small amount of work.

2.1.2 Crisis classification API

The Crisis Classification Web API is an open-source holistic framework that tailors advanced technological solutions to enable first responders, authorities and civil protection organizations to manage efficiently the pre-emergency and emergency phases of a hazardous natural event. Specifically, it consolidates functionalities for producing timely early warnings, by fusing heterogeneous weather forecasts and estimating the potential overall crisis level for the upcoming natural event in specific areas and/or regional levels.

2.1.3 Analysis Module

The Analysis module is the heart of the beAWARE system and its functionality consists of collecting and combining heterogeneous data from various sources, such as social networks, visual and audio input from first responders or people in danger. These data are semantically integrated in a service-oriented way to provide decision support to stakeholders seeking solutions on operational and strategic aspects of crisis management.

The analysis module consists of three different analysis components (Visual/Audio, Textual, and social media) and is supported by an ontological framework, which provides the backbone of the reasoning mechanisms of the system. The semantic reasoning process facilitates decision support for authorities while communication with decision makers is achieved through a semantic verbalization framework that translates the integrated data to natural language reports. In a nutshell, it provides the foundations for the decision support services to the authorities and can be easily incorporated in relevant disaster management systems.

2.1.4 Drones Platform

With advances in technology, drones can carry high-resolution cameras and sensors (e.g. thermal) and are able to capture aerial data in a safe and accurate way in natural and man-
made environments. Autonomous flight capabilities and cognitive edge analytics leads to
novel ways to bring impactful and at times lifesaving solutions applied using drones.

Building safe drone-based solutions brings technical and scientific challenges, which are
not only related to autonomous accurate drone piloting and route planning in resource-
constrained environments. Managing, provisioning, storing and analyzing high volumes of
data and dynamically changing the route based on insights extracted from this data is criti-
cal. The intention is to create an eco-system for the easy creation, management, provisioning,
and consumption of drone services which is drone vendor agnostic.

2.1.5 Knowledge Base for Crisis Management

Crisis Management is a knowledge intensive discipline: to orchestrate the right response in
a crisis, the decision makers need to be aware of the situation in the disaster area. The
beAWARE Knowledge Base offers means to access and aggregate all existing knowledge
about a natural disaster incident. Through the usage of an ontology, the Knowledge Base
structures all available information according to its semantics. Therefore, it not only works
as a full-fledged glossary, offering a common language and understanding of the domains
for all stakeholders, but also enables the user to understand the connection between the
data. Since every piece of data is part of an information network, the user can browse avail-
able information starting from high-level facts and finish his exploration at raw sensor data.
Depending on the user’s tasks, the relevant links can be customized: The Knowledge Base
additionally integrates a graphical ontology editor to highlight the most important links be-
tween data important to the user. Quick understanding of the domain is accompanied by
fast access to the most important data.

Furthermore, the Knowledge Base not only offers means to retrieve, but even more fuse
information from different kinds of sources. Information in natural disaster management
is often only useful, when combined with geospatial information. Therefore, the Knowl-
edge Base contains mapping tools showing the situation at hand and integrates risk maps
about possible threats fostering efficient response and preparedness actions. In this context,
the beAWARE Knowledge Base is able to query information from other data sources, for
example the Wikidata Knowledge Base. Through this approach, the beAWARE Knowledge
Base makes use of already existing information expanding and complementing the depth of
knowledge of the platform.

2.2 An agent for exploitation

Following the recommendations and the discussions that took place throughout the project,
the consortium approved the decision to appoint the business development of the beAWARE
solutions to INFALIA (www.infalia.com), a commercial company, spin-off of Information
Technologies Institute of the Centre for Technology Hellas (CERTH) that already has a successful experience in
providing services for public authorities. Since INFALIA is a spin-off of CERTH, it is an
organisation close to Lead partner and is the best option to assign this role. INFALIA satisfies
the examined criteria of relevance, experience and capacity.

INFALIA will continue to promote the beAWARE system through its network and through
participation in relevant conferences and events after the project’s completion as well through
other dissemination channels.
2.3 Legal aspects and IPR related matters

beAWARE complies with all IPR rules regarding H2020 projects as outlined in Regulation No 1290/2013 of the European Parliament laying down the rules for participation and dissemination in Horizon 2020.

As concerns the background IP, necessary to implement the project, the partners agreed and stated in the Consortium Agreement that was signed in the beginning of the project to make their technology available on a royalty-free basis.

Any foreground IP that was produced during the project will be owned by the partners that generate it. In the case of joint creation as when 2 or more partners are working together towards a common solution then the partners should jointly hold the Intellectual Property rights. In this case the partners have to enter an explicit agreement that will detail the operational, legal and financial rules of the allocation of these rights. As in the case of background, access rights to foreground that is needed for the completion of the project will be granted on a royalty free basis.

Since all partners are committed to continuing the development of the solution, they have decided to maintain the exploitation board at an advisory board capacity and as a conflict resolution competition. Each partner will appoint one representative for the exploitation board which will oversee the business development carried out by INFALIA.

2.4 Dissemination Actions at a glance

During the three years of the project’s lifetime, 3 prototypes have been implemented, demonstrated through three large scale pilots and thoroughly evaluated during the three development cycles of the project. In addition to the participatory design, testing and evaluation stages, which resulted in the involvement of more than 600 individuals (FRs, and general public), the project reached several communities through participation to conferences, workshops, showcases and seminars. In total there were published 45 papers in conferences and workshops giving an overall boost to science in the field of Crisis Management. A focused Network of Interested was established to support the direct liaison with relevant stakeholders that reached 149 members. A detailed list of dissemination and societal engagement activities can be found in the D8.3(M36), available online at https://beaware-project.eu/results/public-deliverables

The website will continue to be used as the dissemination tool of the project. Additionally, social media channels will keep supporting and spreading useful information about the beAWARE.

- Facebook: https://www.facebook.com/BeAWARE.H2020/
- Twitter: https://twitter.com/beAWARE_H2020
- YouTube: https://www.youtube.com/channel/UCoogTOO-dmd4JSS47gC1nGw
- LinkedIn: https://www.linkedin.com/groups/13515863/

2.5 A permanent demo environment

Despite the end of the project in December 2019, the consortium is now moving in several directions aiming at promoting the activities carried out during the project, further exploit
the project outcomes and maximise future impact.

Following the success of the pilot demonstrations and the positive reviews of the community and potential clients, the consortium will setup a permanent demo environment that will be used to demonstrate the platform’s capabilities. This infrastructure was utilised and stress-tested during the final pilot demonstration in Valencia and will continue to serve as the main point of demonstrating the integrated system after the completion of the project, under the responsibility of Valencia Police (PLV).

INFALIA but also all other partners of the beAWARE consortium will continue to promote the beAWARE solution in conferences, events and their network of potential stakeholders. When a potential customer is interested in adopting the beAWARE solution, all communication on behalf of beAWARE will be directed and handled by INFALIA, which will act as a proxy of the consortium. A demonstration will be set up in cooperation with PLV in order to present the system to the customer.

The setup of the permanent Demo will be settled after the end of the COVID-19 emergency.

2.6 Contacts and Information

For further information visit the project web site https://beaware-project.eu/ or send e-mail to the Project Coordinator Dr. Ioannis Kompatsiaris, ikom@iti.gr, to the deputy Project Coordinator Dr. Stefanos Vrochidis, stefanos@iti.gr or to the second deputy Project Coordinator & Scientific Manager Dr. Anastasios Karakostas, akarakos@iti.gr.
3. Testimonies of the EndUsers

3.1 Introduction

The project internal users played a core role in the strategic orientations of the project, the execution of the pilots, the evaluation and the validation of the project outcomes. Their experience from the project is outlined fully in this section.

3.2 Frederikssund-Halsnæs Fire & Rescue Service (FBBR)

Frederiksborg Fire & Rescue Service provides fire and rescue services to municipalities of Frederikssund, Halsnæs, Hillerod, Gribskov, Egedal and Fureso in the center of the island of Zealand, in Denmark. The six municipalities are home to approximately 250,000 inhabitants, who live within a land area of 1058 square miles.

The fire department’s key activities and responsibilities include responding to and preventing; fires, road accidents, flooding, fires at sea, hazardous material and chemical incidents, major incidents including terrorist attacks, boat preparedness and providing other humanitarian services such as rescuing casualties from a variety of emergency scenarios. Like all fire and rescue services in Denmark, Frederiksborg Fire & Rescue Service’s operational activities are overseen at the national level by the Ministry of Defense. Frederiksborg Fire & Rescue Service has long term strategic aims of providing the social, economic and environmental well-being of the residents of the six municipalities. Central to this is a focus on preventing fires and other emergencies from happening and in doing so reducing death, injury and damage to property.

3.2.1 Role in the project

In beAWARE, FBBR was responsible as domain expert for the Fire use case and requirements and also participated actively in all three well planned and executed pilots. Moreover, employees from FBBR have participated as active players and been present in the control room,
among the decision makers and rescue teams, as well as participating as citizens and observers.

FBBR contributed to the content of all use cases, script of actions and locations including weekly Telco’s.

3.2.2 How beAWARE could support the recovery phase and evolve toward multi-hazard or multi-risk platform?

We believe that beAWARE can help and support the recovery phase, through social media analysis (citizen tweets) and communication in the form of important messages through the beAWARE app. In addition, the platform can contribute to early detection of emergencies, and help organisations like us to predict the evolution of extreme events. This should ensure that decision makers are given a smoother and more successful process, while helping to speed up the recovery phase and return to normalcy, with lower economic costs and impact on climate change. We will use the platform in all phases of our work, as we believe the platform can help address an emergency in an even more comprehensive way. This means that all relevant risks in the area of interest will be analysed. This would require a deep understanding of past dangers, monitor current risks, and predict the future.

![Diagram](image)

Figure 3.1: FBBR needs of operation

3.2.3 Highlight the results of the final platform that would more interest your organization.

- PSAP: Map + Task assignment + task management
- Corporation and coordination between responsible authorities during the event.
- Image / video analysis + drone platform
- Communication support (Disseminate information)
- Real time weather data in relation to a crisis classification and a crisis progression
• Notify the public
• Information from citizens
• Better corporation and coordination between civilians and authorities during interaction.
• Lessons learned
• Common situation Picture and standard situation Report
• Exercise with “real incidents”

3.2.4 How beAWARE can function as a standalone or as a complement to your legacy tools and how it could be adapted for use at FBBR’s premises

The beAWARE platform is the technology to help improve planning, training and coordination with other first responders in extreme weather events. It has a strong focus on data analytics for the detection of early events and management support through analysis of social networking activities and the app developed specifically for this purpose. FBBR will subsequently conduct an analysis of whether beAWARE can be used, instead of, or in addition to the tools / technologies we are currently using, and which are approved and accepted by all stakeholders.

The plan is to place the beAWARE platform on FBBR’s dispatch central but also in the crisis room, which is the coordination enter for major, extraordinary or long-standing events.

Figure 3.2: FBBR dispatch central
3.3 Alto Adriatico Water Authority (AAWA)

The Alto Adriatico Water Authority (AAWA) is a Public Body responsible for the management of the rivers flowing into the Northern Adriatic Sea, namely Isonzo, Tagliamento, Livenza, Piave, and Brenta. The AAWA is in charge of the catchment planning, including remedial measures to reduce hydraulic and geological risks, as well as for the protection and the sustainable use of water resources. It coordinates the activities to be implemented on a basin scale such as safeguarding the quality and quantity of water resources, attain the best possible balance among the contrasting water use, study the schemes necessary to prevent, in particular, disastrous events - droughts and floods. According to the Water Framework Directive 2000/60/EC and Floods Directive 2007/60/EC, the AAWA coincides with the Eastern Alps river District and promotes Basin Plans which indicate the objectives of water resources and flood risk management in the North East Italy, and the measures aimed to achieve these objectives.

3.3.1 Role in the project

In beAWARE, AAWA was responsible as domain expert for the flood use case and requirements and for the organisation of the Flood Pilot. Also, AAWA participated actively in the execution and evaluation of the rest of the Pilots.

AAWA’s staff had been actively involved in all the three beAWARE field pilots; in particular, AAWA organized the second pilot, held in Vicenza, focused on the flood risk management. In that occasion, AAWA’s staff was also involved as active player of the pilot itself, covering many roles (like citizen, support to the decision maker, control room operators, etc.).

Concerning the other two pilots, AAWA’s delegates performed role of observers in different situations (i.e. there were AAWA’s staff in control room, other delegates followed the rescue teams on fields etc..) in order to have a clear overview of the pilot. It is worth to be emphasized that the role of ‘observer’ in beAWARE hasn’t to be intended as a ‘passive’ figure, since it was of primary importance in the evaluation process which led to the final system.

In fact, because of its experience throughout the various pilots, AAWA provided a complete and coherent evaluation of the iterative process that brings to the final system. In addition, it was able to make a comparison with the previous prototypes, evaluated the evolution of the technologies and their improvements, listed the issues that have been resolved during this complex process. Finally, it evaluated to what extent the final platform met the requirements for each use cases.

3.3.2 How beAWARE could support the recovery phase and evolve toward multi-hazard or multi-risk platform

From AAWA’s point of view, beAWARE represents a new integrate approach, based on the analysis and fusion of the many different data that are crucial for the have a clear overview of the situation during a flood. It’s worth to be mentioned that the developed techniques
for collecting and analyzing multimodal data can be support the flood risk management not only in the emergencies but also in “ordinary times” (like AAWA’s planning activities).

Moreover, the platform has a particular focus on the Social media and citizen involvement, aspects that are indeed crucial for a proper flood risk management, but that are currently almost totally leaved out by many legacy systems and protocols.

That’s also a crucial point for AAWA since, in order to overcome these gaps in the current flood management practices, we are in continuous search of new technologies, tools, approach and guidelines to be inserted as non structural measures for risk reduction in our flood risk plan. In addition, AAWA represents an excellence in Italy in terms of involvement of Citizen in the flood risk relates issues. That means not only raise public awareness and knowledge, but also provide tools to let the Citizen participate actively in the environmental monitoring process to provide, like sensor, estimation of the hydraulic variables.

For this reason, AAWA stated to establish Citizen Observatories in its district, as measure of the Flood Risk Management Plan; this is requiring a constant search of new technological guidelines and standard for implement and refine them.

Some of the beAWARE developed technologies (integration with social media, tools for sending incident reports with images, video audio etc…) represent a indeed a step ahead in this direction of involving actively the Citizen in the emergency management process and in environmental monitoring, allowing a bidirectional communication with the authorities. In addition, these technologies could effectively transform Citizen in a crucial source (social sensors) of information about the territory for the decision Makers.
3.3.3 Highlight the results of the final platform that would more interest your organization.

In addition to the above-mentioned features, other capabilities of the beAWARE platform that are particular useful in relation to AAWA’s institutional role, and can thus complement our current systems, are:

- The crisis Classification tool, which allows to estimate risk from flood incident reports, thus to create a real time, dynamic and geo-referenced risk map of the current situation, complementing our static flood risk maps;

- The report Generation, which could simplify the post event assessment, since it creates a summary, incorporating all the different kind of relevant datasets collecting during the crisis;

- New advanced technique of video and image analysis, which could be applied to estimate water level from innovative sources (like fixed video cameras and from UAVs). The results of this kind of analysis can be used to integrate the information of the sensors’ network or to cover the areas where there is not any sensor at all.

It has to be clarified that, due to its institutional role in coordination of flood risk in the entire Eastern Alpes River District, AAWA is called to provide technical, scientific and decisional support to the decision makers in case of flood; however AAWA it is not directly executing in the more ‘operative’ aspects of the emergency management, like assign tasks to teams of first responders.

However, the functionalities of beAWARE platform dedicated to the team and tasks managements are indeed of crucial importance for the local Authorities in our River District, to effectively help them in the management of a flood, both from an operative, both from a decisional point of view.

Another very relevant aspect for the Local Authorities is the multi-hazard address of the beAWARE platform. In fact, even if tested to three pilot cases of natural hazard, beAWARE could be easily extended to manage many other crisis types that the municipalities could have to face, due to the extreme flexibility of the system. It could also help them to cope with simultaneous crisis event, which is not a remote possibility.

3.3.4 What AAWA gained from beAWARE

- Some features (like report generator) could simplify the post event assessment, incorporating all the different kind or relevant dataset collecting during the crisis

- The Crisis Classification module allows to estimate risk from flood incident reports, thus to create a real time, dynamic and geo-referenced risk map of the current situation

- New advanced technique to estimate water level from images and video of fixed video cameras and from UAVs. These techniques can be used to integrate the information of the sensor network or to cover the areas where there isn’t any sensor at all

- Integrating our flood forecasting model AMICO with a new type of weather input (Hirlam model)
Chapter 3. Testimonies of the EndUsers

Figure 3.5: Above: AAWA’s static flood risk map (related to pre-defined flood scenarios); Below: Dynamic flood risk map generated by the crisis classification during the flood pilot, reflecting the real situation.

Figure 3.6: In the field operation of the civil protection teams during the Flood Pilot in Vicenza
PLV is a Law enforcement agency in the city of Valencia. The city of Valencia has a metropolitan area which reaches over 1,500,000 inhabitants. It is, in terms of population, the 3rd largest city in Spain. Around 1600 police officers form the Valencia Local Police. The duties of the Valencia Local Police (PLV) are wide, ranging from surveillance of crowded events, aerial surveillance & monitoring with UAV/drones, road traffic control, management of emergencies, environmental police, investigation traffic accidents, citizen security, community police, domestic violence, mediation police, etc. Community policing together with foot patrolling, which is a strategic approach that has been implemented for more than 30 years, is one of the PLV’s operational strengths in terms of information gathering to fight against violent radicalisation. Furthermore, the commitment in fighting against Hate Crimes brings PLV the opportunity of being in touch with all diverse communities in Valencia.

Overall PLV is one of the most active local police forces in Spain due to their continuous innovation in technology. Its Centre of Security and Emergencies is the best example of innovation in police management by using ICTs tools, as well as a great test bed for pilot experiences and tests. PLV has managed (as leader or partner) 23 successful European projects form different Programs (H2020 – Secure Societies, 7th FP of R+D in Security, Lifelong Learning Program, Prevention and Fight against Crime, Daphne III, Civil Protection Financial Instrument, Criminal Justice, etc) during more than 13 years (since the EU projects department was created).

### 3.4.1 Role in the project

In beAWARE PLV was involved in shaping the user requirements and in validation of the developed platform through their participation in the Pilots and especially the organisation of the Fire Pilot. Moreover, PLV will host the permanent demo environment to demonstrate all the platform capacities and to generate interest to third parties for the platform.

### 3.4.2 Testimony

According to PLV, the three pilots have been well planned and executed based on the maturity of beAWARE prototype at each phase.

To this effect, from the first pilot held in Thessaloniki (Greece) related to a heat wave incident, to the last one on forest fires in Valencia (November 2020), it has been proven that there has been a progressive level of maturation of the tools and the beAWARE platform, resulting in a more reliable response in increasingly complex pilots.

One of the factors that has determined the successful execution of the pilots has been the ongoing collaboration among all the members of the consortium. In fact, from the beginning, a well designed work plan has been followed. It has encouraged communication between all members through weekly teleconferences, meetings and so on…

For the monitoring of the pilots specifically, a script of actions, locations and schedules was carefully pre-designed, so although the pilots were implemented in the native language of the host, the thread couldn’t be lost. In addition, the rehearsals prior to the pilots execu-
tion were fundamental, since they helped all participants to position themselves in the field, understand the setting, the incidents, and the resources to be mobilized or used. Another point to highlight is the importance of the involvement and training of the participants in the beAWARE tools and platform to ensure the testing has the necessary guarantees. To carry out this evaluation, it has also been very important to fill in the observers sheets, to verify the functioning of the tools during the incident. However, what has provided an exceptional added value is the final evaluation questionnaires and, especially, the final debriefing held after each pilot with observers and participants. The aim of this meeting was discussing, making proposals and exchanging ideas with the users of the beAWARE tools.

beAWARE project has allowed EndUsers to create pilots in real scenarios, with real actors and infrastructures simulating the usual conditions in which end users work in an emergency situation, respecting at all times the protocols and practices of the end users.

### 3.4.3 Fire Pilot in Valencia

Regarding the organisation of the fire pilot in November 2019 in Valencia (Spain) to test the final platform of the beAWARE platform, all the details were carefully considered: the date, the selection of the scenarios, resources to be used and the profiles of the participants.

Firstly, the scenario was the Mediterranean forest of La Devesa de El Saler located within the Albufera Natural Park (Valencia) in the district of El Saler was selected as the setting. Specifically, 16 km away from the PLV headquarters (PSAP).

The selection of this location was due to its high ecological value and its vulnerability to forest fires. In fact, this area has suffered frequent fires, which have affected its fauna and vegetation.
Table 3.1: Number and causes of fires between 1968 and 2016

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>FIRE NUMBERS</th>
<th>FIRE NUMBERS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Lightning</td>
<td>6</td>
<td>1,78%</td>
</tr>
<tr>
<td>4 Negligence and accidental causes</td>
<td>52</td>
<td>15,38%</td>
</tr>
<tr>
<td>2 Arson attack</td>
<td>52</td>
<td>15,38%</td>
</tr>
<tr>
<td>1 Unknown cause</td>
<td>220</td>
<td>65,09%</td>
</tr>
<tr>
<td>3 Fire spread</td>
<td>8</td>
<td>2,37%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>338</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Secondly, the date: it was decided to do the pilot in November, as that month registers low temperatures and there are less people in the streets, which would facilitate the development of the pilot and the mobilization of the first responders.

In spite of PLV found some problems to develop the pilot due to its complexity, it has been a very rewarding experience for us and from our point of view is one of the most ambitious and complex pilots we have ever faced from a technological and operational point of view.

![Training Session before the day of the Fire Pilot in Valencia](image)

The pilot was developed in 4 different locations:

- PLV headquarters (PSAP)
- Casa Forestal (PMA),
- Devesa Forest (Operational deployment and app use for first responders and citizen)
- IES El Saler (Educational center evacuation)

More than 500 people were involved:

- PLV
- Valencia Firefighters
- Civil protection
- Forest Guards
- Citizens, (teachers, students, neighbours)
Observers profile:

• 112 emergency agency (Regional Government)
• Albufera Natural Park Director (Regional Government)
• Murcia Local Police
• PLV (CISE, IT & 8 Districts Commanders)
• Valencia Firefighters
• Forest Guards
• Emergency Military Corps
• Guardia Civil (SEPRONA)
• National Police (Communication Dpt & Citizen security)
• Regional Firefighters
• Civil Protection
• Emergency IT companies
• NGOs (OpenArms, Bombers pel món)
• Citizens

Attendees:
• 3 UE reviewers, +P.O.+Consortium
• PLV Chief Constable
• Deputy mayor of Public Safety
• LEAs
• Albufera Natural Park Manager and 112
• First responders
• Emergency companies
• Universities (Valencia Polytechnical University)
• NGOs
• Neighbours association

Participation of 6 corps of first responders:
• Murcia Local Police
• PLV (CISE, IT & 8 Districts Commanders)
• Valencia Firefighters
• Forest Guards
• Emergency Military Corps
• Guardia Civil (SEPRONA)
• National Police
• Regional Firefighters
• Civil Protection

### 3.4.4 How beAWARE could support the recovery phase and evolve toward multi-hazard or multi-risk platform.

We consider that beAWARE can support the recovery phase by using tools focused on early detection, such as FROST, the multimodal data analysis component or crisis management and emergency classification component, with which we can predict the development of extreme events. It will allow a more agile and successful decision making. This means that the duration of the emergency phase is reduced and also that the recovery phase and return to normality are faster, with a lower economic cost and, of course, with a lower climate events impact.

Moreover, other beAWARE tools could also help in the recovery phase, like the social media analysis component (information from citizens’ tweets) or the beAWARE app for citizens. The alerting mechanism offers the ability to the manager to send public alerts to citizens, to
inform them of the beginning or the end of the emergency and the start of the recovery phase, with recommendations to return gradually to normality.

What makes the beAWARE platform more interesting is that it evolved in the lifetime of the project towards a multi-risk platform to deal with an emergency in an even more comprehensive way. This means that all relevant risks in the area of interest would be analysed. This would require a deep understanding of past hazards, monitoring current risks, and predicting the future. Likewise, in order to manage risks related to extreme events caused by climate change, it is essential to strengthen the early detection components, as has been done in beAWARE.

In this regard, it could be said that through the implementation of the three pilots of the project where different adverse weather events (heat wave, heavy rains that cause floods or forest fires) in different nature scenarios were simulated, the versatility and robustness of the platform has been confirmed.

3.4.5 Highlight the results of the final platform that would more interest your organisation.

Although PLV work in the emergency management with its own police emergency platform (SIRE), our work in beAWARE has been useful to be aware of some gaps and needs that we have in our organization to tackle the emergencies. The most interesting results of the final beAWARE platform for PLV:

- **Aggregation of multimodal information from sensors, meteorological stations etc. for issuing early warnings.** One of the main problems in our daily operations is that we cannot forecast the evolution of the incidents, because we do not have enough information from sensors. In this sense, having multimodal data in all the phases of the emergency, such as meteorological sensors, video, data or images, implies that we will get further information of the situation and that we reduce the costs and the time response.

- **The Crisis classification component**, in other words, the capability of forecasting the level of emergency in order to mobilize the proper resources. Currently, we cannot forecast the amount of resources needed.

- **Multimedia analysis and Social media modules**: The enrichment of the information with video, audio, text and their analysis would be more than interesting, because nowadays we only receive information from the phone calls.

- **beAWARE Mobile Application.**
  
  - Firstly, it allows the geolocation of the different first responders and resources. Consequently, the tasks coordination among them would improve.
  
  - Secondly, the app has two different versions, one for citizens (SCAPP) and another for first responders (FRAPP). Both of them would improve the bilateral communication (APP):

- Another important point is the **Multilingual report generator** from aggregated emergency data to gather useful information in multilingual reports. A tool like that would be very useful for tourist destinations such as Valencia to gather information from tourists that may experience an emergency and report in the native language of the responders.
3.4.6 How beAWARE can function as a standalone or as a complement to your legacy tools and how it could be adapted for use at your premises.

From our point of view, beAWARE provides us with a series of cutting-edge technologies that will help to improve coordination with other first responders in extreme weather events. It pays special attention to data analysis for the detection of early incidents and community empowerment to support the manager through their activity on social networks or through the app generated for this purpose.

Finally, I would like to comment that the tools offered by beAWARE should be integrated as a complement to the legacy tools (SIRE, radio station) that we currently use and that are endorsed by experience. Specifically, the beAWARE platform could be located in the CISE Room, which is our emergency coordination centre, close to the post of the emergency manager in a stand-alone equipment, to facilitate the decision making. In this way, beAWARE could be used at any time that is necessary, but without to interfere with our own emergency management programme (SIRE). Besides, when it is necessary to show the metric data or images, they could be displayed in the videoworld of the hall.
3.5 Hellenic Rescue Team (HRT)

The Hellenic Rescue Team (HRT) is a non-profit, volunteer search and rescue organization. It began as a mountain rescue group between friends in 1978 only to evolve to an association in 1994. All HRT members who act as first responders and rescuers are volunteers. Today, HRT has 32 branches all over Greece and a base of approximately 2,000 volunteers nationally.

HRT is the only Greek full member of I.M.R.F. (International Maritime Rescue Federation) and the only Greek member of the International Commission of Alpine Rescue (I.C.A.R.). Moreover, HRT is a registered organization in the Civil Protection mechanism in Greece and works closely with governmental authorities like fire department, coast guard and the army in search and rescue operations.

Today HRT does focus on a single field of operations but operates in various fields, like sea, mountain or urban environment. More specifically, depending on the field, HRT supports its operations through dedicated departments. Currently, HRT has seven (7) departments, which are:

- Mountain Rescue, which is the most experienced department and how HRT started its operations
- Urban Search and Rescue, which operates, in earthquakes, wild fires,
- Water Rescue, which operates at sea as well as lakes and rivers
- First Aid, which manages first aid training of all HRT members and also offers training to citizens
- Social and Humanitarian, which provides humanitarian support to people in need.
- Research and Technology, which carries out research in the field of communications and supports HRT’s network
- Rescue Dogs, which mostly supports the USAR department

3.5.1 Role in the project

During the implementation of the beAWARE project, HRT was responsible to carry out a pilot based on the heatwave scenario in order to evaluate the first version of the platform. Additionally, HRT participated in the other two pilots carried out for the flood and fire scenarios with the goal to evaluate the 2nd and 3rd version of the platform respectively.

Moreover, HRT evaluated internally the later version of the platform in order to provide its feedback for tools and features that were developed in a later stage of the project’s lifecycle. Through that process, HRT was able to examine whether the system met the User Requirements that the organization had formed in the early stages of the project. However, apart from participating in the evaluation process of the system, HRT had the opportunity to test and examine whether a state-of-the-art DSS system like beAWARE can support its own operations as well, like mountain rescue or other search and rescue scenarios.
3.5. Hellenic Rescue Team (HRT)

The participation in the beAWARE pilots and in the overall project was a fruitful and productive experience for HRT, since it had the opportunity to examine its role in a scenario like heatwave, where usually there are not much to do and the organization is not so commonly involved. In addition, during the development of the User Requirements of the system, HRT had the opportunity to visit local authorities in order to examine their view on what a system like beAWARE can offer. At the same time, HRT was able to increase awareness on the topic of how to address extreme weather related events and especially how to manage the consequences of a heatwave more efficiently. This was also a stimulating process, because HRT was pushed to think how a scenario like heatwave could be addressed with a DSS system like beAWARE, which is not a very common approach.

Furthermore, through the execution and participation in the pilots, HRT had the opportunity to exchange ideas with other end users and academia partners from other parts of Europe and discuss its problems and challenges with them. In addition, the pilots offered the ground to train further and see how beAWARE could potentially support its operational procedures, thus being a generally teaching experience. Finally yet importantly, through the implementation of the pilot in Thessaloniki, HRT was able to promote its image to other stakeholders by demonstrating its involvement to the development of new and innovative solutions. Thus, HRT enhanced its reputation and the trust that local authorities show towards the organization during the management of a crisis.

3.5.2 How beAWARE could support the recovery phase and evolve toward a multi-hazard or multi-risk platform

beAWARE with its tools is a system that can support the management of weather related events during all phases of an emergency: before, during and after. However, the system can be developed further in order to evolve toward a multi-hazard or multi-risk platform.

Since the system supports a weather forecast based early warning system, it can also be used in other weather related events, such as storms, blizzards, extreme cold etc. Additionally, all the tools are designed to support first responders during the management of an event. However, the post emergency and recovery phase is equally important. beAWARE has tools and functionalities that can enhance the system’s support during the recovery phase.

More specifically, as demonstrated in the flood pilot, the system can present and simulate in a map the affected area in case of a flood. Moreover, an operator can use the Knowledge Base in order to insert information regarding the affected area like the buildings that are there, land use, etc. Through that process, a user can extract information about the impact of the crisis and therefore be able to take more effective decisions during the recovery phase. Furthermore, tools like PSAP, task management, task assignment can help authorities to address the consequences of an event by supporting the management of first responders during the recovery phase.

By addressing the recovery phase, beAWARE can enhance its holistic approach as a management system. However, the tools that the system offers can support its evolution toward a multi-hazard or multi-risk platform. More specifically, it is worth mentioning that the majority of beAWARE tools, like task management, task assignment, image analysis, etc. can be used during any kind of crisis. Thus, the system in its current form has the basis to be a multi-hazard or multi-risk platform. What is required in order to reach that level is primarily to train the systems tools, like the analysis module, to be used in other scenarios as well, different to the ones used during the project’s lifecycle. Moreover, examining and documenting requirements from other scenarios is also a step the needs to be taken towards
that goal.

3.5.3 Highlight the results of the final platform that would more interest your organization.

beAWARE is a platform that offers various tools to first responders. In the case of HRT and based on the operational needs that the organization has, the following tools are those that would address them more efficiently.

![Incident Manager and Task Manager](image)

(a) Incident Manager (b) Task Manager

**PSAP: Map, Task assignment and task management**

The PSAP with the map along with the task assignment and task management can provide and overall incident management where HRT can manage its operations and all its rescuers that are on the field. Being able to monitor first responders who are on the field and at the same time their status, allows HRT to assign roles and use its rescuers in a more effective and efficient way, saving time which is vital in a search and rescue operation.

**Image / video analysis and drone platform**

Image and video analysis is a tool that can be of high value to HRT. This feature in enhanced with the use of the drone platform that can allow the analysis of input provided by the cameras of a drone, which can increase the search area significantly. Many operations that HRT carries out, either in a mountain, in a forest or at sea, have to do with the location of missing persons. This tool can help to locate a missing person easier and quicker, during a search and rescue operation in a mountain area or at sea, which can be a matter of life and death, since there is a high probability that this person might be unconscious and unable to communicate with first responders and ask for help.

Additionally, the analysis of images or videos provides by a drone can help HRT to locate a wild fire at an early stage in remote areas. In the summertime, members of HRT patrol specific areas of the forest, in cooperation with the fire department, a prevention measure. The use of a drone that can provide images of the area can increase significantly the efficiency of the patrol, which is enhanced further with the use of the image and video analysis that can locate smoke and fire. This allows spotting a fire at an early stage and by responding appropriately to minimize its consequences.
Communications support with first responders on the field

One of the results of beAWARE that would be of interest to HRT is the ability to communicate with first responders on the field by using its mobile application. The beAWARE mobile application allows PSAP and authorities to communicate with first responders and exchange information with them. This information is not limited to text messages but can also include images and videos that can be sent both ways, a functionality that can support effective dissemination of information which in turn increases the ability to manage a situation more efficiently.

Notify the public through the mobile app

Since HRT is a volunteer search and rescue organization, all of its members originate from ordinary citizens who wish to offer to the community. As a result, the interaction that HRT has with the public is crucial for the organization. The beAWARE mobile application can also support interaction with citizens since the PSAP is in position to send messages that...
are targeted to the public in order to inform them about an imminent crisis or about the progression of an ongoing one. Furthermore, the application allows citizens to communicate with the PSAP as well, so they are in position to inform them about an event, whether they are in danger or in proximity to a dangerous situation so that the authorities can respond appropriately. Therefore, the interaction and exchange of information that the application can support can potential increase the impact of HRT to the community and enhance is social image.

Figure 3.14: Public alerts as they display on the beAWARE mobile application

Figure 3.15: Example of the public Alert mechanism

Real time weather data in relation to a crisis classification and a crisis progression

A beAWARE tool that can offer high value to HRT’s operations is the information about weather forecasting in real time in relation to the crisis classification of the progressing event and estimate of its progression. Weather forecasting is vital for HRT operations, especially in the microclimate of the mountains or at sea, in order to be able to manage its members on the field accordingly and notify them in case the weather is going to deteriorate. By combining the weather forecast with the progression with an event and its crisis classification and by presenting this information in an easy and understandable visual way, HRT is able to take appropriate decisions while participating in a crisis and reducing the risk for its members.
on the field.

Figure 3.16: beAWARE dashboard can offer high level information about weather forecasting in real time

**Report Generator**

A tool that is also of high interest to HRT is the report generator. Having a tool that can produce a standardized report of an event and all actions taken during its management, allows HRT to evaluate its performance, revisit its decisions and act appropriately in order to increase its efficiency. In addition, the report generator can help HRT to have a historical archive of its operation in a standardized form that contains all information and decision-making process, which can be used in the end in order to evaluate operational procedures and their effectiveness after multiple operations.

Figure 3.17: Summary reports cover the occurrence of incidents in chronological order

**3.5.4 How beAWARE can function as a standalone or as a complement to your legacy tools and how it could be adapted for use at your premises;**

beAWARE is a system that can be used both as a standalone solution and as a complement to legacy systems and tools, something that participants in all pilots have recognized. More
specifically, an organization can decide and adopt only those tools that are more suitable for its operations and especially the ones that are more complementary to its existing. By using beAWARE there is no requirement to abandon existing system and tools since the system can be used alongside them.

In the case of HRT, all participants that participated in the 1st pilot and had the opportunity to use and see how the system could be used in action, mentioned the fact that is a great tool to have together with existing tools that HRT uses in its operations. For instance, the mobile app can support communications on the field in areas where radios is hard to use, a case that was demonstrated during the first pilot. Furthermore, the fact that the system can present all first responders on the field in a joint operational picture, something that is absent today, can allow HRT to play the liaison between volunteer teams and national authorities, hence upgrading its role during an emergency. At the same time, this would reduce the communication gap between volunteer and first responders from civil protection authorities thus increase the overall efficiency and operational capacity when managing an event.

Overall, since currently HRT is developing its own operational center in its premises, a system like beAWARE, which can be used through a web application and is cloud based and in addition can be used in parallel with existing systems, could be used in order to allow the organization to monitor and manage all its operations. Moreover, all the tools that have been mentioned above could potentially support a wide range of HRT’s operations. Finally, it is worth mentioning that HRT would be interested in revisiting the user requirements that were used to develop the system and examine in what extend they can cover the requirements of its operations.
4. Impact Achieved

4.1 Introduction

After three years of progress, the beAWARE project has achieved a significant impact in the fields in which it is involved. Overall the project has shown the ability of a system to support authorities and first responders in the management of events related to extreme weather conditions, both as a stand-alone solution and as complimentary to legacy tools, demonstrating a great value for further exploitation. All evaluation results of the pilots of the project that were derived from the feedback of the participants, supported the continuous evolution of the system which in turn increased the system’s impact in the management of events related to extreme weather conditions, revealing the exploitation potential of the system.

4.2 Expected Impact

More effective and faster emergency responses to extreme weather and climate events;
Faster analysis of risks and anticipation;

beAWARE, through the development of early warning mechanisms, which are based in various sources of data and analysis of those data, is able to support a faster response from the authorities and first responders to upcoming events. Weather data analysis provides a weather forecast which is combined with the crisis classification module. As a result, beAWARE provides information to the authorities regarding an upcoming event as also information about its progression during the event’s lifecycle. Moreover, information from sensors also support authorities if fast decision making process. Additionally, analysis that is provided to information that is derived from social media, especial when coming from citizens who are in proximity to an event, allows authorities to provide a more effective and faster response to an event.

This is based on the fact that information reaches authorities faster and it is analysed quicker and in relation to specific thresholds offering at the same time authorities a visual overview of the situation. beAWARE’s DSS mechanisms which are based on reasoning, together with a PSAP which supports a visual overview and analysis of a situation, strengthen the overall situational awareness capabilities of the authorities in order to act faster and
more effective.

The final evaluation results for the real time data demand was rated from good to excellent during the pilots of the project. Moreover, the clustering of information from similar events and the deletion of irrelevant ones coming from social media, allows the faster analysis of information and therefore of potential risks during an emergency supporting authorities to focus only on relative information.

Publicly available online now- and forecasting systems for disasters triggered by (extreme) weather conditions; - improved coordination of emergency reactions in the field, including the use of adapted cyber technologies;

beAWARE is not limited to traditional voice communication, but also takes into account other channels, such as social media, and multimodal information from images, videos, drones, etc. helping a PSAP operator assess the validity of information. Weather information can be provided from publicly available sources and can be used as input to the system. In addition, beAWARE effectively supports the coordination of emergency response in the sector through the use of cyberspace technologies. In addition, the functionality of task assignment and the task management of the first correspondents through beAWARE’s PSAP also improves the coordination of emergency response. The operator of the PSAP can easily supervise his resources, the location and the status of each team on the field in real time, assign tasks to specific teams and receive feedback from them in real time. This feedback, is not limited to written or speech communication, but it can also be an image or a video sent from first responders who are on the field, to PSAP and the authorities so that they have a direct view of the situation on the field.

Improved capacity to provide adequate emergency responses to extreme weather and climate events; - shorter reaction time and higher efficiency of reactions;

Due to the fact that potential end-users of the system may come from different fields, from volunteers up to civil protection authorities on any level, beAWARE was developed with in a flexible and adaptive way, in order to support their different approaches, requirements and needs. More specifically, the layout of the PSAP can adapt to meet the needs of different operators offering different level of information. This allows an operator to adapt the system to his needs and not for the operator to adapt to the environment of the system, supporting at the same time the strengthening of the operators’ capacity to manage emergency responses using all beAWARE tools

In addition, all the functions of beAWARE that support the decision-making process help an organization to improve its ability to provide adequate emergency situations in extreme weather and climate events. More specifically, the early warning mechanism provides a warning even from the stage where an incident is imminent. In addition, the analysis of images, videos, texts, as well as information coming from social media, allows an organization to quickly and efficiently collect and analyze information from various sources, which are also used by other tools, such as the Classification Unit. Crisis in order to provide specific and detailed information to the authorities in relation to the management of a weather-related event.

A statement made by almost all the participants in the pilots and demonstrates the impact of beAWARE on increasing the capacity of an organization is that beAWARE is a complimentary system to the existing legacy tools that have already been used. This means that it
4.3 Overall Impact

beAWARE does not only limit its impact to the expected impacts of the call. Throughout its implementation, it has demonstrated its impact in other areas as well, like science and innovation. Since the core objective of beAWARE is to support all the phases in a crisis management sequence, its impact in the society is also important.

The overall impact of the beAWARE solution establishes a well-taken investigation of a wide range of exploitation prospects, the potential for their wider use and, of course, their
impact on the economy as also the society, locally, nationally and in Europe. The evaluation methodology was mainly based on the user perspective, such as PSAP operators, first responders and citizens, and was mainly focused on the impact of the beAWARE solution in life-saving, protection of infrastructure and property, reducing response time and lowering costs. The impact of the system was evaluated by comparing the management of an emergency before and after the implementation of the beAWARE system. This comparison between existing technologies and the beAWARE solution in all three pilots gave the opportunity to identify and record the impacts of the beAWARE system in order to maximize the dissemination actions.

More details about the overall impact of the system can be found in D8.10 (M36), available online at https://beaware-project.eu/results/public-deliverables
5. Technical Partners

beAWARE comprises a highly experienced and well-distributed consortium of research institutes, industries and First-Responder’s organizations. beAWARE’s consortium includes ten partners, four of which are research institutes (CERTH, UPF, IOSB, FMI), two big industries (MSIL and IBM) and four are FR teams. Partners are distributed in 7 countries (Greece, Spain, Italy, Germany, Israel, Denmark and Finland). All partners have a wide experience in the domain of security through their participation in numerous European and National projects in the field, which guaranteed the high quality of developed services and the overall project. Most of the partners had also, to a greater or lesser extent, collaborated in several projects in the past, which guaranteed the successful coordination and management of all the project activities. In the following subsections, a thorough description is given of each organization participating in beAWARE’s consortium, along with details of their expertise, experience, infrastructure and equipment.

5.1 Centre for Research and Technology Hellas (CERTH)

The Centre for Research and Technology-Hellas (CERTH), founded in 2000, is the only research centre in Northern Greece and one of the largest in the country. CERTH has important scientific and technological achievements in many areas including: Energy, Environment, Industry, Mechatronics, Information & Communication, Transportation & Sustainable Mobility, Health, Agrobiotechnology, Smart farming, Safety & Security, as well as several cross-disciplinary scientific areas. Today CERTH consists of the following five institutes: (a) Chemical Process & Energy Resources Institute (CPERI), (b) Information Technologies Institute (ITI), (c) Hellenic Institute of Transport (HIT), (d) Institute of Applied Biosciences (INAB), and (e) Institute of Bio-Economy and Agri-Technology (iBO).

CERTH is essentially a self-supported Research Centre generating an average annual turnover of €25M coming: (a) > 30% from bilateral industrial research contracts, (b) > 60% from competitive research projects, (c) < 10% as government institutional funding. More than 700 people work at CERTH with the majority being scientists. CERTH has received numerous awards and distinctions such as the European Descartes Prize, the European Research Council (ERC) Advanced Grant, Microsoft International Contest Prize, the
Trading Agents Competition Award and many more. In addition, CERTH is listed among
the Top-12 of the EU’s Research Institutions with the highest participation in H2020 com-
petitive research grants and is currently among the leading organisations in Greece in se-
curing H2020 funding. CERTH has participated successfully in more than 1200 competitive
research projects (with a total budget exceeding 450M€ and involving more than 1100 inter-
national partner organizations) financed by the EU, leading industries from USA, Japan and
Europe, and the Greek Government via the General Secretariat of Research and Technology
(GSRT). CERTH's research results (more than 350 publications per year) have significant sci-
entific impact (about 7100 heterocitations/year). Four spin off companies have been already
launched through CERTH's research activities.

Information Technologies Institute (ITI)

CERTH participated in beAWARE through one of its insti-
tutes, the Information Technologies Institute (ITI). ITI was
founded in 1998 as a non-profit organisation under the aus-
pices of the GSRT, with its head office located in Thessaloniki,
Greece. Since 2000 it has been a founding member of the
GSRT-supervised CERTH. CERTH-ITI is also an active member of the European Cyber Se-
curity Organisation (ECSO), i.e., the contractual counterpart to the European Commission
for the implementation of the Cyber Security contractual Public-Private Partnership (cPPP).

The participating team of CERTH-ITI in beAWARE is the Multimedia Knowledge and So-
cial Data Analytics laboratory (MKLab). The MKLab has significant experience and scientific
expertise on the technical aspects of beAWARE including (but not limited to) Web discov-
ery and mining, social media monitoring, semantic integration of heterogeneous resources,
social network analysis, visual analytics, and multimedia processing, analysis, and under-
standing. Furthermore, MKLab has a strong background in Semantic Technologies and
Knowledge Representation & Reasoning, Artificial Intelligence (including Machine Learn-
ing and Deep Learning), Cyber-Threat Information Gathering, Sharing, Intelligence, and
Visualisation, Big Data Analytics, Security and Crisis Management.

Role in the project

The Information Technologies Institute (ITI) of CERTH is the coordinator of beAWARE and
is responsible for the management and administrative activities of the project (WP1). ITI-
CERTH is also involved in R&D activities related to social media analytics, crisis classifica-
tion, visual analysis, speech recognition, semantic representation and reasoning for decision
support.
Motorola Solutions Israel Ltd. was established in 1948, and since 1964 has been a wholly owned subsidiary of Motorola Inc., a multinational communications corporation headquartered in the USA. In January 2011, Motorola Inc. was divided into two separate companies: Motorola Solutions and Motorola Mobility. Motorola Solutions Israel Ltd. (MSIL) was Motorola Solutions Inc.’s first subsidiary outside the USA, and the first design and development centre outside the US.

Motorola Solutions creates innovative, mission-critical communication solutions and services that connect people through technology and help more than 100,000 public safety and commercial customers in more than 100 countries build safer cities and thriving communities. MSIL’s solutions span across a variety of industries including law enforcement, fire, emergency medical services, national government security, utilities, mining, energy, manufacturing, health care, retail, transportation, logistics, education, and public services. The company develops and provides communication solutions based on advanced technologies to governmental bodies, public safety authorities, Enterprises and to a variety of commercial entities in Israel and around the world. MSIL is one of the leading high-tech companies in Israel. It comprises several business units involved in the company’s R&D, marketing and sales activities, and solutions and integration services functions. The Design Center is an industry leader in implementing prestigious global projects such as developing broadband (LTE) products for emergency, public safety and security organizations and mobile terminals for the global courier industry and commercial enterprises. These include technology and market leading TETRA and ASTRO systems - the foundation for security forces’ communication networks; ruggedized mobile computing terminals; Safe City and command and control solutions; power-, water- and irrigation control and monitoring systems; advanced GPS integrated location systems; and enterprise wireless access networks that also deliver high quality service on trains around the world. The Advanced Services group is responsible for planning and implementing solutions and systems for all customers in Israel and in the export markets and for providing support, maintenance and added value services to all the customers. The Advanced Services group employs highly qualified engineers specializing in analysis, planning and design, provision of solutions, integration and management of projects involving complex communication systems and products for the institutional market and for public safety bodies. The group develops and deploys Safe City Solutions in Israel and abroad. These solutions include full command and control application and service suites, wireless access networks, mobile video, analytics, GIS, incident management, public announcement, emergency buttons, and more.

**Role in the project**

In beAWARE, MSIL was responsible for implementing the main Public Safety Answering Point for handling “calls” enriched with multimedia content (WP6) and carried out tasks of developing the user interface and visualization, data integration. Finally, MSIL contributed to the communication network implementation and integration tasks (WP8).
5.3 Universitat Pompeu Fabra (UPF)

Universitat Pompeu Fabra (UPF) was established in 1990 as a public university with a strong dedication to excellence in research and teaching. In the meantime, it has become the 1st Spanish university in the world Top 200 (THE2018) and among the best 15 under 50 years (THE2018). According to the U-Ranking 2018-2019 of the BBVA Foundation & Ivie, UPF is also ranked first among Spanish universities for the 7th consecutive year. It was the 1st Spanish University to obtain the “HR Excellence in Research” distinction in April 2014. In beAWARE, UPF participates through the Natural Language Processing Group (UPF-TALN) of the largely international (60% of its staff come from 48 countries other than Spain) Department of Information and Communication Technologies (DTIC) and the Business Shuttle of the UPF. DTIC is strategically located within the vibrant 22@ technological district of Barcelona. It has an important track record of active participation and in EU projects, including coordination (a total of 66 FP7 projects and 10 other projects in non-FP7 program such as CIP, Ambient Assisted Living and the Lifelong Learning Program, and, up to now 38 H2020 projects). DTIC is the Spanish university department with the largest number of ERC grants (9 FP7 and 9 H2020), and is part of the FET Flagship initiative “The Human Brain Project”. It is the only Spanish ICT department that has been awarded the “Maria de Maeztu” excellence by the Spanish government for the quality and relevance of its pioneering scientific research, and as the top IT research concentration in Spain.

UPF-TALN (http://www.taln.upf.edu/) has been founded in 2005 by its current director Prof. Leo Wanner. During the 15 years of its existence TALN has gained widely acknowledged expertise in a number of areas in Natural Language Processing, including text analysis, content (concept and concept relation) extraction from multilingual material, multilingual text generation and summarization, natural language interaction and speech processing. UPF-TALN has a solid record of coordination of and participation in large scale European and national RTD projects

Role in the project

In beAWARE, UPF was responsible for a number of R&D tasks related to multilingual text analysis and report generation.

5.4 Fraunhofer Institute of Optronics, System, Technologies and Image Exploitation (IOSB)

The Fraunhofer-Gesellschaft is a leading organization of institutes of applied research in Germany, undertaking contract research on behalf of industry, the service sector and the government. Fraunhofer-Gesellschaft is actively involved in industrial consortia seeking technical solutions to improve the competitiveness of European industry. At present, the organization maintains 72 research institutes with some 26,600 employees at locations throughout Germany. In December 2017, the Fraunhofer-Gesellschaft was awarded the Logo ”HR Excellence in Research” from the European Commission in recognition of its outstanding Integrated Human
Resources Management. The Logo "HR Excellence in Research" is based on the 40 principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers ("EU-Charta & Code"). As Europe’s leading organization for applied research and as a project partner in many EU-projects, Fraunhofer fulfills these principles. Fraunhofer is one of the first organizations for applied research in Germany to receive the Logo.

The Fraunhofer Institute of Optronics, System Technologies and Image Exploitation (IOSB), that participates in beAWARE, has 530 permanent employees, of which 350 are scientists or engineers, and has annual operational costs of about 57 million € (2018). IOSB develops innovative concepts and application solutions in information technology. It provides sustainable solutions of advanced control and information management, monitoring and diagnosis systems mainly for industrial partners including SMEs as well as for public bodies such as environmental agencies. IOSB has over 30 years of experience in the design, implementation, integration and optimization of complex control and information management systems for distributed applications using modern model and knowledge-based methods. Advanced techniques for information fusion and handling of big data are used in monitoring and control applications in environmental and industrial domains.

Role in the project
In beAWARE, IOSB was responsible for a number of R&D tasks related to aggregation and semantic integration of emergency information for decision support and early warnings generation, including the creation of the beAWARE ontology, the development of the SensorThings API and the mobile application.

5.5 Finnish Meteorological Institute (FMI)

Finnish Meteorological Institute (FMI) is mandated by the Finnish government to produce reliable information on the state of the atmosphere, and its characteristics and phenomena, with the aim of promoting safety and serving various needs of the public, industry and commerce, as well as contributing to scientific ends. FMI observes the physical state, chemical composition and electromagnetic phenomena of the atmosphere and seas, as well as the physical state of the Baltic Sea and the Arctic marine region. Operating on the 24/7 principle, the Institute produces information and services about the past, present and future states of the atmosphere and seas. FMI employs about 720 people, about 50% of which are involved in research. The Finnish government has designated FMI as the national air quality expert; FMI is also responsible for the national background air quality monitoring. Most of our measurements are part of the international monitoring and research programmes. Atmospheric dispersion models have been developed and applied at the Finnish Meteorological Institute since the early 1970’s, addressing the following main topics: urban air quality and exposure, regional and long-range transport and accidents involving hazardous and radioactive materials. FMI also conducts research of a high international standard in the fields of meteorology, marine sciences, air quality, space physics and earth observation. The FMI carries out competitive business specialised in expert services, both in Finland and abroad, and contributes actively to national and international cooperation in
its field. It also works to keep decision-makers, industry and the general public constantly informed of issues associated with the atmosphere, seas and near space. FMI’s projects of Atmospheric Composition Unit involve monitoring of air quality and atmospheric composition (e.g., EMEP, HELCOM/EGAP, WMO/GAW, AMAP), research and development in air chemistry and aerosol physics (including a National and two Nordic Centres of Excellence), and assessment and modelling of airborne pollutants (including also pollen, volcanic ash, smoke from forest fires) from the local to the continental scale. Relevant FMI’s activities involve: measurements and modelling of atmospheric environment, big data processing (meteorological and environmental data from satellites and in-situ measurements), data fusion.

Role in the project

In beAWARE, FMI was responsible for the weather forecasting and extreme climate events prediction and also was the WP2 leader.

5.6 IBM Israel - Science And Technology LTD (IBM)

IBM has the world’s largest IT research organization, with more than 3,000 scientists and engineers working at 12 labs in 10 countries. IBM invests more than $5 billion a year in R & D and is the world’s leader in patent filings. The company holds nearly 37,000 patents worldwide. IBM strives to lead in the creation, development and manufacture of the industry’s most advanced information technologies, including computer systems, software, networking systems, storage devices and microelectronics. IBM participates in and contributes heavily to the work of standards consortia, alliances, and formal national and international standards organizations. Where appropriate, IBM adopts consensus technologies to maintain openness, interoperability, and application portability.

IBM Israel Science and Technology Ltd (IBM ISRAEL) for short is known as IBM Research – Haifa. Since it first opened, the IBM ISRAEL research lab has conducted decades of research that have proved vital to IBM ISRAEL’s success. The lab is the largest of the research laboratories located outside of the United States and has close working relationships with IBM Israel and its twin research laboratory in Zurich. In Haifa, 25% of the technical staff has doctorate degrees in computer science, electrical engineering, mathematics, or related fields. Employees are actively involved in teaching in Israeli higher education institutions and in supervising post-graduate theses. R&D projects are being executed today in areas such as storage systems, cloud computing, mobile, healthcare and life sciences, verification technologies, business transformation, information retrieval, programming environments, optimization technologies, and analytics.

The Cloud and IoT Foundations department is involved in developing software technologies to exploit advances in computing infrastructure that benefit IT users from traditional enterprise IT, system engineering, IoT and cloud based IT developers and consumers. The department’s technology areas span distributed middleware, cloud computing technologies and business models, mobile and client platform middleware, event-based and proactive middleware, location-based descriptive, predictive and prescriptive analytics. The group focuses on scalable and highly available infrastructure for IBM middleware, such as extreme transaction, high throughput messaging technologies. In addition, the technologies developed enhance dependability in very large-scale multi-tier environments and sup-
port hosting web applications and services in large-scale compute clouds. The group is also heavily involved in research and development projects in IoT, edge and blockchain related technologies.

**Role in the project**

In beAWARE, IBM was leading the development of the architecture and the infrastructure of the platform and was involved in R&D activities related to the development of the drone platform.