THE INTERNATIONAL EMERGENCY MANAGEMENT SOCIETY

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A TIEMS Special Issue Covering the DRIVER EU Project

DRIVER EU PROJECT

The International Emergency Management Society Newsletter - Scientific Articles Part

TIEMS network constitutes a large international multidisciplinary group of experts, with different educational backgrounds and various experiences. Their knowledge and experience are important to share with other experts worldwide. TIEMS has therefore decided to issue this new part of TIEMS newsletter, which we call TIEMS Newsletter - Scientific Articles. We have received nine scientific articles for publication in this second issue, which we nominate issue no 2. Depending on the response, in form of feed-back and new scientific articles to be published later, we will consider continue with issuing the scientific articles part of the newsletter together with the regular newsletter, or we may have to have a less frequent publication of this part. Time will show, but please, give us feed-back and send us new articles for publication.

Joseph Pollack
TIEMS Newsletter Editor

Articles in this issue

This issue is dedicated to the DRIVER EU Project
http://driver-project.eu/

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Message from TIEMS President

TIEMS global network of chapters and members worldwide, constitutes a large international multidisciplinary group of experts, with different educational backgrounds and various experiences in the field of emergency management and disaster response. They represent a unique source of expertise and ideas, which are important assets for research and technology development activities.

However, dissemination and publication of the results of their research is as important as the research itself. It is important to share the results and conclusions of their work with other experts in the emergency management and disaster response community. We need to learn from each other and share experiences to be able to progress with excellence in global emergency management and disaster response.

This is the second issue of TIEMS Newsletter - Scientific Articles Issue 2 as an addition to the regular TIEMS Newsletter.

This second issue is dedicated to the EU Project DRIVER, and this issue comprises nine articles in total, some descriptive and some scientific ones, all describing different issues about the DRIVER projects and the results so far. I hope this newsletter is welcomed by the emergency management and disaster response community, to learn more about the DRIVER project and the results of the project. Likewise, it is an additional and hopefully an interesting publication channel for the DRIVER project to reach further out to the global emergency and disaster management community.

We reach today approx. 100 000 experts worldwide with the distribution, and we hope this could lead to improved contacts and exchange of expertise between worldwide experts and lead to more cooperation and new and excellent ideas to be explored in the emergency management and disaster response field,

Depending on the response and feed-back of this second issue, where we dedicate the Newsletter fully to one EU project, we plan to invite other EU Projects to use this opportunity in later issues for publishing articles about their projects and the results.

The articles are reviewed only by the editor, but depending on the response, we will consider to establish a review panel and have a peer review of the articles in the future.

Our readers decide the future of this TIEMS Newsletter - Scientific Articles Issue, so please, send us feedback and constructive critics and also articles for publication.

Oslo 31st March 2016
K. Harald Drager
TIEMS President

DRIVER – Innovation in Crisis Management

Abstract

There are many types of disasters, both man-made and natural, that crisis management (CM) professionals have to deal with today. Some 23,000 lives were lost worldwide in natural disasters during 2015; weather-related disasters accounted for 94% of incidents that resulted in insurance claims during the same period. One of the major European projects currently looking at innovation within crisis management is DRIVER (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience), a large-scale, demonstration project funded by the EU under the Seventh Framework Programme (FP7). Although the scope of the DRIVER project covers many types of disasters, the focus of this article is on weather-related ones to give a demonstration of what will be achieved during the life of the project.

The project is focussed on three key areas: *improving civil society resilience* so that local communities are better prepared to respond to, and recover from, a disaster; *strengthening first responders* in terms of the crisis management solutions they have available to them; *training and learning solutions* designed to enhance the capacities and capabilities of trainers and human resources professionals dealing with those involved in crisis management. DRIVER is a unique multi-national project, working across many sectors, looking to find ways to implement a new approach to improving crisis management in Europe. It is achieving this by establishing a distributed European test-bed for CM capability development with proven evaluation methodologies. DRIVER aims to assess and validate innovative, yet practical, crisis management solutions that work, that have been tried and tested, and above all are used for, and by, emergency practitioners.

Severe weather natural disasters dominate crisis management issues in 2015

For millions of Europeans, the threats caused by climate change may seem to happen elsewhere in the world: rising sea levels in south Asia, crop failures in Africa, huge storms in the tropics, drought in the developing world.

But the reality is that Europeans are already facing more and more indications of climate change themselves as well, including heavy rainfall resulting in widespread flooding, and heat waves which contribute towards a growing number of forest fires. When a natural or man-made disaster does strike, saving lives is the priority and speed of response is crucial. The Emergency Response Coordination Centre (ERCC), operating within the European Commission's Humanitarian Aid and Civil Protection department (ECHO), was set up to support a coordinated and quicker response to disasters. Providing 24/7 support both inside and outside of Europe and with the capacity to deal with multiple, simultaneous emergencies in different time zones, the ERCC coordinates resources from the countries participating in the European Union Civil Protection Mechanism.

In fact, since its launch in 2001, the EU Civil Protection Mechanism has monitored over 300 disasters and has received more than 200 requests for assistance. It intervened in some of the most devastating disasters the world has faced, including the floods in Serbia and Bosnia and

Herzegovina (2014), the Ebola outbreak in West Africa (2014) and the earthquake in Nepal (2015). [1]

The impact on life was extremely significant in 2015 with a total of 23,000 people known to have been killed by natural disasters around the world, many in the Nepal earthquake in April. This total compared with 7,700 the previous year, but was well below the 10-year average of 68,000 (1994 – 2013). [2]

The European Union Civil Protection Mechanism was activated 15 times (as either a pre-alert or due to a request for assistance) over the last three summers as a result of forest fires inside and outside Europe. In July 2015, firefighters battled wildfires on the outskirts of Athens and in other parts of southern Greece, as some 50 forest fires, fanned by strong winds and high temperatures, sent clouds of smoke billowing over the city forcing hundreds of residents to flee from flames threatening their homes. As always in such situations, the authorities had to activate their plans to accommodate and feed these citizens, also ensuring that medical facilities were able to deal with any situations that arose.

One of France's worst forest fires in the last five years also raged in the southwest of the country in the same month. The fire consumed approximately 550 hectares (1,360 acres) of pine forest on the western edges of the city of Bordeaux. Then just a few months later in October, 19 people were killed when torrential rain across the French Riviera sparked flash floods that upturned cars, submerged whole streets and inundated homes. According to French news agency AFP (Agence France Presse), witnesses described how “driving, horizontal rain” struck the Côte d’Azur – a record 107mm fell in Cannes in just one hour – along with hailstones the size of ice cubes, damaging both cars and property. Burst riverbanks sent torrents of water pouring through French towns in the area as a combination of lightning and water damage knocked out electricity to tens of thousands of homes. Continuity of power supply is of course essential for hospitals – people on life support machines or on kidney dialysis machines may die if power is lost. If heating or cooling systems break down in winter or summer, the elderly, young and the sick in particular are vulnerable, and this may also have dramatic consequences.

All of these factors emphasise the need for practitioners and government authorities to create, use and share a Common Operational Picture at local, regional, national and even international levels for large-scale crises. This is one of the areas explored in some detail in the DRIVER project.

Crucial agreement at UN Conference in Paris

Insurers paid out around €24.87 billion ($27 billion) for natural disaster claims last year with weather being responsible for 94 per cent of incidents, underscoring the challenge posed by climate change, according to data released by re-insurer Munich Re. This was down from €28.56 billion ($31 billion) in 2014. [3]

While the climate phenomenon known as 'El Niño' reduced the development of hurricanes in the North Atlantic during 2015, storms and floods still inflicted billions of euros of damage in Europe and North America, the world's largest reinsurer said in its annual review. The company added that floods in the UK and Scandinavia from storm "Desmond" in early December 2015 would cause about €700 million ($764 million) in claims, while later flooding from storm "Eva" in the UK was likely to cause overall damage of more than 1 billion euros. Analysts at U.S. bank

Citigroup and brokerage Canaccord later estimated total economic losses at more than €3.88 billion ($4.4 billion). [4]

It is no surprise then that the insurance industry pressed hard for action to be taken to curb climate change in the run-up to the important COP21 UN climate summit in Paris last November, citing both rising payouts in heavily insured rich country markets and a lack of affordable insurance in developing countries where it is most needed.

The conference was attended by a total of 30,372 people from 195 countries, with almost 150 world leaders including US president Barack Obama and Xi Jinping from China playing central roles. [5]

An agreement was thrashed out over two weeks of talks that saw ministers negotiate into the early hours for the final three nights, amid deep divisions over the relative responsibilities and needs of rich nations, emerging economies, and poor countries vulnerable to the impacts of climate change. The first universal, legally binding deal to tackle climate change signed at this ground-breaking summit committed countries to keeping global temperature rises “well below” 2C, the level that is likely to herald the worst effects of climate change. It also committed them to “pursue efforts” to limit warming to 1.5C, a highly ambitious goal that could require many countries to take even more radical action than they planned to under their existing climate change legislation.

Environmental and campaign groups were divided, however, on the details of the deal, with international charity Christian Aid describing it as “a new era which has the potential to transform the global economy to address climate change” while Friends of the Earth criticised it as a “sham” that failed to go far enough. Only time will tell which perspective is closer to the truth.

Contribution of the DRIVER project

Both the number and the impact of natural disasters are increasing all the time and so, too, is the need to find new or better ways of protecting society. Of course, Crisis Management is the responsibility of each Member State and so it is a country’s own responsibility to have a suitable CM system with the necessary resources and assets in place. Most disasters are managed in the country where they occur, but a country can request assistance from the ERCC, if it is facing a major disaster.

A recent Eurobarometer survey, carried out for the European Commission, looked at citizens' attitudes towards EU civil protection and their awareness of disaster risks as well as the economic impact. The research identified that there was widespread concern amongst EU citizens about the potential economic impact of natural and man-made disasters in the region. Whilst eight in ten (80%) said that a coordinated EU action in dealing with disasters is more effective than actions undertaken by individual countries, perhaps more concerning, however, was that the research results showed that only 37% agreed that their country has sufficient means to deal with major disasters alone. [6]

Countries are continually looking to improve their civil protection strategies and resources – by improving the skill sets of their practitioners through better or more frequent training, by increasing awareness in local communities so they can be better prepared themselves and of course by adopting new technological solutions, all topics addressed by the DRIVER project.

Weather-related disasters clearly have a major impact on our society and the economy, and it is important to identify ways of continually improving our response to CM, so this is an area in which the European Commission continues to invest heavily. One of the leading research projects that is looking at innovation within crisis management is the project DRIVER, a large-scale, demonstration project funded by the EU under the Seventh Framework Programme (FP7). There are 36 partners involved in the project, drawn from researchers, solutions providers, practitioners, operators and other interested stakeholders. DRIVER is a unique multi-national project, working across many sectors, looking to find ways to implement a new approach to improving crisis management in Europe.

Right at the core of DRIVER’s strategy is the understanding and experience that neither R&D in itself, nor even strong demand from the many beneficiaries always lead to innovation in the area of crisis management. DRIVER is not attempting to re-design wholesale all existing crisis management capabilities, but rather is looking to evaluate and validate, and improve upon, those existing capabilities. Europe already has a wealth of local, regional and national systems that are able to collaborate in varying configurations and with varying degrees of interoperability. Radical changes could be very costly and are likely to incur an unacceptable loss of capability over a potentially long transition phase, so it is more a case of progressive evolution than revolution.

There are three crucial areas on which the project is focussed that are recognised as containing some vital ‘innovation gaps’ that need to be addressed to cope with the climatic, societal and economic trends faced by today’s crisis management policy makers and practitioners:

1. *Improving civil society resilience* so that local communities are both better prepared to respond to, and recover from, a disaster;

2. *Strengthening first responders* in terms of the crisis management solutions they have available to them and

3. *Training and learning solutions* designed to enhance the capacities and capabilities of trainers and human resources professionals dealing with those involved in crisis management.

One of the known difficulties facing CM professionals is that when they are dealing with an actual major incident or crisis, they realistically often have neither the opportunity nor the capacity to assess innovative solutions in the field. It's not the ideal time to be questioning whether a new solution is really better than the one it is proposed to replace. Human nature means that it is more prudent to continue using a tried and tested solution, rather than risking trying something new at such a crucial time. A better evidence-base for CM capability investment decision-making is therefore clearly needed, so that practitioners can use a new solution knowing that it has been validated and proven to be effective.

By building upon gap analyses undertaken in previous EU-funded road-mapping projects like ACRIMAS and CRYSIS, the DRIVER project is improving Member States' and Associated Countries abilities to adapt crisis management tools to future demands by establishing a distributed European test-bed for CM capability development with proven evaluation methodologies that enable replicability. The test-bed will include exercise facilities and crisis labs, some connected virtually, allowing new CM approaches and solutions to be tested and evaluated in real-life exercise scenarios. In addition to technical capabilities, expertise and experience are also key features of the DRIVER test-bed.

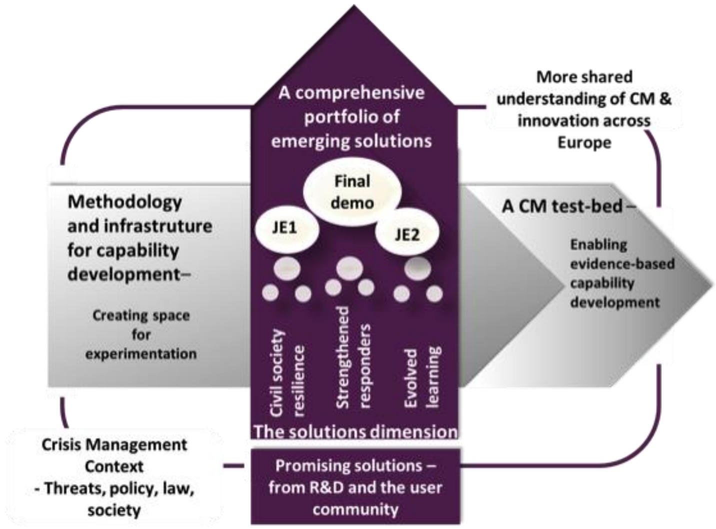
The ultimate result of DRIVER will be the development of a comprehensive portfolio of solutions that will undoubtedly deliver tangible and sustainable results for the future. In other words, DRIVER aims to assess and validate innovative, yet practical, crisis management solutions that work, that have been tried and tested, and above all are used for, and by, emergency practitioners.

Experimenting solutions for Crisis Management

So this is where the DRIVER project fits in, with its overarching aim of reviewing and validating through experiments the incredible wealth of European innovation and science in crisis management. It will achieve this by assessing, and improving, crisis management solutions that can be used not only as they are, but also combined with other solutions designed to address different types of large-scale crises. Working together with local communities and authorities, civil contingency and technical relief agencies, it aims to improve the existing knowledge base. The experience gained during the project will be shared with crisis management practitioners, policy makers and technology suppliers, for example through local innovation for crisis management (I4CM) workshops. Two workshops were held in 2015 in Marseille and Berlin; three additional events will be held during the lifetime of the project – in Sweden, Poland and the Netherlands.

Experimentation, in DRIVER, involves the testing of novel 'solutions' (a mix of existing and new technological, conceptual or organisational solutions) under controlled conditions. An experiment is considered in the widest sense of the word, and can include laboratory experiments, in-field demonstrations, benchmarking, workshops, tabletop exercises, qualitative & quantitative research and even structured discussions, provided they satisfy basic scientific requirements.

Campaigns of successive experiments are already underway to explore in part how innovative methods and technologies can be used to manage crises better or more efficiently. Other experiments are investigating how communities can be better prepared for a disaster and a third area is focussing on enhancing the capacities and capabilities of trainers and human resource professionals dealing with those involved in crisis management.



DRIVER Campaign of Experiments Infographic

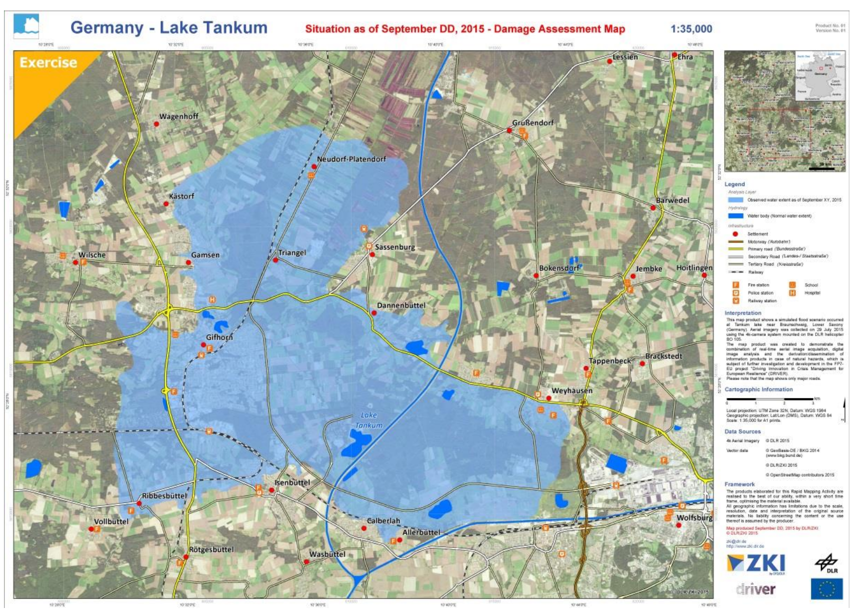
These campaigns consist of comprehensive programmes of experiments that compare novel solutions with currently used ones in scenarios of increasing complexity, providing a sound evidence base for future investment and procurement decisions. The participating DRIVER partners contribute to the development of the experimental scenarios according to their expertise, e.g. practitioners host and often participate in the experiment, solutions' providers integrate and connect the solutions and research organisations assess the outcome using rigorous scientific methods.

Additional levels of complexity will be added that combine different solutions in more demanding CM scenarios, culminating in two Joint Experiments and a Final Demonstration. The scenarios used in these complex experiments have been selected to be a major flood and a heat wave, as it is felt that these scenarios will generate results that are particularly relevant to the crisis management community.

One of the preliminary experiments conducted in the project combined bespoke traffic management software with imagery taken by a RPAS (Remotely Piloted Aircraft System). The research aircraft took images of people trapped in an area inundated by floodwater – the information was collected, processed and passed in almost real-time to a crisis control room.

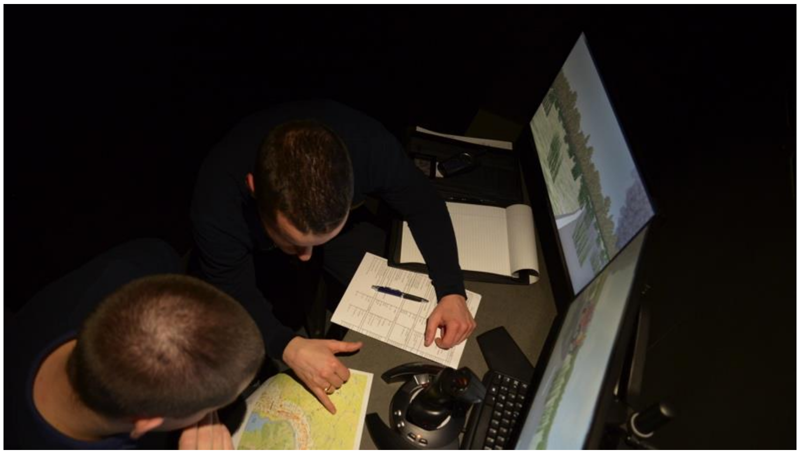
Crisis Control Room for Experiment 40

The traffic management software then enabled the crisis operators to determine the fastest route to a precise location in the disaster area, improving the response time of the emergency services. Subsequently, all the gathered information was fused into a new type of map product for situational awareness of responders. The map below shows the disaster area in a 3D-model with layers of additional information derived from the aerial images (e.g. water levels, locations of people etc.). This scenario not only tested the technological feasibility of the provided system, but also compared the benefits of the portfolio of tools to existing (state-of-the-art) systems.



Assumed crisis area for Experiment 40 (provided by ZKI Portal)

Another experiment has looked at whether crisis management information technology is able to provide fire incident commanders with a better Common Operational Picture (COP) than the legacy systems currently available to them. Incident commanders compared new COP systems with legacy solutions in a tabletop exercise using a fire-training simulator, with a forest fire scenario in southern France, but with the added complication of a chemical transporter caught in the proximity of the fire.



XVR Simulator used to create a forest fire scenario during Experiment 41

A recently completed experiment in Vienna addressed the issue of tasking volunteers effectively during a crisis, which can be a significant challenge. Professional responders work within established information chains and assigned roles. In contrast, volunteers rarely have any experience of the task at hand and do not fit within a chain of command. A two-day exercise used a CrowdTasking smartphone app, developed by DRIVER partners, that enabled citizens to volunteer online by providing disaster managers with answers to posed questions/tasks. This was combined with a web-interface for coordination and evaluation used by responders. The results of the experiment will certainly help to improve the interaction with volunteers in crisis and disaster management.

Crisis Managers from the Austrian Red Cross participating in Experiment 36.2

Finding innovative ways of making civil society more resilient, helping first responders to do their jobs better and improving training and learning are right at the heart of DRIVER – the project will review, test and analyse a variety of solutions for crisis management across a wide range of operational scenarios over the next two and a half years. Proven major improvements in the way we manage crises in Europe are just on the horizon. The outcomes of this important project are certain to be felt across the European Union for years to come.

If you are interested in finding out more about any aspects of the DRIVER project, including the full programme of events and experiments, or in joining the DRIVER Community, please visit the dedicated project website at www.driver-project.eu.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n°607798.

Any communication or publication related to the action, made by the beneficiaries jointly or individually in any form and using any means reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

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[1] European Commission, Brussels, 17 July 2015.

[2] ReliefWeb, United Nations Office for the Coordination of Humanitarian Affairs (OCHA)

[3] Munich Re Annual Report 2015

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[5] The Daily Telegraph, UK

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Unmanned Airborne Rescue - Experiment 40

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Abstract

The scope of Experiment 40 was to test whether it would be possible to integrate ground-based and airborne systems to provide (nearly) real-time information about the crisis – improved situational awareness – and possible rescue plans to second responders. In this experiment a research aircraft – demonstrating the capabilities of Remotely Piloted Aircraft systems (RPAS) – was deployed to gather aerial images over an assumed crisis area. RPAS are becoming increasingly important in civil protection and crisis management. The advantage of unmanned aircraft is that they can be used even in dangerous or hard-to-access areas, and enable observation of the affected regions – or regions under threat – over an extended period of time.

Based on the aerial sensor data and the perceived dimensions of the crisis area, the RPAS flew a scanning pattern above the most flooded areas to try to identify any people trapped. Identified persons were then reported to the ground systems to enable the fast coordination of rescue teams. The flight path then scanned the main traffic routes of the crisis area. The traffic situation was observed, analysed and the data overlaid onto a GIS map, providing improved situational awareness for the rescue teams involved.

New disaster relief system demonstrates its effectiveness

Heavy and persistent rainfall has caused massive flooding of the Elbe Lateral Canal and the Tankumsee, a lake near Gifhorn in Lower Saxony, Germany. The roads are completely covered by water, and in some places people have become isolated. Parts of the transport infrastructure are damaged, hindering the deployment of the emergency services. Similar situations have already occurred in other parts of Germany, as an area of deep low pressure has settled over central Europe in recent days.

In the meantime, the national aeronautics and space research center of the Federal Republic of Germany (Deutsches Zentrum für Luft und Raumfahrt e.V.) DLR's D-CODE research aircraft is taking off from Braunschweig-Wolfsburg Airport on a reconnaissance mission. Its objective is to acquire up-to-date aerial images to determine the situation in the crisis area and to provide essential information to assist with the planning of relief operations. On board the research aircraft is a single safety pilot, but the aircraft flies almost automatically, controlled and monitored from the ground – an important first step towards the use of unmanned aircraft (Remotely Piloted Aircraft Systems; RPAS) for Crisis Management (CM).

This is a simulated crisis scenario however - one that formed one of the second round of experiments in the large-scale demonstration project DRIVER (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience). The project began in May 2014 and involves a total of 36 European project partners from 15 countries, making DRIVER one of the world's largest publicly funded demonstration projects in the field of crisis management.

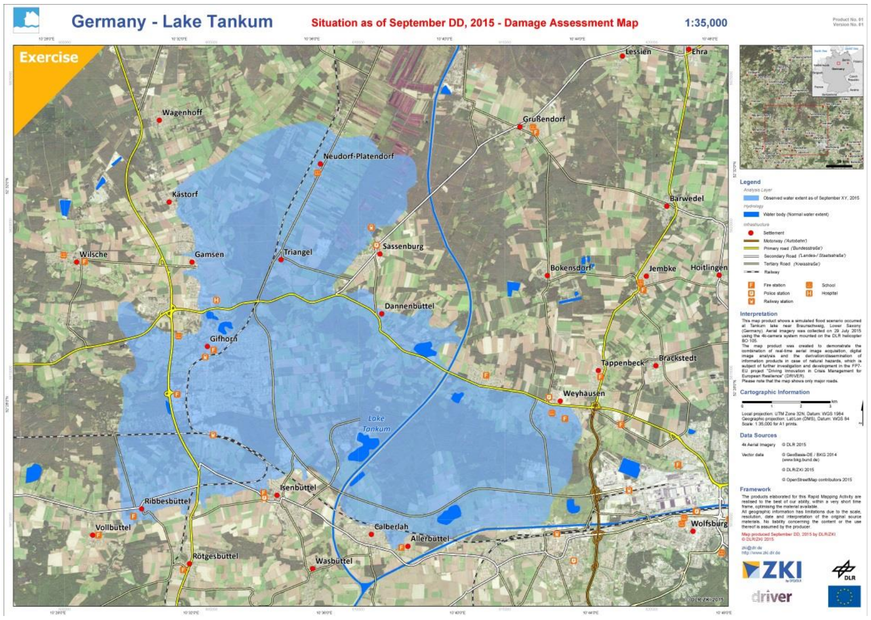
Crisis Control Room for Experiment 40

The scope of Experiment 40 was to provide a functional test within a realistic crisis scenario with the requirement to acquire, process and transmit aerial images in (nearly) real-time and to provide these data to first responders. A pre-defined set of parameters of the Airborne Sensor Processing System (ASPS) was analysed, therefore, both during and after the experiment to ascertain whether the provided solutions enabled a safe application of RPAS in crisis scenarios and whether the ground based solutions provided an added value to CM.

The focus was on potential improvements for *Coordination*, *Command and Control*, *Information Gathering* and *Situation Assessment and Sense Making*. With the ability to gather real-time information on crisis dimensions and dynamics, support crisis logistics and transport, and provide map products for improved situation awareness, several known gaps in European crisis management capability were addressed.

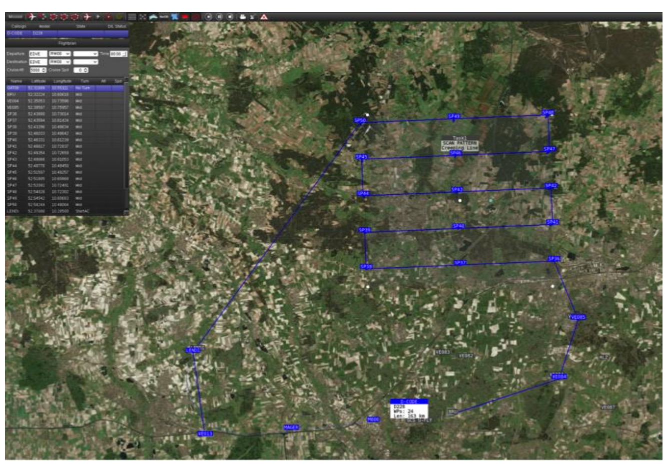
Fastest possible position detection

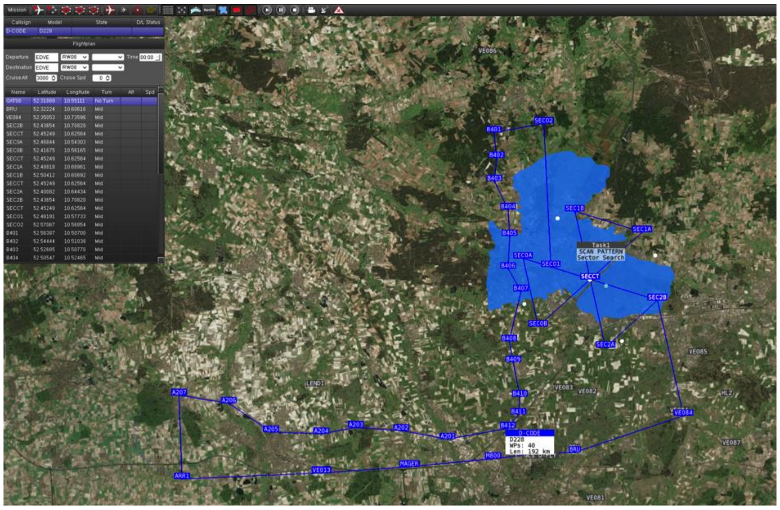
Real-time aerial images contribute significantly to the ability to assess the situation in a disaster region, in turn enabling more effective planning of relief services. For DRIVER, the D-CODE research aircraft, a Dornier 228-101, was equipped with an experimental system to demonstrate the features of unmanned flights. On board the aircraft were camera systems provided by DLR's Earth Observation Centre (EOC) in Oberpfaffenhofen, Germany.



Assumed crisis area for Experiment 40 (provided by ZKI Portal)

Based on the aerial sensor data and the perceived dimensions of the crisis area, the RPAS flew a scanning pattern above the most flooded areas to try to identify any people trapped. Identified persons were then reported to the ground systems to enable the fast coordination of rescue teams. The flight path then scanned the main traffic routes of the crisis area (main road B4, motorway A2). The traffic situation was observed, analysed and the data overlaid onto a GIS map, providing improved situational awareness for the teams involved.


Flight Plan for Scenario (Experiment Step 1)



Flight Plan for Scenario (Experiment Step 2)

Using the 3K Camera System on board D-CODE, and depending on the flight altitude, it was possible to record an 80-kilometre-square area in approximately two minutes, produce geo-referenced aerial images and transmit the results to a ground station via a data link. As soon as the image data had been transmitted to the ground, further analysis of the situation was conducted and maps were created at the EOC's Centre for Satellite-Based Crisis Information (ZKI). Transport-related crisis information (such as road navigability) was then derived from the aerial images, and special maps produced to generate a realistic visualisation of the crisis.
In parallel to the work being undertaken by ZKI on DRIVER, the DLR Institute of Transportation Systems in Berlin used the latest aerial images provided in near real-time by the RPAS flight demonstrator together with the survey data from the EOC, to produce an up-to-date picture of the traffic situation in the affected region. The rescue teams were then able to coordinate the logistics of disaster relief measures, as they had data regarding the current and predicted situation, as well as information on travel routes and times. Various scenarios for the arrival of additional rescue teams were then simulated and evaluated.

The flight experiment took place at the German Aerospace Center in Braunschweig and involved several DLR institutes (Flight Guidance, Transportation Systems, Remote Sensing Technology and the Center for satellite-based Crisis Information), observers from the DRIVER consortium and volunteers from the DLRG e.V. (German Life Saving Association). The German Federal Agency for Technical Relief (THW) assisted by ensuring the flooding scenario was realistic and by describing the information normally provided to practitioners, the available technology and the process of crisis resource planning and logistics.

The technology that was tested during Experimentation 40 can be divided into two solution categories: Real-time Imagery and Maps, and Traffic Management Solutions.

Solutions for Real-time Imagery and Maps

Typically during a flood THW uses maps, primarily paper-based maps at the incident and digital maps such as Google Maps1 and Top 502 in crisis and control rooms. Although not requiring electricity or a functioning Internet connection, paper maps can be out of date and are not adjusted to reflect the changing dynamics of a scenario, for example flooded streets or bridges that can no longer be used. That means that when crisis managers attempt to dispatch units to a scene of operations, they have to base their decisions on potentially out-of-date information.

The systems used in this experiment may offer the following advantages:

- Real-time information contributes to better-informed decisions;
- Updates on crisis dynamics and changes over time can be provided, e.g., in situations with rivers bursting, dykes breaking and water spreading, road blockages could occur and would require new responses;
- Additional mask layers can be placed on top of digital maps, indicating how floodwaters have progressed, facilitating predictions and precautionary action;
- Improved training opportunities, as the digital maps with mask layers can be used to demonstrate how to respond to dynamic situations.

Solutions for Traffic Management and Routing

During any large crisis where THW's extensive assistance is needed, units from all over Germany have to be sent to the affected area. Requested units gather in convoys that then drive to an assembly area near the scene of operation. These convoys commonly consist of 15-20 vehicles, most of them trucks, sometimes pulling trailers with heavy equipment.

Once the convoys have arrived at the assembly area, the units wait for their orders and deployment. THW can only use open access programs such as Google Maps to guide units to the desired destination. However, these do not feature real time maps that might indicate a route needs to be adjusted and lack important information such as the height and bearing capacity of bridges.

The following advantages might be provided by the systems:

- Real time information based on the aerial maps (how fast floodwater spreads and which streets will be available at what time) allow more logistics' planning and execution;

- Additional information such as height and bearing capacity of bridges;
- Offers the possibility to calculate how quickly certain units will arrive at their destination;
- Could offer information on petrol stations and the availability of truck pumps;
- As a result allows routes to be planned more effectively (technical halts, respecting resting periods).

The Aerial Sensor Processing System consists of several individual components, which were integrated into a complete experimental system for the setup of this experiment. In detail, the following systems were part of the experiment's architecture:

- RPV D-CODE: The research aircraft D-CODE, a modified Dornier 228 with digital autopilot and control/payload data link; can be controlled via the ground control station (GCS) and used as RPV-demonstrator (Remotely Piloted Vehicle).
- 3K: Camera system integrated into the research aircraft D-CODE, transmitting geo-referenced images and derived image products to the GCS;
- U-FLY: a ground control station (GCS) for RPV; capabilities include mission planning and evaluation for single RPAS or swarm formations. Receives aerial sensor data, processes and evaluates data and dynamically adapts RPAS missions to newly received information;
- SUMO: traffic simulation suite, allowing modelling of intermodal traffic systems including road vehicles, public transport and pedestrians; supporting tools can be used to import common network formats (e.g. OSM);
- EmerT (Emergency mobility of rescue forces and regular Traffic): processed aerial images and provided access of images to other systems such as U-FLY; displayed aerial images together with the traffic data;
- KeepMoving: information about the traffic situation, predicted travel times for specific routes, isochrone maps and general traffic predictions based on actual or historical traffic data;
- ZKI-Portal: the rapid acquisition, processing and analysis of Earth Observation data and the provision of satellite or airborne-based information products on natural and environmental disasters and for humanitarian relief activities.

Evaluation approach and metrics

Both qualitative and quantitative data were collected during and after the experiment. Quantitative data such as data link quality and detection rate were used in conjunction with the qualitative data to assess overall performance against the experiment objectives.

Quantitative Analysis

Objective 1: Safety of RPAS operations

The safety of the RPAS flights executed in Experiment 40 was assessed by three different factors. The most important factor was that the RPAS operations had to meet the regulations and procedures defined for the respective airspace category at all times. A second factor was the validity and feasibility of the transmitted data between the ground station and the aircraft. Another important factor to consider was the perception of the aircraft's pilot. The operation can be considered safe, when the pilot states that the steering commands and flight paths transmitted from the ground station were similar to him/her flying manually. This factor is addressed by a questionnaire and is further discussed in the paragraphs below about Qualitative Analysis.

A primary function of the Flight Management System (FMS) is the in-flight management of the flight plan. Using various sensors the FMS determines the aircraft's position and translates the flight plan into steering commands to follow the planned route. Commands from the ground are passed to the FMS and checked for feasibility and validity before activating them. The Flight Management System (FMS) in Experiment 40 accepted the commands and trajectories generated by U-FLY at all times. No errors were recorded on-board the aircraft or at the ground control station. Conclusively, the steering commands and flight paths generated were always valid and feasible and the corresponding success factor was therefore completely satisfied.

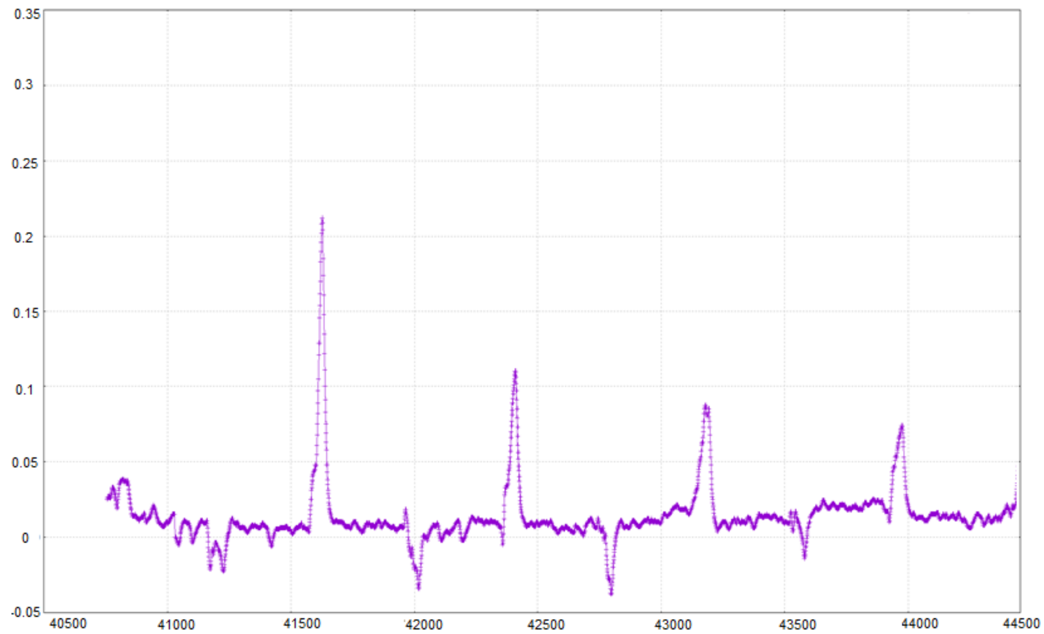
Aircraft operations in controlled airspace can be considered safe if they meet the regulations and procedures defined for the respective airspace category. The concept of Performance Based Navigation (PBN) defines navigation requirements applicable to aircraft conducting operations on specific routes, on an instrument approach procedure, or in a designated airspace. PBN also refers to the level of performance required for a specific procedure or a specific block of airspace. The level of navigation performance is defined by allowed lateral deviations from a specified route.

These limitations are categorised according to the flight phase the aircraft is currently operating in. According to ICAO (Procedures for Air Navigation Services – Aircraft Operations) [1] the following lateral deviations are allowed:

a) ±3.7 km (2.0 NM) in en-route mode;

b) ±1.9 km (1.0 NM) in terminal mode; and
c) ±0.6 km (0.3 NM) in approach mode.

The aircraft is required to operate in conjunction with a flight director system or coupled autopilot system to ensure the required level of performance is provided. The highest requirements are specified for the areas around airports (Terminal Areas) and during approach. An RNP of 0.3 means the aircraft navigation system must be able to calculate its position to within a circle with a radius of 3 tenths of a nautical mile (~0.5km). This can be taken as a measure of safety for the evaluated RPAS system. In detail, cross-track errors are measured and compared to the performance level required for RNP 0.3.



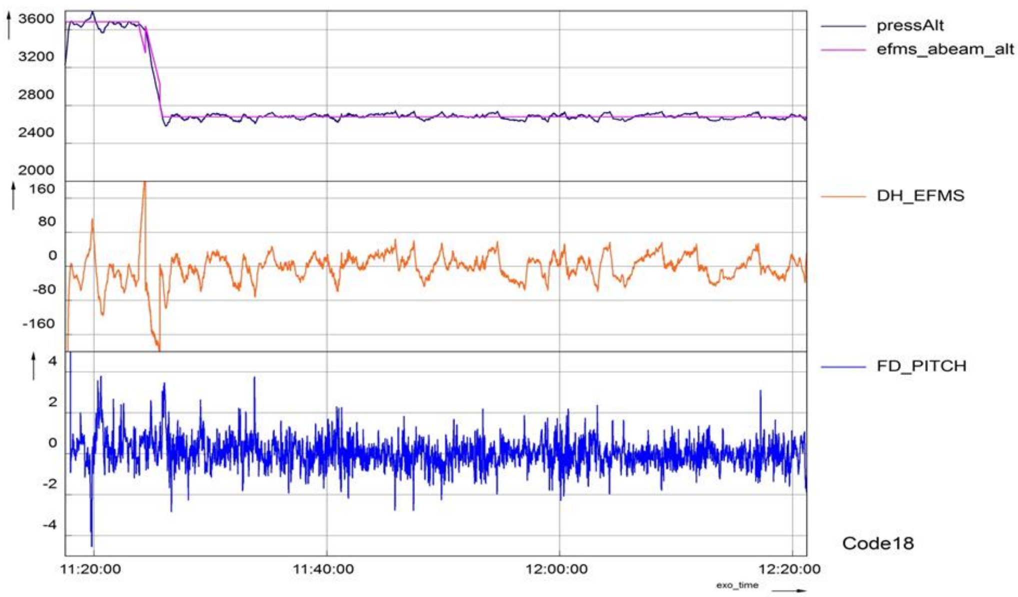
Cross-Track Error (Experiment Step 1)

The Cross Track Error (showing lateral deviations from the planned flight path) is displayed over the time (in UTC) for Experiment Step 1. Analysing the data shows that deviations occur periodically in the positive and negative direction. This can be explained by comparing the data to the corresponding flight path. In Experiment Step 1 a search pattern with creeping lines including alternating flight turns in left and right directions were performed. These turns were planned with bank angles of up to 30 degrees.

The FMS accepts these kinds of high values for bank angles, because the aircraft theoretically is able to execute them according to the aircraft's performance parameters. In the flight experiment this maximal bank angle turned out to be higher than the aircraft is able to execute safely when considering weather influences (e.g. strong winds).

In forthcoming experiments the value of maximal bank angles for the RPAS will be reduced to 25 degrees. Nevertheless, the deviations in Experiment 40 never exceeded values of 0.22 NM. Therefore, the performance requirements for PBN 0.3 are completely satisfied. When comparing the data for Experiment Steps 2 and 3 these even show average deviations of 0.04NM. These deviations are extremely low and demonstrate a very high level of precision.

In Experiment Steps 2 and 3 search patterns similar to a 3-leaf clover were executed. The flight paths relating to these patterns included several flight turns with lower bank angles. These commands could be easily followed by the aircraft and resulted in a very high precision level.



Altitude Error (Experiment Step 1)

Besides adhering to the lateral path, it is equally important for safe RPAS operations to be able to maintain a planned vertical path. In order to ensure safe transition between regions, a global height-keeping performance specification was developed and defined for aircraft in EASA AMC 20-27A [2]. According to EASA the aircraft's performance should demonstrate on a 99.7 per cent probability that vertical errors should be less than:

- At or below 5000ft (MSL): < 100ft
- 5000 ft to 10000ft (MSL): < 150ft
- 10000 ft to 15000ft (MSL): < 220ft

In the figure above, the results from Experiment Step 1 are displayed. The figure is composed of three parts. The part on top shows the planned altitude in red (in ft) compared to the actual uncorrected pressure altitude (in ft) in blue over the time. The figure in the middle shows the actual deviations (in ft) between the planned and actual altitude values. The figure at the bottom shows the deviations between the planned and the actual vertical speed (in meters per second). It can be seen from the figures that the highest deviation (~158ft) occurred shortly after the departure of the aircraft.

Due to bad weather conditions on the day of the experiment (low visibility and low cloud ceiling) the flight altitude had to be reduced significantly to be able to collect images with adequate quality. This sudden change of altitude caused these deviations that were handled and managed quickly. During the remaining flight the altitude deviations stayed well beneath 80ft. These results are similar to the data recorded for Experiment Step 2 and Experiment Step 3.

With altitude errors below 80ft the requirements on safety for RPAS operations are satisfied even for low altitude operations. The third success factor was also satisfied conclusively.

Qualitative Analysis

Qualitative data describing the participating pilots' and second responders' ideas and thoughts concerning the experiment objectives was collected. A set of questions was presented to the pilots after each phase of the flight experiment, divided into four different sections:

- Overall feeling of safety
- System reliability
- Loss of skills
- Situational awareness

One particular area of interest was the Overall Feeling of Safety of the RPAS. Both pilots (two test flights) reported positively, indicating safety was not endangered during the flights. Both pilots stated, however, that they felt they needed to stay in the control loop at most or all times and felt responsible for the aircraft. They would not feel completely safe if the aircraft was controlled by the GCS exclusively. Feedback on topics like feasibility of instructions, feeling of safety when following commands, and feasibility of the provided 4D trajectory, can be seen as positive.

System Reliability can be seen as high and mature for this kind of flight experiment, as this was scored very highly by the pilots.

In the section Loss of Skills, it is remarkable that both pilots strongly agree to the statement that a pilot needs the same qualification for aircraft operation from a GCS as onboard the aircraft.

However, the role of the pilot is also rated as a monitoring and scanning role in most cases. The pilots both fear the deterioration of flying skills when using higher automation.

In the section Situational Awareness, only one of the pilots answered the questions. A slightly higher situational awareness requirement with increased automation is expected.

The other area that was assessed on a qualitative basis was Added Value for Crisis Management. Although the evaluation of the interviews is not considered reliable as two of the practitioners were using the tools in the German Aerospace Center in Braunschweig, nevertheless, the feedback of the practitioners gave a positive first impression. The demonstrated traffic management tools had certainly provided added value for the practitioners; in particular the functionalities of routing, forecasting (e.g. evacuation situation) and the current traffic situation were seen as beneficial.
The practitioners suggested further functionalities, which will be taken into account in future experimentations:

- Include details of blocked roads (due to roadworks, flooding etc.) to assist with routing;
- Display the traffic information directly over the aerial images;
- Incorporate current weather conditions for a more reliable estimation of travel times;
- Consideration of more criteria for the rescue routing.

In summary, the feedback showed that the presented traffic management tools would generate a benefit for practitioners and could be practicable. But before they would be used, some adjustments such as having one common interface and further features (e.g., blocked roads) would be needed to increase the feasibility and usability.

Full experimentation results are available from Dr. Dagi Geister at DLR.

Unmanned aircraft for crisis management

RPAS are becoming increasingly important in civil protection and crisis management. The advantage of unmanned aircraft is that they can be used even in dangerous or hard-to-access areas, and enable observation of the affected regions – or regions under threat – over an extended period of time. Besides the fact that RPAS offer great benefits in comparison to manned aviation, these kinds of aircraft are still not allowed to operate in non-segregated airspace. Different legislation initiatives and roadmaps for a safe integration have already been made at a national level. In this experiment it was shown that RPAS are able to perform complex flight manoeuvres for gathering aerial imagery even in crowded airspace without jeopardizing the safety of other airspace users or people on the ground.

For the flight trials of RPAS in controlled airspace, the D-CODE research aircraft was modified to allow flight control commands to be received from the ground and processed. The aircraft's flight and mission were planned by the ground station for unmanned aircraft, U-FLY, at the Institute of Flight Guidance in Braunschweig. U-FLY is able to create various four-dimensional flight paths in advance for simulations and flight experiments and check a variety of aspects, most notably safety (such as altitude, obstacles and restricted areas) and mission objectives (for example, identifying objects as quickly as possible, acquiring comprehensive aerial image data), for different unmanned aircraft types.

The flight test began by examining the current extent of the crisis situation from the air. To this end, an RPAS pilot produced a mission plan at the U-FLY ground control station, which provided for the most extensive aerial images possible. Then the flight path was rerouted from the ground to find the most affected areas in terms of impact on people and observe the main transport routes from the air. Based on the aerial images acquired, the transport situation was then analysed and all available emergency routes revealed. In parallel to this, an image analysis system that can be used to detect people in an emergency situation on the aerial images was evaluated. Test subjects had been sent to the Tankumsee for this purpose – some of whom swam in the water by themselves, while others were grouped together in boats.

The RPAS demonstrator flew search patterns over the test area and supplied images, from which the necessary information was extracted for targeted response measures. If it was suspected that people were in distress, the U-FLY ground station altered the aircraft's flight path to confirm rapidly the 'initial suspicion'. In this way, in a real crisis situation, it would be possible to provide rescue teams with more specific information, direct help to the right locations and transport aid supplies – such as water, medicines or food – to the crisis zone. In a possible future scenario, these technologies could be used to enable an unmanned aircraft to perform other tasks in addition to independently observing the crisis zone, such as delivering urgently needed relief supplies directly to the optimum locations.

Two further flight trials will be conducted in the next two and a half years as part of large-scale experiment campaigns within the DRIVER project. These will investigate different disaster scenarios, such as floods in The Netherlands and tsunamis in the Mediterranean region. The overall system created in the DRIVER project will then be put to the test during a realistic exercise – with the involvement of rescue and aid workers, including the German Federal Agency for Technical Relief (THW) and representatives of the Red Cross from Austria, the United Kingdom and Denmark. The project will conclude in the autumn of 2018 with a Europe-wide demonstration of the system.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n°607798.

Any communication or publication related to the action, made by the beneficiaries jointly or individually in any form and using any means reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

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Delivering a Common Operational Picture to Crisis Management Professionals - Experiment 41

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Abstract

Informed decision-making is essential to the successful management of an incident or crisis, whatever its size, nature or duration. Experiment 41 in the DRIVER project investigated whether providing and distributing an accurate and current Common Operational Picture (COP) to all levels of the crisis management team would result in better decision-making, potentially saving lives, both of the public and of emergency services personnel.

Experiment 41 tested two existing legacy information systems with new COP solutions and assessed both options, quantitatively and qualitatively. A bespoke forest fire scenario was run three times on a training simulator involving first responders from France and Sweden. The scenario challenged players in a multi-agency situation at all levels of command – at local, regional, national and even international levels. The exercise was also observed by external subject matter experts (SMEs), who were first responders in Germany and the United Kingdom.

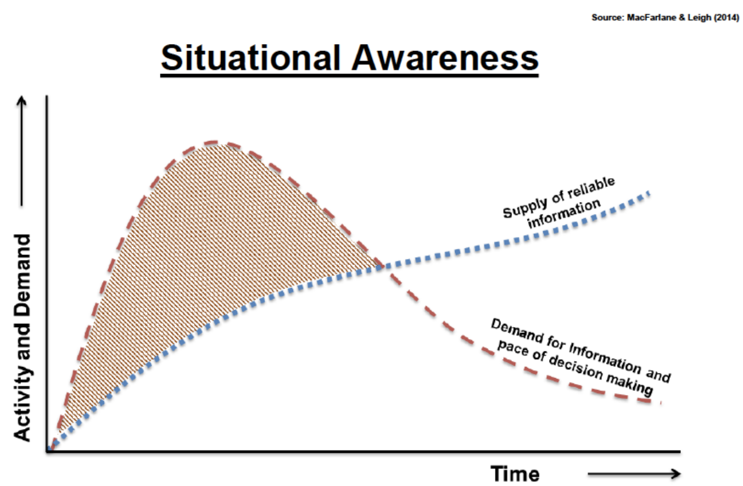
The experiment confirmed that comprehensive, current and co-ordinated information in a COP can indeed assist an incident commander or crisis manager to process a vast amount of dynamic risk information and enable him or her to make better, more informed command decisions. One particularly interestingly result, however, was that the COP was discovered to be more beneficial at the strategic and tactical command levels, and less so at the operational, or field level.

Introduction

Crisis management (CM) professionals, particularly in the frontline emergency services, are highly trained individuals that are able to assimilate a significant amount of information from a variety of sources during an incident. They use this knowledge, combined with their training, experience and expertise, to make crucial decisions calmly, even though the situation around them may be extremely stressful. Situations can develop very quickly during a crisis and the decisions they make will affect the outcome of the incident and may well save lives, both of members of the public and of the emergency services personnel themselves.

To make the right decisions, an incident commander or crisis manager first needs to have a comprehensive and current understanding of the risks faced, the resources available and any other factors that may influence a decision, for example the wind direction. Knowing what has already happened and what is happening within an environment, and understanding the implications and potential outcomes of these events, is essential. This situational awareness can then be shared with other levels of command if the incident escalates, including with other services and organisations in a multi-agency crisis, as part of a Common Operational Picture (COP).

This COP will support unity of purpose and effort and in turn enable an effective, collective response in a multi-agency event. A COP should provide a single, identical display of relevant (operational) information immediately to all levels of command to ensure that the right decisions are taken at the right time by the right people.



The Evidence Gap in Crisis Management – The period of greatest uncertainty

Situational awareness is of course crucially important to an operational or tactical commander to enable him or her deploy the resources effectively on the incident ground. A COP, however, becomes absolutely essential for the management of larger, more complex and even cross-border operations, involving diverse Crisis Management (CM) organisations. Depending on the stage and nature of the incident, the COP could be available at the incident itself, in the operational command unit, in a central control room, at a regional headquarters or even in central and European government for a very major crisis.

McNeese et al. (2006) [1] judged a COP to be a visual representation of tactical, operational, and strategic information to support rapid assimilation and integration by team members. The distinction was drawn between the COP as a product (i.e. a picture of the state of the situation) and as a process (i.e. an integral part of decision-making). The requirement for a common understanding of the nature of the situation and the appropriate response, over and above a superficial awareness of information, was emphasised by McMaster, R., Baber, C (2009) Common Operating Pictures and their Potential for Multi-agency Work, University of Birmingham, UK [2].

Stephen Carr, Director Central Operations, Alberta Emergency Management Agency, stated in 2014 [3] that a COP is an overview of a situation that is created by assessing and fusing information from multiple sensors or sources to support timely and effective decision-making (normally a product of technology).

DRIVER establishing a distributed European test-bed

The DRIVER project (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience) is a unique multi-national project, working across many sectors to find ways to implement a new approach to improving crisis management in Europe. This is being achieved by establishing a distributed European test-bed for CM capability development with proven evaluation methodologies, meaning that practitioners can be confident of adopting innovative solutions in the field that have already been validated scientifically.

DRIVER, a large-scale, demonstration project funded by the EU under the Seventh Framework Programme (FP7), which runs from May 2014 until October 2018, is focussed on three key areas:

- *Improving civil society resilience* so that local communities are better prepared to respond to, and recover from, a disaster;
- *Strengthening first responders* in terms of the crisis management solutions they have available to them;
- *Training and learning solutions* designed to enhance the capacities and capabilities of trainers and human resources professionals dealing with those involved in crisis management.

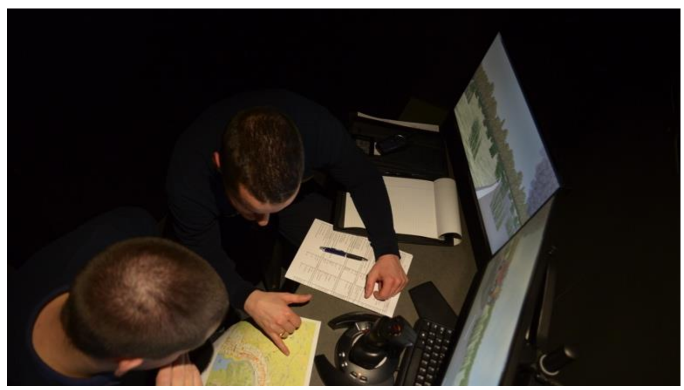
Experiment 41 in the DRIVER project looked at ‘Operational Data Lift’ by assessing the potential operational benefit that a Common Operational Picture based approach could bring to professional first responders in a complex operation involving diverse Crisis Management organisations. The key area that was assessed concerned *Situational Awareness* – the collecting and presenting of relevant static and dynamic information about the incident. Another DRIVER experiment will look more closely at the area of *Adaptable Command and Decision Support* – coordinating action between various rescue organisations.

The experiment explored how the current legacy information management systems used in two Member States (France and Sweden) compared with new solutions designed to provide an improved Common Operational Picture to crisis managers at all levels of command. The experiment comprised several DRIVER partners (Entente Valabre, Swedish Civil Contingencies Agency, Frequentis, Safe Cluster, Thales Communications & Security, E-Semble, JRC) as well as French first responders from the Bataillon des Marins Pompiers de Marseille (BMPM), EMIZ-South of France Securité Civile HQ, SDIS83, and Brigade des Sapeurs Pompiers de Paris (BSPP). External observers from the Institut der Feuerwehr Nord Rhein Westfalen in Germany and Norfolk Fire and Rescue Service from the UK also contributed greatly.

Sharing and using a Common Operational Picture

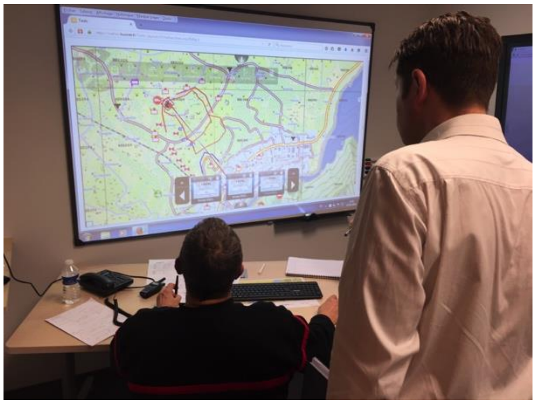
A tabletop exercise was run using the XVR training simulator, so that the scenario could be repeated several times in a consistent way. A bespoke forest fire scenario was designed with cascading effects onto a main road, creating a chemical threat on the nearby town across the border. This allowed the crisis management teams to escalate the incident to French Department level, then to Regional and National levels and ultimately to European level. The whole command chain was played, from the site command post right up to European level.

The XVR Simulator was used to run the forest fire scenario



There were three stages to the experiment, which took place in the simulation centre CESIR at Entente Valabre (firefighters' research centre) near Aix en Provence in France. A rehearsal was originally held in November 2015; a first run in December 2015 and the second run took place during the first week of March 2016. The post-experiment report is being drafted at the moment with key findings and recommendations for first responders and policy makers.

These new COP systems have been developed by two DRIVER Partners, Thales Communications & Security and Frequentis, and were used in operators' positions in the different headquarters – local, regional and national. The COP tools (Thales Large Event and Frequentis Life-X COP) were connected with the French and Swedish legacy local tools (Valabre Asphodèle and MSB LUPP) and the European legacy tool (JRC Crisis Wall) and aggregated the information from the field.



These prototype COP solutions are web client tools, enabling distant connections from multiple users. By being connected to the same system the various stakeholders were able to access and share the same information from the incident. Although the solutions were assessed during the experiment, this was secondary to the principle of how a COP could actually benefit operational, tactical and strategic commanders.

Both quantitative and qualitative measurements were used to evaluate the systems. The different features of the legacy system and the COP system were recorded in an evaluation sheet, which was used to measure the difference in their functionalities. Messages that were sent and received during the experiment were captured in message logs, recording the actual time that data was shared. This meant that a physical measurement could be made of how quickly the COP was shared by each system between the different organisations and the higher levels of command.

One of the particularly interesting results to come out of this experiment was the discovery that whilst it is mandatory, and indeed sometimes crucial, to report to higher levels of command during a crises, it was found that the legacy systems do not actually always facilitate this. The COP solution was identified by the players as saving both time and effort in the reporting process – a significant benefit to all concerned. It was also discovered that the COP was found to be more beneficial at the strategic and tactical command levels, than at the operational, or field level.

Qualitative results were obtained via feedback from the participants and by means of a questionnaire given out to the observers and evaluators. They were asked to assess several areas of the experiment, including:

i. Did the COP solution bring operational benefits to those involved in the experiment?
ii. Did the way the experiment was set-up enable the current practices to be compared to the COP approach?
iii. Are the tools implementing the COP solution practical for crisis managers to use?
iv. Did the simulator contribute positively to the set-up of the experiment?

v. Have all the participants learnt from this experiment?

Results should benefit the wider Crisis Management community

There are several ways in which it is envisaged that the outcomes and recommendations from this experiment will hopefully impact positively on the wider CM community:

i. The COP approach is currently being considered by many civil protection organisations throughout Europe. The French and Swedish civil protection agencies were actively involved in Experiment 41, which has enabled them to test this way of working, and allowed them to assess its value and see how it might impact on their organisations.

ii. Some of the solutions providers involved (Valabre, Swedish Civil Contingencies Agency, European Commission Joint Research Centre) are members of the DRIVER project. Preparing for this experiment has improved their ability to exchange (send or receive) standard information through structured messages (EMSI Standard) within their legacy solutions. They have also improved their ability to communicate with other solutions and these changes have also raised the awareness within these organisations of the interest of structured information exchange in Command & Control (C2) systems.

iii. The CESIR simulator has to date only been used to train practitioners; however Valabre has been able to assess the potential interest in using the simulator for other purposes, such as the evaluation of various tools and procedure modifications. This is potentially a future business model, which Valabre is now considering.

iv. Experiment 41 has enabled the solutions' providers to learn a lot about the practitioners' needs but also their constraints. Participating in the experiment has shown ways they can adjust their products' roadmaps and/or provide better system specifications.

The hot wash debrief immediately showed a high level of satisfaction from the participants:

- The operational benefit brought by the COP solution: faster/easier dissemination of situational information between the various levels of command, and the various organisations involved
- The experiment set-up enabled all levels of command to participate realistically in a complex exercise
- The support that the XVR simulator provided to the experiment meant that the exercise scenario could be repeated in a consistent manner

Important feedback that will be input into the subsequent Joint Experiment JE2, later in the DRIVER project, was also collected. A cold debrief meeting will take place at Valabre in April, during which the analysis of the data recorded during this experiment will be presented and additional feedback from the participants will be collected.

A COP will result in more informed decision-making

A mobilising or dispatch system automatically provides initial in-cab data with the location of the incident, as well as some hazard information. But when the resources arrive at the incident, the incident commander often resorts to pen and paper, and simple whiteboards, to manage them. Important, potentially life-threatening, decisions are being made using an approach, which by its very nature is labour-intensive, time-consuming and is often out of date – by essential minutes or even hours in a long-running incident.

Providing a Common Operational Picture vertically to all levels of command and horizontally to other emergency services and partner agencies involved in a crisis makes enormous sense. Comprehensive, current and co-ordinated information in a COP can help an incident commander or crisis manager make better, more informed decisions.

This experiment is one part of the DRIVER comprehensive campaign of experiments. There will be two other experiments that will build further upon Experiment 41: one in 2017 as preparation for one of the final Joint Experiments and the actual Joint Experiment 2 (JE2) itself in 2018.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n°607798.

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Message Mapping - Experiment 35.1

Who to talk to, how to reach them and what to say: Using Stakeholder Message Mapping to shape communications in major emergencies.

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One of the most important developments in the study of communications during major emergencies has been an understanding that a single approach to message content and delivery risks failing to reach or impact on many groups in society. Different groups rely on different channels of communication, have different information needs and receive messages differently. The recognition of distinct stakeholder groups is becoming as embedded in communications as it is in wider emergency management.

Communicating effectively with a diverse public is, however, a consistent problem given the limited resources available for communications and the highly pressurised nature of emergency situations.

Part of this challenge is the growing evidence that it is difficult to frame effective short messages during a major emergency. A recent extensive review of 10 years' practice in mobile alert messaging in the United States found that "the odds of writing a successful yet brief mobile warning message from scratch during a rapid onset emergency appear slim".[1]

Within the DRIVER (*Driv*ing Innovation in Crisis Management for European Resilience) project work is advanced on providing a methodology to aid organisations in preparing for communications with the public in general and stakeholder groups specifically during major emergencies. The specific objective has been to define and validate a methodology which will enable them to:

- Identify likely information needs during different types of emergencies.
- Identify the most effective channels for communicating this information.
- Define the most effective wording for short warning messages.

Adapting the tool of message mapping

In the field of public health emergencies the tool of Message Mapping is used extensively in order to prepare, for example, for possible pandemics. Substantially developed by Vincent Covello [2] and used extensively by organisations such as the World Health Organisation and the U.S. Environmental Protection Agency, a message map is a tool used to map out hierarchical anticipated questions or concerns for different stakeholder groups for specific risks or threats. It is claimed that a systematic approach such as this is capable of anticipating up to 95% of likely questions. The tool has been implemented successfully for a range of public health outbreaks such as Ebola in 2015.

Message mapping is a very detailed approach which is particularly suited to situations where it is required to gather and make intelligible scientific and medical information and where the risk of widespread fear of the unknown is present. Guides to implementing message mapping are freely available.

No comparable approach has been defined for other types of major emergencies such as flooding or extreme weather. As such, work is progressing on adapting message mapping to the stakeholder communications challenges DRIVER has outlined.

Stakeholder Message Mapping for Flooding

Using a flooding scenario involving wider complications similar to the one which will be used in a major experiment in 2017, an adapted message mapping approach was followed. Initially this involved defining the scenario, developing lists of possible questions from the public, developing short answers to these questions, defining current channels of communication likely to be used by public authorities and, finally, preparing a series alerting messages of 140 characters or less.

Following this initial work a template for focus groups was developed. Conducted in Ireland and Germany, a total of seven groups were held in the period June to November 2015. Each group was made up of individuals who shared a specific trait such as age, student status or a disability.

The objective of the groups was to examine if the initial work and the group feedback would enable the definition of:

- Key information needs.
- The most effective channels of communication.
- The effectiveness of specific alerting messages.

The structuring of the different focus groups was intended to allow for the isolation of factors distinct to different groups as well as commonalities.

Outcome

The initial review of the research has shown that it does provide concrete information to assist in the planning and delivery of communications in a major flooding. It identifies distinct information needs and responses for different groups within the general public.

In the preparation of a final report the outputs defining information needs, channels of communication and messages will be reviewed by potential end-users.

In addition to a detailed research report a short user's guide to stakeholder message mapping for major emergencies will be published during 2016.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n°607798.

Any communication or publication related to the action, made by the beneficiaries jointly or individually in any form and using any means reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

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Communications in Crisis Management - Experiment 35.2

"Are we up to date and on the same page?": Ensuring shared understanding of theory & practice in communications for civil society resilience.

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Michelle Comer (Q4PR & National University of Ireland, Maynooth)

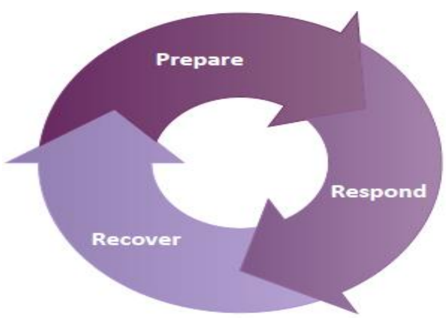
It is nearly four decades since the Three Mile Island nuclear accident gave rise to what is one of the greatest examples of how not to communicate in an emergency. When asked afterwards why he had ignored professional communications advice the most senior manager in charge of the emergency said "PR isn't a real field. It's not like engineering. Anyone can do it"

A lot has changed since then.

The importance of expert communication with the public during major emergencies is universally accepted. Broad and deep communities of academic study and practice have developed. Communication with the public is routinely identified as a priority in crisis planning.

Within this there has been an overlap if not a full convergence between the once distinct fields of risk communication and communication in crises situations.

As has been stated in the work of the *Crisis Communications Scorecard* project (2011), the most important summary of research is that effective communications in this field are "strategic and continuous". It runs through each phase of the crisis management cycle, which can be divided into what is required before, during and after an emergency.



Communications Cycle for Civil Society Resilience[1]

From Theory to Practice?

[1] We believe that the use of 'Crisis Communication' within civil protection in Europe leads to a distorting focus on the Response phase of crisis management. Given how central the periods before and after the response are to the effectiveness of communications there is a strong case for using a title which links to the wider resilience agenda.

What is less clear is how far there is a shared understanding within and between organisations of principles to be followed and practices to be adopted. In fact, the difficulty in finding the personnel and financial resources to turn theory into practice is a constant refrain. So too is acknowledgement of the need to expand the understanding of communication strategies far beyond communications professionals.

In the context of cross-border emergencies there is a clear need to work to a common set of core principles and practices in communications. In fact the international dimensions of information sharing and dissemination during major emergencies are increasing rapidly – and if this is to be done effectively organisations cannot wait until an incident is underway to discuss how they will deal with communications.

Put another way; 'if we're going to work together we need to be up to date and on the same page'.

Review and Development of Training

The DRIVER (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience) research consortium has incorporated communications within its ambitious agenda of enabling greater innovation and cooperation in civil protection within Europe.

The starting point of this work has been a review of current practices and of academic research followed by the presentation of this in a report which is intended to be accessible and useful to end-users.

Arising out of this is advanced work on developing a short training course which would meet identified gaps:

1. Reflect core agreed standards which can be implemented at each stage of the crisis management cycle.
2. Provide the basis for practice beyond professional communications staff.
3. Avoid contributing to 'training overload' by requiring limited time commitment.
4. Be easily adaptable to the concerns of different groups (i.e. types of emergencies covered).
5. Act as a stimulus to further in-depth training where of benefit.

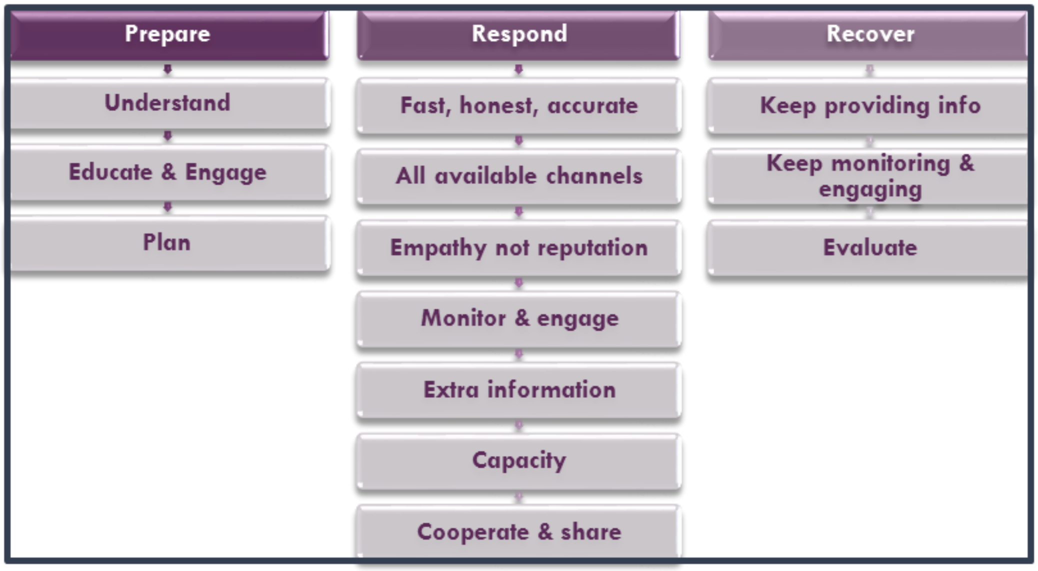
In consultation with a national-level crisis planning and coordination department a half-day training course in underpinning concepts and actioning principles was developed in 2015. Insights derived from the Stakeholder Message Mapping process were used to provide practical examples backing up the concepts and actioning principles.

The format for the training involved distinct 5 sections, within which concepts and practices were identified and then illustrated with examples of how each might impact on strategies and practices concerning different potential emergencies.

1 – Underpinning Concepts of Effective Communications
During this section the following concepts were introduced and discussed:

Each was illustrated with reference to relevant research findings and practical examples.

2, 3 & 4– Talking with the Public Before, During and After a Crisis
As mentioned above, the best practices which can be identified at each stage of the crisis management cycle were divided into Before, During and After – and defined in terms of the key actioning principles in each phase.



For each actioning principle, specific examples of practice were provided and occasional case studies were introduced.

5 – Message Framing and Dealing with the Media

In developing the training, a specific request of the crisis coordination department was that the framing of short messages and the principles of media engagement be addressed.

Participants

A total of 26 senior personnel from a range of government departments and agencies participated in two training sessions. These included senior decision makers in all of the country's principal response agencies.

The average level of experience within their organisations was 19.5 years, with an average of 6.8 years serving in their current role. As such, participants were both senior and experienced. The groups were mixed in terms of levels of responsibility for and experience of direct communication with the public.

The sessions were held while a national flooding alert was underway.

Conduct of Training Groups

The training involved a mixture of presentation of material, discussion and group work. The group work was used to develop lists of points based on their own experiences and to work on framing alerting messages linked to a specific scenario. These messages had previously been developed using an adapted message mapping procedure.

Evaluation

At the conclusion of each session anonymous feedback forms were completed which allowed participants to rate it using 10 criteria and allowed for qualitative comments. 77% rated the sessions as 'very good', 23% rated them as 'good' and none gave a poorer rating. 100% stated that they would "recommend the course to others working the [your] field".

As the groups were mixed in terms of experience and role it was expected that there would be a significant difference between them. However this was not the case, with even highly experienced communicators rating the usefulness of the course highly.

A specific example of the course subsequently influencing national strategic policy has been shown.

Building on the feedback, the following changes are being introduced to the version of the training to be finalised in mid-2016:

- Additional time for role-play and message framing.
- A list of potential case studies to be circulated in advance to participants with their preferences reflected in the content.
- Increased use of video examples.

Summary & Next Steps

To date, research indicates that a short-training can help address the need to get a diverse civil protection community to accept core principles and practices in communication for civil society resilience. This can be done without requiring significant resources.

In the next year the training will be developed further to assist in the preparation for a major experiment using an international disaster scenario. In addition it will feed into work concerning a potential European standard in this area.

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Any communication or publication related to the action, made by the beneficiaries jointly or individually in any form and using any means reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

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Optimal Geospatial Allocation of Volunteers for Crisis Management - Experiment 36.2

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Abstract

Volunteer supporters play an important role in modern crisis and disaster management. In the times of mobile Internet devices, help from thousands of volunteers can be requested within a short time span, thus relieving professional helpers from minor chores or geographically spread-out tasks. However, the simultaneous availability of many volunteers also poses new problems in terms of coordinating and managing their activity, which may indeed become more of a burden than a relief to the professionals.

In this work, we study the task of optimally assigning volunteers to selected locations, e.g., in order to perform regular measurements, to report on damage, or to distribute information or resources to the population in a crisis situation. We formulate the assignment tasks as an optimization problem and propose an effective and efficient solution procedure. Experiments on real data of the *Team Österreich*, consisting of over 36,000 Austrian volunteers, show the effectiveness and efficiency of our approach.

1 Introduction

Volunteer based support in crisis and disaster management (CDM) has always been an important factor in dealing with local crisis situations. With the recent revolution in modern communication technologies, support from spontaneous volunteers has reached a level of extent that cannot be ignored by first responders [1], [2], [3]. Examples such as the 2010 earthquake in Haiti, the 2011 nuclear catastrophe in Japan or the recent floods in Central Europe have shown the potential of involving volunteers in crisis support [4], [5], [6], [7], [8], [9], but also revealed shortcomings of their involvement. While offering valuable support for crisis mapping and performing simple tasks, the presence of non-trained volunteers may hinder professionals from doing their work. In order to deploy the offered support where it is useful and needed most, crisis managers require suitable tools for coordinating large numbers of volunteers efficiently.

Current approaches to coordinating efforts focus mainly on involving volunteers in crisis mapping tasks [10]. This is either done in a passive form by gathering information with the help of social media platforms such as Twitter, Facebook or Flickr. The work of crisis managers is then limited to performing text mining on the respective sites [11]. Alternatively, dedicated crowdsourcing platforms for crisis management such as Ushahidi, GeoChat or CrisisMappers allow the collection of crisis relevant information posted by volunteers in the affected region.

One attempt at channeling spontaneously offered workforce is undertaken by the Austrian Red Cross, who maintain a database of more than 36,000 registered volunteers. They can be activated by first responders for performing simple tasks. However, there are currently no proper tools at hand to automatize and monitor this process.

In this paper we suggest a method for optimal geospatial allocation of volunteers in a defined area. It is straightforward to implement based on existing optimization toolboxes and therefore can be integrated easily into software platforms for crisis and disaster management. We focus on two scenarios: 1. the assignment of at least one volunteer within a distance *r* per landmark; 2. the allocation of a number of volunteers proportional to the number of inhabitants of a landmark. To show the practical usefulness of our method we demonstrate the distribution of volunteers according to the locations of residence of the *Team Österreich* members and consider as landmarks the locations of the 2,357 municipalities in Austria.

2 Volunteer Allocation

To allow crisis managers to distribute tasks to a large number of volunteers efficiently, flexible management tools are needed that provide automated task allocation according to the volunteer's skill profile, current geolocation and availability. In contrast to the allocation of sensors or equipment, volunteers are constrained to locations in the proximity of their current location and their timeframe of availability. For this research, we focus on the geospatial aspects for distributing volunteers optimally, i.e. their current location and their distance to the location of interest.

Team Österreich was founded by the Austrian Red Cross and Hitradio Ö3 in August 2007 to pre-organize volunteer support in case of natural disasters. For example, during the severe floods in Central Europe in 2013 Team Österreich provided substantial support by installing emergency quarters and cleaning up water damage. The volunteers are spread according to their location of residence all over Austria with focal points in larger cities. The aim of this research is to develop a method for activating the optimal subset of volunteers for performing specific tasks considering a realistic distribution of volunteers.

The scenario used for this research is a crisis event that affects certain parts or all of Austria and requires the activation of volunteers, to check important landmarks for potential damage or to distribute food or water in their local neighborhood.

We define two formal scenarios in this context: in the *first scenario* the number of volunteers needed by crisis managers is at least one per landmark. As a case study, we construct a task, where each of the 2357 municipalities of Austria should have at least one member of the Team Österreich pre-assigned, who lives within a specified radius from a crisis event. The same volunteer can be responsible for more than one municipality, if the geographic situation allows for this. The goal is to achieve this task with as few volunteers as possible, thereby leaving the remaining as large as possible set of volunteers available for other tasks. Since it cannot be guaranteed that volunteers are always immediately available when needed, e.g. because of travel or sickness, we also study the situation of k-fold redundancy, in which each landmark is assigned a larger fixed number of volunteers. For example, if the probability for each volunteer to be available is 90%, and assuming statistical independence between different volunteers, already k = 3 reduces the risk of having no volunteers for a location from 10% to 0.1%.

In a *second scenario*, the number of required volunteers per landmark depends on its characteristics, e.g. its size. Such an assignment reflects, for example, the situation when resources have to be distributed to the local population, or in flood prevention, when different numbers of sand bags are required at different locations based on the local topography. In this scenario, we are aiming to assign volunteers in proportion to the number of inhabitants of each municipality. For example, at a ratio of 1:1000, a city with 100,000 inhabitants would be assigned at least 100 volunteers living nearby, while a village with 2,000 inhabitants would be assigned only two volunteers.

3 Data Source and Preparation

For our study we use realistic data sources. The volunteer locations of the Team Österreich were provided in anonymized form by the Austrian Red Cross. The names and populations sizes of all Austrian municipalities are available as open data from *Statistik Austria*.

A. Geocoding

The first step to make the available data usable for automatic assignment is *geocoding*, i.e. converting the textual addresses into latitude/longitude coordinates, both for the volunteers, as well as for the landmark locations (district centers).

For the landmarks, we relied on the Google geocoding service. It is known to be very reliable, but allows only up to 2500 queries per day. Therefore, using it for geocoding of large datasets, such as the complete volunteer set, is not practical. Instead, we followed a two-stage strategy: we first performed geocoding using the Yandex interface, which has lower quality but allows for bulk queries. Afterwards, we find geocoding mistakes in the results by identifying returned coordinates that lie outside of Austria. For these (approximately 1%), as well as for addresses that Yandex was not able to resolve (approximate 3%), we perform a second attempt of geocoding, now using the Google service. Subsequently, only 23 volunteer addresses remained unresolved. We inspected these manually and found them to be incomplete or dummy entries, which we removed from the dataset.

Overall, we obtained the geospatial coordinates of 2,357 landmarks and 36,023 volunteers as lat/long coordinate tuples. Their illustration in Figure 1 shows well the problems of volunteer assignment in a mountainous country, such as Austria. The population and the locations of interests are distributed spatially inhomogenously, such that simple heuristics, e.g. assignment on a regular grid, are bound to be suboptimal.

B. Distance computation

In the next step, we compute a matrix of pairwise distances between all volunteers and all landmarks. While the algorithm we propose works for any distance metric, for the purpose of demonstration we use a simple option: the shortest distance over the earth's surface, i.e. the air-line distance. To be precise, we calculate the geodesic distance between a pair of lat/long coordinate tuples on the earth's surface with Vincenty's method [12] based on an ellipsoidal earth model. In principle, nothing speaks against a more advanced form of distance computation, for example driving time, but this would require full topographic knowledge of the region, i.e. the presence of streets, hills, buildings or watermarks, which is beyond the scope of this work.

The resulting distance matrix has 2,357×36,023 entries, ranging between 0 and 574 km. Most volunteers live only 0−3 km from their nearest landmark, with the median distance being less than 1 km. This shows that the Team Österreich has excellent coverage of the country.

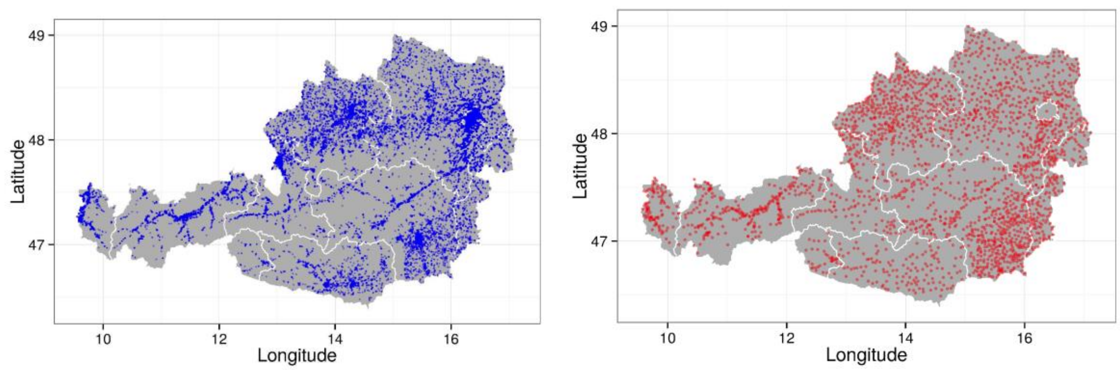


Fig. 1: Left: Spatial locations of 36,023 *Team Österreich* volunteers in Austria. Right: Locations of 2,357 municipalities.

One can see that Austria's population is distributed non-homogeneously, with large parts of the population clustering around the larger cities, in particular around Vienna in the east. Large regions in the centre and southwest, however, are mountainous and sparsely populated.

4 Methods

In this section we formalize the problem of selecting an optimal set of volunteers using techniques resembling *vector quantization with distortion bounds* [13] and propose an effective two-stage solution algorithm.

Let n be the number of available volunteers characterized by positions $p_1,\ldots,p_n$, and let m be the number of landmark locations with distinct positions $q_1,\ldots,q_m$. Let D be an $(m\times n)$-matrix that contains the distances between all volunteers and landmarks, i.e. $d_{ij} = \mathrm{dist}(p_i; q_j)$ for $i=1,\ldots,m$ and $j=1,\ldots,n$, where *dist* is the desired distance measure.

In Scenario 1, the goal is to identify the smallest subset, S, of volunteers such that for each landmark, i, at least one volunteer, j, is selected at a distance not larger than a fixed distance r, i.e. $d_{ij} \leq r$. Introducing k-fold redundancy, the goal is the same, but at least k such volunteers should be selected. In Scenario 2, the number of volunteers within a distance of r differs between locations. We denote the number of required volunteers for landmark i by w_i. Clearly, Scenario 1 can be expressed as a special case of Scenario 2 by setting $w_i = 1$ for the original situation, and $w_i = k$ for the situation with *k*-fold redundancy. Therefore, we phrase our method in the rest of this section only in the notation of Scenario 2.

To formalize the task of selecting a subset of volunteers, we introduce a vector of indicator variables, $z = (z_1,\dots,z_n)$. Each entry z_j can take values 1 or 0, where 1 indicates that the volunteer is selected and 0 means that he or she is not. This fixed-length representation has the advantage that it can be handled more easily by a computer than a variable size subset. Furthermore, we can recover the subset of selected volunteers as $S = \{j : z_j = 1\}$, and the size of *S*, i.e. the total number of selected volunteers, can be computed simply as $\sum_{i=1}^{n} z_i$.

The above coverage conditions that the volunteers' selection must fulfill put constraints on the allowed values for *z* in the form of *linear inequalities*. Let *A* be an ($m \times n$)-matrix with entries, where indicates that the distance between volunteer *i* and landmark *j* is less than a fixed distance of *r*, and indicates the opposite, for all $i = 1,\dots,m$ and $j = 1,\dots,n$. In this representations, the product is 1, if the volunteer *j* is selected and if he or she is sufficiently close to the landmark *i*. Summing these expressions over $j = 1,\dots,n$, we obtain the total number of sufficiently close volunteers that are selected for a landmark. This value has to be larger or equal to the landmark weight for a valid selection.

Combining the objective of finding the smallest volunteer set with the necessary coverage constraints, we obtain an *integer linear program (ILP)* [14]:

$$\min_{z_1,\dots,z_n} \sum_{i=1}^{n} z_j \qquad (1)$$

subject to

$$z_j \in \{0,1\}, \quad \text{for } j = 1,\dots,n, \qquad (2)$$

$$\sum_{j=1}^{n} a_{ij} z_j \geq w_i, \quad \text{for } i = 1,\dots,m\,. \qquad (3)$$

To find the optimal subset of volunteers, we solve the optimization problem numerically.

4.1 Numeric Optimization

Solving integer linear programs, such as (1)–(3), is in general *NP-hard* [15]. While several highly optimized software packages exist for this purpose, e.g. CPLEX, Gurobi or COIN-OR, they are typically only practical for problem instances with up to a few thousand variables and constraints. Therefore, we follow a two-stage solution strategy: first, we apply a relaxation technique to reduce the number of variables, then we solve just the reduced-size optimization problem. The relaxation strategy is based on the insight that the hardness of the original ILP comes mainly from the presence of the integrality constraint (2). We form a new optimization problem of the same structure as the ILP (1)–(3), but use a vector of unknowns, $y = (y_1,\ldots,y_n)$, that can take fractional values, instead of $z_j \in \{0,1\}$. The result is an ordinary *linear program (LP)* [16], which can be solved efficiently even for hundreds of thousands of variables and constraints:

$$\min_{y_1,\ldots,y_n} \sum_{j=1}^{n} y_j \qquad (4)$$

subject to

$$y_j \in [0,1], \quad \text{for } j = 1,\ldots,n, \qquad (5)$$

$$\sum_{j=1}^{n} a_{ij} y_j \geq w_i, \quad \text{for } i = 1,\ldots,m\,. \qquad (6)$$

From the solution to the LP, $y^* = (y_1^*, \ldots, y_n^*)$, we can recover a set of volunteers by selecting all volunteers with non-zero selection value, $S_{LP} = \{j : y_j^* > 0\}$. Because of the monotonicity of the constraints, it is easy to check that the set S_{LP} has the desired coverage properties. However, it is in general not of minimal size.

We therefore refine the solution by a second optimization step, where we solve the original integer optimization problem (1)–(3), but fix the values $z_j = 0$ for all j $\notin S_{LP}$, i.e. we only search over those volunteers that were selected as candidates in the previous step. The resulting solution, z^*, defines a set, $S_{ILP} = \{j : z_j^* > 0\}$, that we take as solution to the volunteer assignment task.

In our experience, the two-stage procedure described above is much more efficient than attempts to solve the ILP directly. At the same time, the solution is typically significantly smaller than the solution obtained from just solving the LP (see Section V for experimental results).

5 Experiments

To highlight the practical usefulness of our method for allocating volunteers to locations, we perform experiments on real data using the CPLEX optimization toolbox on a workstation with 20 CPU cores and hyperthreading enabled. All experiments use the Team Österreich as volunteers and the Austrian municipalities as landmarks, as described in Section II.

A. Scenario 1

For Scenario 1, we set up the method such that for each landmark at least one volunteer is assigned. If no volunteer is available within the desired radius, the volunteer living closest by was assigned. Figure 2 visualizes the results for *r*=10 km and *r*=20 km. One can see that the assigned volunteers are spread homogeneously across the map, thereby achieving full coverage with a minimal number of volunteers.

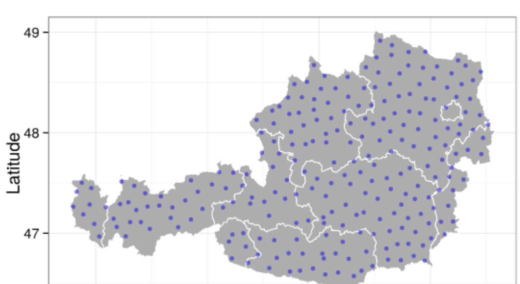
Table 1 summarizes the results in numeric form. As expected, increasing the permitted distance from the landmark, *r*, decreases the number of required volunteers. For a radius *r*=1 km, 2128 volunteers have to be assigned, i.e. almost one volunteer per landmark. For 502 of the landmarks, no volunteer is available within the 1 km radius, so the assignment is made on a nearest neighbor basis instead. For *r*=10 km, 243 volunteers suffice to cover all landmarks, i.e. less than 0.7% of the overall volunteer pool, and for *r*=50 km a total of 16 volunteers are sufficient to cover all landmarks.

Table I also allows us to compare the two-stage method we propose to the simpler linear program relaxation approach. While for *r*=1 km both methods find the same solution, for *r*=10 km, the LP approach selects 1021 volunteers, more than four times the necessary amount, and for *r*=50 km, the LP solution contains 173 volunteers, which is reduced in the second optimization stage to 16, a reduction by more than 90%.

A disadvantage of the two-stage procedure is its less predictable runtime. While solving the LP in the first stage never takes longer than a few seconds, the second stage, the ILP, might take anything between fractions of a second to several minutes. We believe that this is a small drawback, however, as the volunteer assignment is done infrequently and typically without time pressure.

B. Scenario 1 with Additional Redundancy

The above results show that already a small fraction of the Team Österreich volunteers are sufficient to achieve fine-grained coverage of relevant locations. Due to this observation, we performed further experiments studying the option of introducing redundancy by having more than one volunteer assigned to each landmark. Table II shows the results for *k*=2, *k*=5 and *k*=10 volunteers per landmark. Because of its clearly better results, we only report the values for the two-stage assignment procedure. For easier comparison, we also include the values without redundancy from Table I as *k* = 1. One can see that, except for very small radii, the number of required volunteers grows approximately linear with the redundancy factor *k*. We interpret this as an indication that the assignments found by the two-stage method are close to optimal, in the sense that they do not contain a lot of inherent redundancy anymore.



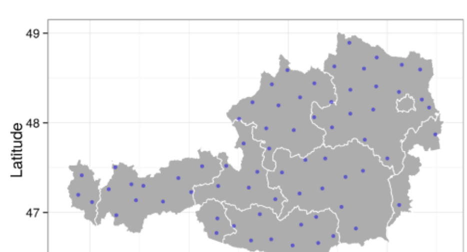


Figure 2: Visualization of Scenario 1: locations of selected volunteers such that each landmark has at least one selected volunteer within a radius of *r*=10 km (left, 243 volunteers selected) or *r*=20 km (right, 69 volunteers selected).

Table 1: Numeric results for Scenario 1. 1st column: coverage radius. 2nd column: number of selected volunteers and runtime for LP method, 3rd column: number of selected volunteers and runtime for two stage (LP+ILP) method, 4th column: number of landmarks for which nearest-neighbor assignments were made because no volunteer lived in the desired radius.

r [*km*]		(runtime [*s*])		(runtime [*s*])	
1	2128	(0.01)	2128	(0.01)	502
2	1770	(0.01)	1770	(0.01)	210
3	1340	(0.02)	1314	(0.03)	99
4	1043	(0.02)	948	(0.11)	55
5	983	(0.02)	699	(0.19)	37
6	812	(0.03)	551	(0.56)	20
7	1050	(0.03)	440	(11.48)	11
8	1007	(0.04)	352	(14.00)	4
9	974	(0.05)	292	(15.84)	1
10	1021	(0.08)	243	(92.59)	0
12	983	(0.08)	182	(541.82)	0
14	885	(0.11)	138	(46.16)	0
16	817	(0.14)	112	(50.02)	0
18	760	(0.18)	89	(13.01)	0
20	707	(0.23)	69	(48.27)	0
25	585	(0.37)	52	(39.84)	0
30	483	(0.62)	37	(4.70)	0
35	283	(0.75)	29	(2.13)	0
40	249	(1.03)	23	(1.32)	0
45	190	(1.05)	19	(1.98)	0
50	173	(1.62)	16	(3.91)	0
60	112	(1.79)	12	(2.01)	0
70	132	(2.42)	9	(2.49)	0
80	12	(2.88)	7	(2.91)	0
90	17	(3.03)	6	(3.05)	0
100	10	(3.86)	5	(3.90)	0

Table 2: Numeric results for Scenario 1 with different levels of redundancy. 1st column: coverage radius, 2nd to 5th column: number of selected volunteers if each landmark is covered by k=1,2,5,10 volunteers.

r (in *km*)	*k*=1	*k*=2	*k*=5	*k*=10
1	2128	4107	8960	14023
2	1770	3474	7793	12663
3	1314	2615	6201	10717
4	948	1916	4746	8748
5	699	1403	3572	6862
6	551	1098	2776	5400
7	440	870	2206	4363
8	352	695	1771	3449
9	292	581	1438	2959
10	243	489	1231	2504
12	182	360	901	1849
14	138	276	684	1386
16	112	221	548	1112
18	89	182	449	903
20	69	154	378	755
25	52	87	247	494
30	37	74	169	337
35	29	56	127	265
40	23	45	111	220
45	19	37	91	181
50	16	31	75	151
60	12	24	58	116
70	9	18	45	90
80	7	14	35	70
90	6	12	30	60
100	5	10	25	51

C. Scenario 2

In Scenario 2, we study the situation in which each landmark requires the assignment of volunteers in proportion to the number of municipality inhabitants. If sufficient volunteers were not found, the closest neighbours were assigned. Figure 4 visualizes the results for *r*=10 km and *r*=20 km with an assignment ratio of one volunteer per 5000 inhabitants. In contrast to Scenario 1 (Figure 2), one can clearly see the accumulation of selected volunteers in major cities, while outside the highly populated areas the volunteer distribution is more homogeneous. For example, for *r*=20 km, an even higher percentage of volunteers is clustered in cities than for *r*=10 km.

Table III summarizes the results in numeric form. In addition to varying the minimal distance *r* between volunteers and landmarks, we also vary the proportionality factor assigned to each landmark between 1:1000 and 1:10000. As expected, larger proportionality factors for the landmarks result in fewer assigned volunteers. Nevertheless, the number of necessary volunteers is clearly much larger in this scenario, even when considering the same radius *r*, and the number of volunteers decreases less rapidly for larger distances *r* than in Scenario 1. This effect is mainly due to the fact that large cities require a minimum number of volunteers regardless of the radius. For example, for a ratio of 1:1000, at least 1,740 volunteers are always required for the city of Vienna alone with its almost 1.74 million inhabitants.

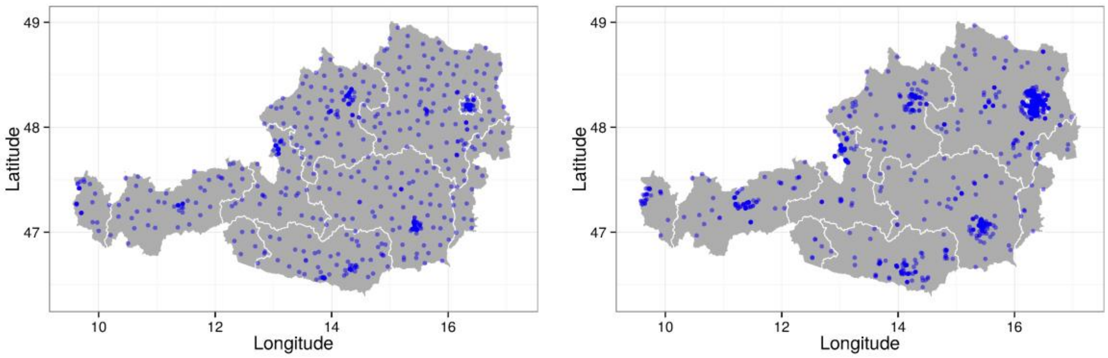


Figure 4: Visualization of Scenario 2: locations of volunteers assigned to landmarks in proportion of at least 1:5000 with respect to their population. Left: coverage radius *r*=10 km (913 volunteers selected). Right: coverage radius *r*=20 km (646 volunteers selected).

Table 3: Numeric results for Scenario 2 with different assignment ratios. 1st column: coverage radius, 2nd to 5th column: number of selected volunteers when each landmark is covered at least at a ratio 1:1000–1:10000 with respect to its number of inhabitants.

r (in *km*)	1:1000	1:2000	1:5000	1:10000
1	9176	5132	3008	2484
2	8376	4612	2629	2142
3	7170	3873	2155	1724
4	6245	3320	1759	1368
5	5487	2884	1498	1129
6	4966	2602	1316	964
7	4567	2393	1168	824
8	4280	2214	1056	731
9	4068	2094	974	655
10	3898	1996	913	593
12	3628	1850	823	510
14	3394	1720	747	442
16	3268	1661	700	411
18	3146	1590	675	385
20	3084	1547	646	360
25	2892	1454	603	322
30	2758	1380	568	301
35	2670	1339	547	281
40	2645	1326	540	276
45	2635	1319	533	270
50	2629	1316	531	267
60	2431	1217	489	246
70	2399	1193	472	236
80	2104	1029	408	204
90	2011	997	396	199
100	1965	983	395	198

6 Conclusions

In this work, we described a practical solution to the task of assigning volunteer helpers to potential tasks. It can reduce the reaction time in a crisis situation and prevent problematic situations in which the effectiveness of professional crisis teams is disturbed by too many well-meaning but uncoordinated volunteers. Based on the volunteer database of the Austrian Team Österreich, we studied two scenarios. The first is purely distance-based: the goal is to find a minimal subset of volunteers such that each set of relevant landmarks has at least one volunteer within a given radius, e.g. to take regular measurements or report on damage after a natural disaster. The second scenario is distance- and population-based: the number of assigned volunteers here depends also on properties of the specific landmark, for example the number of volunteers required to distribute goods in a city depends on its population size. We introduced a fully automatic method to efficiently identify the minimal subset of volunteers that fulfill these requirements based on the geographic location of the volunteers and landmarks. For this, we formulated the task as an optimization problem and proposed an effective two-stage solution procedure.

In future work, we plan to incorporate additional constraints into the assignment process, e.g. volunteer skills, and explore the possibilities of task-dependent distance measures, e.g. driving times under different road conditions and with different means of transport.

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Interaction with Citizens in Crisis Situations - Experiment 42

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ABSTRACT

In the age of ubiquitous computing, self-organised citizens and informal (unaffiliated) volunteers are becoming a key component of the crisis management organisation. Context aware one-to-many and many-to-one communication is the key to efficient use of such volunteers in crisis situations.
In the so-called "Interaction with Citizens" experiments a team of European scientists, developers and practitioners is currently testing the usability and acceptance of different tools and methods for context-aware informing and alerting of citizens; for micro-tasking of informal volunteers; for gathering of situational information about the crisis incident from such volunteers; and for making this information usable in the context of crisis management.

At the time of writing this paper, our experiments are still underway. Therefore, our contribution concentrates on describing the experimental setup and expectations, in the hope of fostering a wider discussion within a crisis management community and eventually reaching a consensus on suitability of the various communication methods in different crisis types and different locations.

INTRODUCTION

The rise of social networking has allowed ad-hoc groups of citizens to organise large-scale activities in a flexible manner. From a crisis manager's point of view, the appearance of such loosely coordinated groups of unaffiliated volunteers is both a blessing and a curse. This has been described e.g. by Hofmann *et al.* in the context of floods that happened in Germany in 2013 (Hofmann, Betke, & Sackmann, 2014). Unaffiliated volunteers may render the society more resilient (Kaufmann, 2013), but they do not fit into the hierarchical procedures existing in crisis management and can be difficult to control.

Equipped with smartphones and social networking software, ad-hoc groups can be very efficient at recruiting a large number of helpers in times of emergency. However, they lack a command structure, mechanisms to distinguish information from misinformation, as well as procedures to prioritise and split tasks among themselves. The merit of unaffiliated volunteers has been demonstrated on various occasions (Reuter, Heger, & Pipek, 2012). Nevertheless, the absence of efficient coordination can render such groups inefficient and, in the worst-case scenario, even destructive (Rheingold, 2009). The question is: how can we harness the power of unaffiliated volunteers, while keeping the associated risks under control?

The crucial issue to address here is, in our opinion, the one of personalised one-to-many and many-to-one communication. In crisis situations, the first responders' organisations can allocate only a small number of people as "coaches" or "managers" of the unaffiliated volunteers. Their ability to communicate with the public using the general-purpose social networks is very limited. Advantages and shortcomings of different approaches for volunteer management and sourcing of information from the volunteers, ranging from passive social media data mining, overuse of dedicated crowdsourcing tools to crowdtasking of the volunteers are discussed in (Schimak, Havlik, & Pielorz, 2015).

The need for improved crisis communication is addressed by the European project DRIVER (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience); http://www.driver-project.eu). The project team evaluates emerging crisis management solutions in three key areas: *civil society resilience*, *responder coordination* as well as *training and learning*. These solutions are evaluated in a series of experiments targeting various gaps in the European crisis management that were previously discovered by the ACRIMAS (*Aftermath Crisis Management System-of-systems Demonstration Phase 1; http://www.acrimas.eu*) project team (Vollmer, Hamrin, Pastuszka, Missoweit, & Stolk, 2012).

The "Interaction with citizens" DRIVER experiments concentrate on the methods and tools for crisis communication with citizens and unaffiliated volunteers. They address the following gaps: (1) informing and involving the society via improved crisis communication; (2) coordination and tasking of unaffiliated volunteers; (3) dissemination of disaster alerts and other relevant information to citizens; and (4) collection of information relevant in crisis situations, such as the needs of, and observations from, citizens.

In this paper, we concentrate on presenting the setup and expectations from the experiments as well as lessons learned regarding methodology. An initial report on the outcomes and lessons learned from these experiments will be presented at ISCRAM 2016 (Havlik, Pielorz, & Widera, 2016). At the same conference, we will also organise a workshop on "best practices, chances and limitations of (use of) informal volunteers in crisis management". We would like to take this chance to invite all interested parties to join us in that workshop and contribute to a joint position paper.

Experiment setup

In early 2015, a selected number of crisis management tools were presented and evaluated within the DRIVER community, by both tool providers and practitioners. Based on a structured evaluation regarding the availability, relevance and maturity of specific crisis management functions, like the gathering of situational awareness, appropriate tools were identified for the current experiments. These tools include:

- **DEWS** (Esbri, Esteban, Hammitzsch, Lendholt, & Mutafungwa, 2010). The DEWS system was initially developed as a Distant Early Warning System for tsunamis and provides mechanisms for extracting the information from multi-sensor systems. From this information specific alerts for various classes of users are generated based on the severity of the event, user profiles and geographical locations. In our experiments, only the alerting part of the DEWS system is used to distribute alerts based on user profiles and their positions.

- **Safe Trip** (http://www.hkv.nl/en/products/apps/231-apps.html) is a mobile application that aims to give travellers and tourists within Europe information on their actual safety within the immediate vicinity of their current location. In DRIVER, Safe Trip will be used to inform the "tourists" about the current and expected situation in their vicinity. In addition, Safe Trip will also provide an easy to use way for tourists to inform the embassies of their respective locations, needs and conditions.
- **GDACSmobile** (Hellingrath, et al., 2012; Link, Hellingrath, & De Groeve, 2013) is a tool that facilitates self-organisation of the volunteers and improves the situational awareness of citizens by sharing an easy-to-understand overview of the situation. At the same time, GDACSmobile also provides a feedback mechanism to the crisis manager/control centre. In this way, GDACSmobile also contributes to the improved situational awareness of the crisis managers.
- Finally, the **AIT CrowdTasker** backend and mobile application (http://crowdtasker.ait.ac.at) realises the crowdtasking concept that has been introduced in (Havlik, et al., 2013). CrowdTasker facilitates targeted one-to-many communication of the crisis management professionals with the "crowd" of pre-registered volunteers, micro-tasking of these unaffiliated volunteers and collection of structured responses. CrowdTasker can be used in several ways: as a micro-learning tool for the volunteers, as a micro-tasking tool for virtual and real-world tasks and as a tool for soliciting and collecting information from the citizens.

Each of the tools represents one of the increasingly more powerful methodologies for crisis communication with the population – from one-way emergency alerting to micro-tasking (Figure 1).

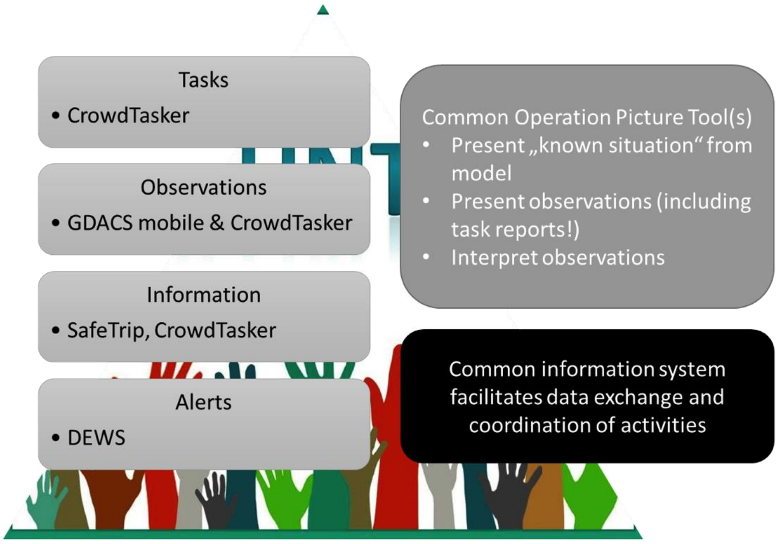

Figure 1: Overview of the tools and functions tested in "Interaction with" Citizens experiments, from (Havlik, Pielorz, & Widera, 2016)

In addition, the experiment also involves the use of two Common Operational Picture (COP) tools and the DRIVER Common Information Space (CIS) infrastructure. COP tools facilitate the interpretation of the information received from the volunteers, whereas CIS facilitates exchange of the information. The choice of tools reflects the specific functions that are addressed in experiments:

- Provision of context-aware[2] and timely information tailored to specific needs of different societal groups over various channels, in order to improve their understanding of the crisis situation and to minimise the adverse impacts;
- Context-aware (micro-)tasking of non-affiliated volunteers to perform real and virtual tasks;
- Efficient gathering of situational information about an incident from volunteers; and
- Efficient usage of the received information from volunteers to improve the situation awareness of crisis managers and consequently their handling of the crisis.

These tools and methodologies have been tested as stand-alone solutions in the past and will be further investigated as a combined solution, which addresses the different needs of citizens and crisis managers, in the upcoming experiment(s). The scenario setup, or the storyline of the experiment, is designed by practitioners acting as experiment platform providers and backed up with the impact models and various methods for conveying the “reality” to participating volunteeers.

Hence, instead of a tool-provider friendly experiment setup, the objective of creating a relevant or “appropriate” scenario (Whitworth, Smith, Hone, & McLeod, 2006) is ensured by defining all of the relevant components by the realities that practitioners face. Accordingly, the evaluation approach has to cover both mission-related indicators (e.g., the assessment results provided by unaffiliated volunteers) and tool-related variables (such as the utilisation of available reporting forms), as shown in the following matrix:

	Volunteers	**Professionals**
Methodology acceptance	Citizens’ perspective: usability of information, performing tasks, posting reports.	Professionals’ perspective: informing, alerting, tasking, situational awareness
Impact on crisis management	Informing, involvement and tasking of citizens	Situational awareness, information dissemination and crisis management
Tool Usability	Citizens’ perspective (mobile apps)	Professionals’ perspective (backend applications)
Tool reliability	Mobile apps	Backend applications

[2] Context is defined by a combination of the user’s profile, position, situation on the ground and needs of the crisis managers.

[1] Context is defined by a combination of the user's profile, position, situation on the ground and needs of the crisis managers.

In addition, dedicated "observers" provide feedback on the experiment setup as well as their own opinions on the observed methodology acceptance, potential impact, tool usability and reliability based on observations of the other participants.

The feedback is collected using a combination of online questionnaires, participant observation, group discussions and structured interviews with different participants. Additional information on the tool reliability is collected automatically where possible, but the information on tool usability and reliability is considered to be of secondary importance, compared to the methodology assessment.

Expectations

The overall goal of the DRIVER "interaction with citizens" experiments is to test the concepts and applications for context-aware informing and tasking of volunteers as well as to evaluate the benefits of these activities for both citizens and crisis managers.

The underlying hypothesis behind the experiment campaign is that modern ICT technology can be used to improve crisis communication between crisis managers and citizens by facilitating the personalised one-to-many and many-to-one communication. On the one hand, citizens can profit from information that is really relevant to them, here and now. On the other hand, crisis managers can use the citizens as human sensors to improve their situational awareness or use their workforce, while at the same time protecting the citizens from misinformation and minimising the risk of harmful self-organised actions.

Additional hypotheses are: (1) this can be achieved without overwhelming crisis managers; and (2) that the tested methodologies and tools (as depicted in
Figure 1) are representative and complementary rather than overlapping.

Three experiments are currently planned in 2016, with more complex "joint experiments" following up in 2017. The first two of these experiments are dedicated to testing of the CrowdTasker tool, whereas all tools (listed on page 54 and following) will be tested in the third experiment – first separately on a tool-by-tool and methodology-by-methodology basis and then as a combined solution. The gradual rise in complexity is also reflected in the expectations, numbers of participants and in the way the ground truth is generated and presented to the experiment participants.

- The first experiment was organised in January 2016, as a side-event at the IPRED IV conference in Tel Aviv, Israel. In this experiment the scenario and the ground truth were provided by the IPRED IV field exercise, the volunteers' actions were limited to reporting what they saw and their feedback wasn't used for decision making. The main expectations from this experiment were to receive feedback from Magen David Adom - a first responder organisation that wasn't involved in the tool development – as well as to discover the technical issues related to use of the app on different android phones.

- The second experiment was organised as a standalone event in Vienna, Austria. The event took place on 11th and 12th February 2016, and the ground truth was conveyed through a series of blog posts. Rather than following the strict storyline, this experiment was used to experiment with different types of tasks of interest to the Red Cross Austria, discuss the usability of such tasks and assess the willingness of volunteers to participate in the tasking activities. At the conclusion of the experiment, 200 volunteers all over Austria had executed a total of 768 micro-tasks.
- The third experiment will be held on April 19-20 in The Hague. This experiment will follow a storyline of a coastal flooding event and the ground truth will be conveyed through flood maps in the whole city area. Real world objects, actors and markers will be installed in the "core zone" (**Figure 2**). Thereby, we expect to prove that the tools and related methodologies introduced in the first section are indeed complementary and address different needs of the crisis managers and population alike. This experiment will be the culmination of our experiment series as far as setup complexity and evaluation methodology are concerned.

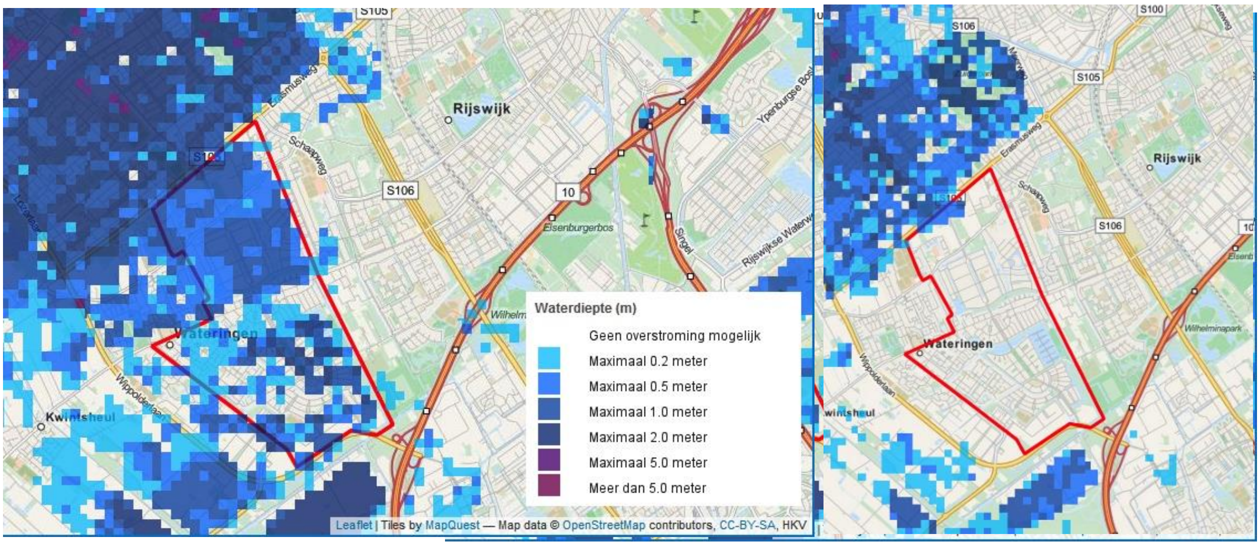

Figure 2: "Ground truth" information, as conveyed to the volunteers (left) and to the crisis management team (right) in The Hague experiment. Red polygon outlines the "core zone" of the experiment.

Lessons learned so far

As explained in the Expectations section, the first experiment was organised as a side-event at the IPRED IV conference in Tel Aviv (January 10-13, 2016) and hosted by Magen David Adom (MDA) in Israel. This initial experiment exposed a number of technological issues that would have effectively prevented the use of crowdtasking outside of a controlled laboratory environment. Recognising such technological pitfalls early was an important step in preparing for the next experiment in Vienna (February 2016, see below). Both the volunteers and the MDA experts in charge of the tasking were fully convinced that the possibility to choose a dedicated subgroup of volunteers easily from a larger pool, instruct them, assign tasks and receive feedback in a structured way was important and beneficial in a crisis. Likewise, the experiment participants had a positive impression of the tasking interface and of the automated "tutorial" functionality for new users of the app that was introduced shortly before the experiment. The experiment setup for first two experiments is illustrated in **Figure 3**.

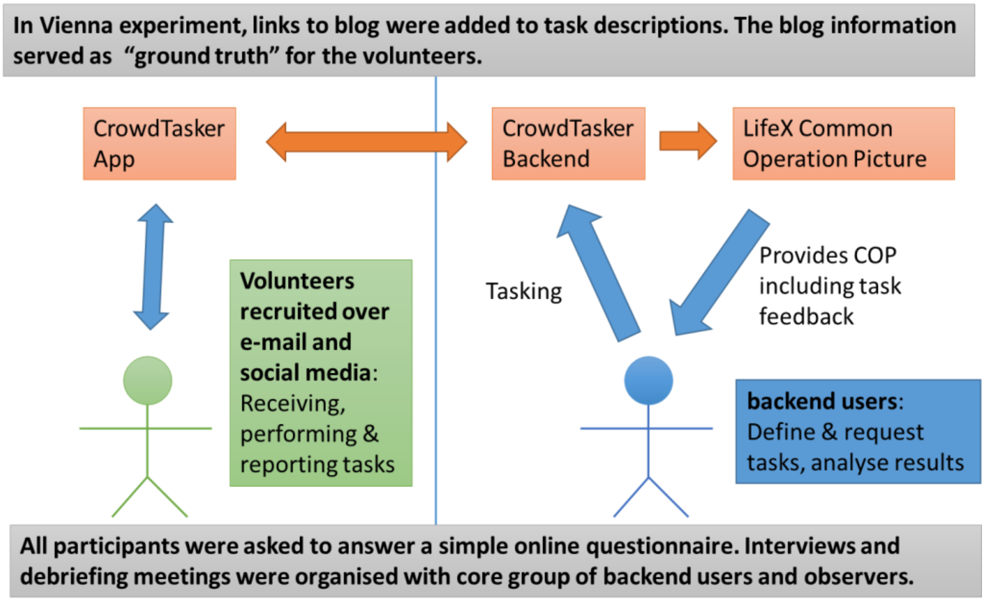

Figure 3: Experiment setup for first two experiments in Israel and Austria.

In Austria, the volunteers were sourced by the Austrian Red Cross from among their existing pool of volunteers. As a result, 200 volunteers from across Austria and parts of Germany joined the experiment. Most of the technological issues that were encountered at IPRED had already been resolved. We were able to assign tasks successfully to different groups of volunteers based on their positions and skills. As a result, we received hundreds of responses within minutes of posting the tasks. This success exposed some issues related to the workflow of defining the tasks and interpreting the results. Part of the issue is illustrated on **Figure 4**a. While a way to analyse the results of the single task rapidly has already been implemented (**Figure 4**b), the map view is not informative enough and the operators do not have time to analyse the results task-by-task during the crisis itself.

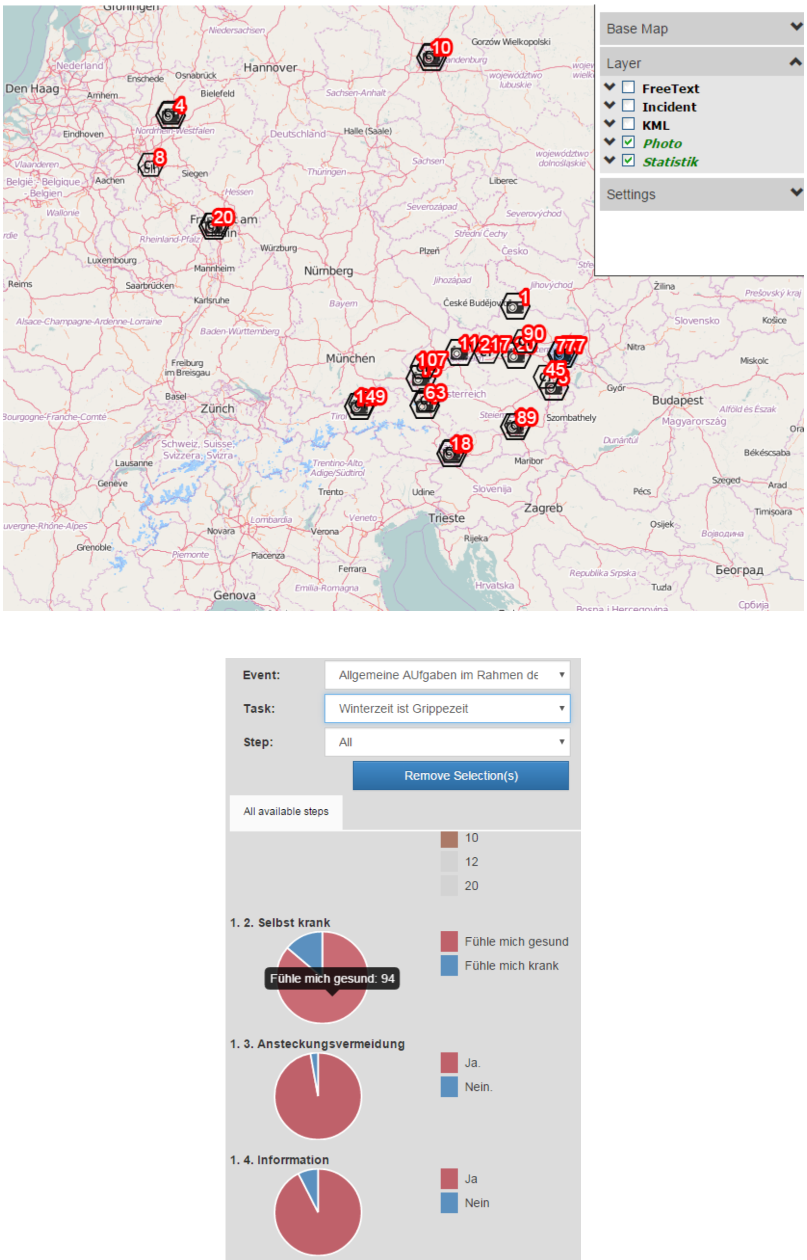

Figure 4: (a) map showing the information received from volunteers; (b) analysis of responses for a single task

Beyond DRIVER experiments

Results of the first DRIVER "Interaction with Citizens" experiments are encouraging in terms of the acceptance of the crowdtasking methodology and usability of the experiment assessment methodology. Nevertheless, the first two experiments have also clearly demonstrated technological and organisational shortcomings that need to be addressed. Most notably, they have demonstrated the need for a robust alerting mechanism, for communicating the key information between the crisis managers and the tool operators and for improved visualisation and presentation of the responses.

In the third experiment, we intend to address these shortcomings in a far more complex setup with a realistic storyline and several activities being conducted in parallel. This experiment will allow us to test the acceptance of four concepts for context aware informing and alerting of citizens: over standard communication channels such as e-mail or SMS (DEWS), using a special-purpose application for tourists that does not require high level of user involvement (Safe Trip), with the help of a shared awareness map (GDACSmobile) and using a platform that facilitates profile and position specific pushing of information and tasks as well as contextual micro learning materials (CrowdTasker). Likewise, it will allow us to test the usability and acceptance of both solicited and unsolicited informing of crisis managers by citizens (CrowdTasker/GDACSmobile) as well as to confront the crisis management professionals with the challenge to deploy unaffiliated volunteers optimally for various tasks.

To the best of our knowledge, no similar tests have been performed to-date and it is difficult to anticipate which of the functions offered by the various systems will be considered most usable by professional and volunteers or even how much the lessons learned will be biased by the choice of tools and by the choice of experiment location(s). With this in mind, we intend to address the wider community of practitioners and researchers through the following activities:

- Third experiment will be broadcast on the internet on April 20th 2016. Please join the DRIVER community mailing list for more information (http://driver-project.eu/content/welcome-driver-community-website).
- We will organise "Informal volunteers in crisis management: best practices, chances and limitations" workshop (https://goo.gl/wH3Dlm) at ISCRAM 2016. The objective of this workshop is to discuss alternative approaches to managing informal volunteers and grassroots movements and to draft a "best practices" white paper. Please join the related Google+ community (https://goo.gl/3ovlXq) for more information.

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Any communication or publication related to the action, made by the beneficiaries jointly or individually in any form and using any means reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

Moreover, the experiments introduced in this paper would not have been possible without active support of the three organisations hosting the experiments: The Magen David Adom in Israel (www.mdais.org/en/), the Austrian Red Cross (www.redcross.at) and the Security Region Haaglanden (www.vrh.nl/). Finally, we thank the DRIVER "Interaction with Citizens" experiment team that has been working together for several months in order to prepare, conduct and finally assess these three experiments.

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Collaborate, Share and Exchange: The DRIVER Community Platform

Early 2016, more than 250 experts from the fields of civil protection, security, technology, police, environment, health, defence and standardisation (to name a few) expressed their interest in the DRIVER project by subscribing to the DRIVER community database available via the public website.

As a simple database seemed to be rather limited in terms of exchange possibilities, collaborative thinking and knowledge sharing, the DRIVER partners are currently developing a sustainable tool, so-called the DRIVER Community Platform (DCP), to go a step further and provide all crisis management stakeholders with a dedicated forum to network and exchange. The DCP will take the form of a type of social network exclusively dedicated to crisis management, where all stakeholders can connect, discuss and collaborate to find new approaches and solutions to crisis management issues.

It is expected that ultimately the DCP will bring together thousands of contacts and their expertise, all in multiple interactions. The DRIVER Community will help the DRIVER project deliver an effective and sustainable impact that will far outlive the project itself.

The DCP is currently being tested by the DRIVER consortium partners before its official release, but if you are a crisis management practitioner, policy maker, technology supplier, or simply a citizen interested in crisis management, stay tuned to the DRIVER website: the access link to the DCP will soon be made available! Or register now with the DRIVER community database so that you will automatically become a member of the DRIVER Community Platform.

I4CM Workshops

DRIVER (*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience) is a unique multi-national project that is identifying ways of implementing a new approach to improving crisis management in Europe. Working across many sectors of Crisis Management (CM), the focus is on three key areas: *improving civil society resilience; strengthening first responders; training and learning solutions.*

An important aspect of the project is the sharing of information about the project itself amongst all stakeholders, including practitioners, crisis managers and policy makers. Whilst sharing details of the project's aims and objectives, as well as the rationale behind what the project partners are looking to achieve, it is also very important that we communicate the specific results and successes achieved throughout the project.

One way this is being achieved is via a series of I4CM (Innovation for Crisis Management) Workshops held regularly throughout the life of the project – DRIVER runs from May 2014 until October 2018. The main objective of the workshops is to target local practitioners that have an interest in CM research and that possess indispensable operational knowledge to guide crisis management innovation. The I4CM initiative is very much complementary to the European Commission DG HOME Community of Users (CoU), to which the I4CM and project results will be disseminated at EU level.

First I4CM Workshop in Marseille

The first workshop was held on the 26th and 27th May 2015 at the "Villa Méditerranée" in Marseille, France and gathered together more than 120 participants from over 15 countries. The event supported the comprehensive approach to crisis management (CM) adopted by the project, by involving people from all major CM functions in Europe and beyond. As there are a number of CM communities representing different professional actors (including fire fighters, paramedics, police, customs, foreign affairs, authorities, policy makers), the I4CM Workshop provided an opportunity to identify, for each community, the opinion leaders or key representatives and further involve them as contributors to DRIVER.

The conference was organised as a series of keynote speeches and panel discussions to stimulate debate amongst the participants. On the second afternoon, visits to two important French experimentation platforms located in the region were organised. Speakers at the Workshop included representatives from EU institutions (DG ECHO, FRONTEX, DG HOME), national authorities (from France, Israel, Slovakia and Sweden) as well as regional and provincial authorities. Several communities of practitioners (including first responders, firefighters, NGOs, police, justice), academics and technology suppliers were also represented.

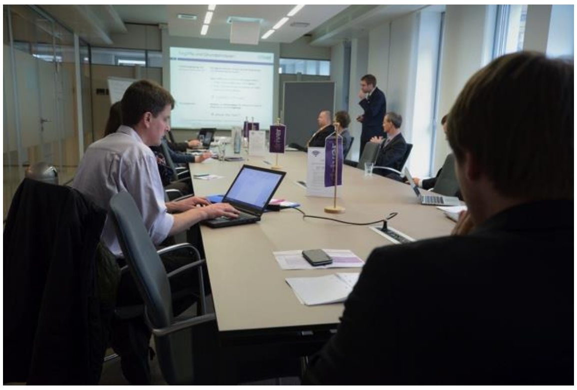
Second I4CM Workshop in Berlin

The second workshop took place on 8th and 9th December 2015 at the Fraunhofer-Forum in Berlin and was co-hosted by the German Federal Agency for Technical Relief (THW) and the Fraunhofer Institute for Technological Trend Analysis (INT).

The two-day workshop was organised in a series of parallel sessions, allowing participants the opportunity to attend the sessions and discuss the topics most interesting and relevant to them. The parallel sessions on the first day focused on the topic of innovative solutions for crisis management, whereas the second day put the spotlight on the potential for improvements in crisis management.

A workshop focussing on Civil Society Resilience led by Dr Wolf Engelbach of Fraunhofer IAO and Dr Christian Kloyber of the Austrian Red Cross stressed the importance for crisis managers of integrating individuals, communities and local governments in their management efforts, including efficient crisis communication via the media and the mobilisation and organisation of citizens as spontaneous volunteers.

The workshop on Command and Control for responders led by Laurent Dubost of Thales and Carsten Dalaff of DLR (Deutches Zentrum fuer Luft- und Raumfahrt eV) described how DRIVER is addressing the specific challenges and opportunities of effective command and control during a crisis by bringing practitioners, industry and researchers together to experiment with two emerging Common Operational Picture (COP) solutions that have been subsequently used in Experiment 41 – covered in a separate paper in this newsletter.



A further workshop on Competence Management and Continuing Training was led by Alexander Karapidis of Fraunhofer IAO and discussed how competence management could ensure CM organisations are fully prepared and able to respond effectively during a crisis. Examples of competence management best practice were presented to demonstrate its effectiveness. During the discussions, it was emphasised that any solutions should incorporate effective methods to measure and evaluate staff competences.

The event brought together local practitioners with indispensable operational knowledge that can guide the future of crisis management research and innovation. In total, over one hundred experts and practitioners from all over Europe attended the 2nd I4CM Workshop.

Alongside the formal discussions and presentations during the workshop, participants actively exchanged best practices and discussed lessons learned during several coffee breaks and a networking dinner.

Participants also had a chance to familiarise themselves with crisis management solutions currently being developed in the framework of several EU-funded research projects. The projects represented at the 2nd I4CM Workshop included EmerGent, EPISECC, RECONASS, SALUS, SecInCoRe, SecurePART, SLándáil, and TACTIC. These projects also presented their results at an accompanying exhibition.

Future I4CM Workshops

With two successful conferences and workshops already having taken place, there are three additional events that will be held during the remaining lifetime of the project – one in Sweden, a second one in Poland and the third in the Netherlands. Full details, including dates and how to register, will be posted on the main DRIVER website www.driver-project.eu as soon as they become available.

Next TIEMS Scientific Articles Newsletter

The next TIEMS Scientific Articles Newsletter is planned for June 2016.

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Issue no. 3 is planned for June 2016 and contributions are welcome. Please, contact one of the editors or TIEMS Secretariat if you have news, an article of interest or like to list coming events of interest for the global emergency and disaster community or like to advertise in this issue.