Driving Innovation in Crisis Management for European Resilience

D934.19 - STAKEHOLDER COMMUNICATION FOR CIVIL SOCIETY RESILIENCE

SP93 - SOLUTIONS

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The DRIVER+ project

Current and future challenges, due to increasingly severe consequences of natural disasters and terrorist threats, require the development and uptake of innovative solutions that are addressing the operational needs of practitioners dealing with Crisis Management. DRIVER+ (Driving Innovation in Crisis Management for European Resilience) is a FP7 Crisis Management demonstration project aiming at improving the way capability development and innovation management is tackled. DRIVER+ has three main objectives:

1. Develop a pan-European Test-bed for Crisis Management capability development:
    a. Develop a common guidance methodology and tool, supporting Trials and the gathering of lessons learnt.
    b. Develop an infrastructure to create relevant environments, for enabling the trialling of new solutions and to explore and share Crisis Management capabilities.
    c. Run Trials in order to assess the value of solutions addressing specific needs using guidance and infrastructure.
    d. Ensure the sustainability of the pan-European Test-bed.
2. Develop a well-balanced comprehensive Portfolio of Crisis Management Solutions:
    a. Facilitate the usage of the Portfolio of Solutions.
    b. Ensure the sustainability of the Portfolio of Solutions.
3. Facilitate a shared understanding of Crisis Management across Europe:
    a. Establish a common background.
    b. Cooperate with external partners in joint Trials.
    c. Disseminate project results.

In order to achieve these objectives, five Subprojects (SPs) have been established. **SP91** ***Project Management*** is devoted to consortium level project management, and it is also in charge of the alignment of DRIVER+ with external initiatives on crisis management for the benefit of DRIVER+ and its stakeholders. In DRIVER+, all activities related to Societal Impact Assessment are part of SP91 as well. **SP92** ***Test-bed*** will deliver a guidance methodology and guidance tool supporting the design, conduct and analysis of Trials and will develop a reference implementation of the Test-bed. It will also create the scenario simulation capability to support execution of the Trials. **SP93** ***Solutions*** will deliver the Portfolio of Solutions which is a database driven web site that documents all the available DRIVER+ solutions, as well as solutions from external organisations. Adapting solutions to fit the needs addressed in Trials will be done in SP93. **SP94** ***Trials*** will organize four series of Trials as well as the final demo. **SP95** ***Impact, Engagement and Sustainability***, is in charge of communication and dissemination, and also addresses issues related to improving sustainability, market aspects of solutions, and standardization.

The DRIVER+ Trials and the Final Demonstration will benefit from the DRIVER+ Test-bed, providing the technological infrastructure, the necessary supporting methodology and adequate support tools to prepare, conduct and evaluate the Trials. All results from the Trials will be stored and made available in the Portfolio of Solutions, being a central platform to present innovative solutions from consortium partners and third parties, and to share experiences and best practices with respect to their application. In order to enhance the current European cooperation framework within the Crisis Management domain and to facilitate a shared understanding of Crisis Management across Europe, DRIVER+ will carry out a wide range of activities. Most important will be to build and structure a dedicated Community of Practice in Crisis Management, thereby connecting and fostering the exchange of lessons learnt and best practices between Crisis Management practitioners as well as technological solution providers.

Executive summary

This report summarises the results of the work conducted within the former WP350 (Communication for civil society resilience) as described in the DOW: "This WP will study current communications approaches during the response and preparedness phases. It will draw on both experimentation with partners and a review of what is deemed to be best in class at present. This will be achieved through working closely with other SP partners and the wider DRIVER consortium. Moreover, it will elaborate and evaluate the mapping of stakeholder-targeted communication, communication structures, toolkits and principal procedures necessary to support civil society resilience at an effective and beneficial level."

There are many major challenges to effective communication during a sudden onset of a major emergency or disaster. One of the most important is the lack of time to develop and distribute messages which ought to reach all groups affected by the emergency, while being properly informed with the most important information. Another important challenge is to be precise regarding the way the messages are worded and how to maximise the impact so they can be delivered through the most effective channels. The purpose of this deliverable is to present different solutions and technologies in place across different countries. The report has focused on the implementation of solutions in France, the Netherlands, Israel, Chile, Czech Republic and Canada. An identification of solutions on the use of social media for communication with the population, has been described. The identification builds on earlier work carried in European Union funded projects such as E2MC, I-React, CRISCOMSCORE and COSMIC. Additionally, this deliverable highlights the traditional broadcast cell service and the more modern SMS method as a way of informing citizens in emergency situations. Attention was also dedicated to GALILEO, another EU funded project which hails great potential with the capacity for global geographic coverage and no need of internet connection from receivers.

The major goal is to compare all of the technologies and try to fill in existing gaps in order to achieve an effective two-way communication system. Amongst the six selected examples and despite some different choices of technologies, we can conclude that countries are trying to find the best means to develop two-way-systems and to combine different channels in order to reach the population and guarantee a maximum coverage. However, the main limitations in all presented technologies are related to the required download of a Smartphone application often neglected by plenty of citizens.

On the other hand, this deliverable seeks to test the viability of applying message mapping as a method of communication in sudden onset disasters with a particular focus on hard to reach groups. The general goal is to facilitate the communication flow between authorities and first responders, such as volunteers and spontaneous volunteers and to provide options to be tested during the DRIVER+ Trials. The solution of message mapping has to date largely been confined to public health emergencies and is widely used by the World Health Organisation. Focus groups were used to test the message maps and gauge the validity of the maps and the preferred channels of communication. These focus groups demonstrated the applicability of message mapping as a tool to engage with stakeholders, especially hard to reach groups, prior to a crisis occurring. However, it would need further study, testing and refinement to have real world applicability in the highly dynamic and complex field of crisis management.

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List of Acronyms

Acronym	Definition
CAP	Common Alert Protocol
CBS	Cell broadcast Service
DHN	Digital Humanitarian Network
ES	Emergency Services
ERO	Emergency Response Officer
EMS	Early Warning Components of Copernicus Emergency Management Service
ETSI	European Telecommunications Standards Institute
GEWS	Galileo-based Emergency Warning System
GNSS	Global Navigation Satellite System
HOT	Humanitarian OpenStreetMap Team
HR	Humanitarian Response
NAAD	National Aggregation and Dissemination System
NS	Red Cross National Societies
SAIP	System of Alert and Information Population
S&C	Social and Crowd
SBTF	Standby Taskforce
UCPM	Union Civil Protection Mechanism
VISOV	International Volunteers in Virtual Operational Support
VOST	Virtual Operations Support Team

Report Structure

This report is structured in four parts. The first part seeks to provide an overview of the use of communications in times of emergencies such as how the messages are worded and how they are perceived by their recipients, what is needed for an effective crisis communication and how to improve this communication within a society.

The second part and also the focus of this study, is dedicated to an assessment of existing new technologies able to enhance communications. In this point, the emphasis go to the use of social media to provide information to crisis managers and examples on how to make information generated by social media useful to them. Here, the prominence goes to a number of EU funded projects - E2mC, I-REACT, CRISCOMSCORE and COSMIC - dealing with social media and crowdsourcing to improve communications in disaster management. The report presents the use of commonly used mobile technologies in public alerting such as cell broadcast service and SMSs. Before this, a few countries are listed as to describe the technologies they have in place to communicate with citizens in the occurrence of an emergency. Still in part 2, this deliverable focus on new technologies used to communicate with volunteers and spontaneous volunteers showcasing examples of Red Cross projects and VOST crowdsourcing. A brief reference to the potential upcoming EU legislative to the “Reverse 112” is also covered. To conclude part 2, there is an explanation of the EU funded project GALILEO.

Part three of this report is essentially centred in the methodology applied as a way of communicating with the public – particularly with hard to reach groups – and it consists of a message mapping elaborated to fulfil the needs of the people likely to be more affected by a given crisis. Yet, the message mapping is defined in such a way that can be applied to any stakeholder.

Finally, the fourth and last part is dedicated to the conclusion of this deliverable and its findings.

1. Introduction

Effective communication to elicit appropriate actions both before and during a crisis should not be sender-focused, but receiver-focused. Therefore, in order to adjust information to receiver needs, it is important to understand how citizens interpret and respond to these messages and how it relates to citizen behaviour during a crisis. This research seeks to identify solutions to communicate with the population in times of crisis and emergency. Several technologies and methods applied in different countries are analysed in order to compare solutions and possible outcomes. The report presents existing solutions in different countries and discover what needs to be improved when it comes to timely informing the population of an imminent danger. Also, this deliverable intends to identify whether these solutions could be useful to communicate with citizens, volunteers or spontaneous volunteers immediately after the occurrence of a disaster. The approach conducted over the course of this report was both based on desk research and under the framework of a designated focus group. In the first part, the sources were essentially from EU funded projects – EmerGent, E2mC, I-REACT, CRISCOMSCORE, COSMIC and GALILEO- and its offered solutions. The original idea was to apply the available technology to future possible communications with populations and first responders who show up to provide assistance in real crisis scenarios. In the last part, the focus goes to the methodology used and how to apply it to a specific hard to reach group, yet taking into consideration that it is a methodology that can be used with different stakeholders. This will serve as an input to the upcoming Trial in Austria.

1.1 Communications for civil society resilience

How an individual perceives and is likely to respond to risk is central to the framing and impact of communications before, during and after a crisis. However there are relatively few studies on how people respond to emergency information (1). Research shows that individuals react to warnings actively to employ their own coping strategies in order to understand and respond to crisis warnings (2), and those warnings are taken more seriously when the perception of closeness is present relative to the position of the communicator or channel (3).

How people respond to emergency information is still an emerging area of study (4). Organisations have crisis response strategies that they deploy in an emergency and the public use their own response strategies that are largely based on building an informational picture of the situation as it relates to them. They construct this picture by using a range of information sources that all make up their personal information network. An individual's trust in a message is the result of prior experience with the source of the message, the channel used and its content. However, the trust they place in these sources directly relates to the impact of the warning and of the warning messages' efficacy. The one constant when communicating risk, is uncertainty therefore the regard it is given largely depends on other factors (5) and message mapping is a well-known way to explore that.

As such, this deliverable seeks to find possible proposals for a better communication between public authorities and the general public, but also with the first responders who often sprung up to offer help and assistance in times of crisis. In order to improve the sustainability of available resources and to refine communication and its dissemination, the Trials carried out as part of the project DRIVER+ illustrate a set of crisis response strategies that could well be applied in real life disasters or emergencies. In total, a series of four Trials - in Poland, France, the Netherlands and Austria - and a Final Demonstration (in Italy and in Poland) will be conducted. The aim is to explore innovative solutions under simulated crisis conditions, by gradually adapting them to operational constraints, as well as creating acceptance among users through their active involvement and by providing evidence to decision-makers that they are cost-effective.

Collaboration is a necessary foundation for dealing with both natural and technological hazards, disasters and the consequences of terrorism. Henceforth, there is no strong collaboration without a solid and robust way of communicating during periods of crisis. Moreover, in a context of crisis, different stakeholders will be

receptive to different channels of communication. Thus, it is extremely important to tailor the messages to convey and wisely choose the networks through which people intend to send our message across.

Crisis communications are in place precisely to address emergency situations that require absolute pragmatism. In parallel, emergency management represents a broader set of functions that go beyond search and rescue, emergency medical services, temporary shelter and feeding, and restoring lifelines. Emergency management also includes:

- Hazard mitigation to prevent or lessen the impact of disaster, such as building levees or moving people out of floodplains.
- Disaster preparedness, such as emergency planning and training.
- Disaster recovery, usually meaning the restoration of lifelines and basic services.

All the above actions require preparation and an effective way of communicating. That's the quickest way to avoid chaos and panic and promptly take action while inspiring others to do the same. In effect, the field and profession of emergency management have been evolving into a more collaborative enterprise since the 1940s and 1950s. This transformation has gradually moved beyond the classic top-down bureaucratic model to become a more dynamic and flexible network model that facilitates multi-organisational, intergovernmental, and intersectoral cooperation (6).

During and after the occurrence of a disaster, there are different types of people who respond and at different times. Many of these people are volunteers. However, not only there are different levels of volunteerism as there are also different categories of the types of people that choose to volunteer. Therefore, it is important to understand the different types of volunteers since this may have implications for managing such volunteers in the different phases following disasters. The communication with volunteers will be specifically addressed.

1.2 Effective emergency communication

Effective emergency communication is often measured by the response rate and behaviour of recipients as well as the speed that reliable messages can be disseminated to them (7). Message mapping is a well-developed method for public health crisis communication which has more predictable outcomes and scientifically proven prevention and treatment methods (8)[1]. For example, a disease will present with a specific range of symptoms that can impact an individual in a predictable way just as a pandemic follows a relatively predictable pattern of infection and spread on a particular population. It has been extensively used by the World Health Organisation and the United States Environmental Protection Agency. At present there is no comparable approach demonstrated for other major emergencies.

Natural and man-made crises do not follow patterns that are as predictable as they are often sudden, unexpected and manifest in unpredictable ways (9). Preparation plans to react to crises are drafted without knowing where the impact will be, the extent or specific areas that will be impacted and when they will occur and this is especially true of natural disasters. A sudden onset crisis creates a unique and specific context that is outside of the norm and this then impacts communication activities which in turn help to shape and influence the context of the crisis itself (10). This unpredictability is a challenge for crisis communication in sudden onset crises or disasters which contrasts with the 95% prediction rate of questions in a crisis using message mapping for public health emergencies (8).

[1] In the early stages of preparing this research Vincent Covello kindly made available message map work which he had completed with the WHO concerning the Ebola Virus.

In view of ensuring an effective emergency communication, all the Trials sought to improve cooperation and coordination between different organisations and agencies from different countries, using innovative solutions for large scale crisis situation. Some of them will have a specific focus on collecting and analysing information coming from social media (Trial France) or involving stakeholders like volunteers or decision makers (Trial 3 and 4).

1.3 Background and context

Effective emergency management operations often pivot around crisis communications. In fact, risk communication is distinguished from crisis communication as crisis is the manifestation of risk and therefore risk communication generally focuses on pre-crisis communication (11). Crisis communication and risk communication often focus on different parts of the disaster management cycle, with risk communication generally focused on the preparation phase and crisis communications focused on the response phase (Steelman & McCaffrey, 2013). Crisis communication will be used here to refer to both risk and crisis communication as they mutually impact and influence each other's processes and outcomes as they often overlap in real-time (11).

Communication is an essential part of emergency management because of the need to reduce uncertainty, increase resilience and affect positive responses. Traditional approaches to risk and crisis communication was for messages that originated with topic experts to be pushed through blanket saturation methods on the whole population (1). Two-way or responsive communication with stakeholders or publics is important as the "meaning" of a message is created jointly between the sender and receivers of the message. This creates a need to understand how messages are received differently by different groups and how a crisis situation makes it harder to phrase and deliver effective messages. The odds of writing a successful short warning message in the throes of a crisis are slim and research is needed to understand how audiences interpret them (12).

Different groups may receive and react to the same message differently. Population demographics are an important consideration when framing and implementing communications and diversity of population requires diversity in communications that factors in linguistic diversity as well as ethnic, age, social class, educational attainment and special needs (13). Framing communications in advance is not optional – it is a core part of achieving basic emergency management objectives. Message mapping is a potential solution that could facilitate engagement with stakeholders, particularly hard to reach groups and test the warning messages and preferred channels of communication in advance of a sudden onset crisis.

Information is fundamental in Crisis Management and the Trial in France has put information sharing at its core. The Social Media Analysis Platform (SMAP) is able to process the volume of data generated by Social Media (Twitter and YouTube) and offers advanced filtering functions based on content, time and space, which should bring some significant benefits to the use of social media in crisis finding relevant crisis information faster, and with more success.

Crisis communication must engage with stakeholders prior to the crisis occurring and both community and individual efficacy is a key variable (12). The process of message mapping places individual stakeholder groups as the fulcrum around which the entire map is drafted. The process therefore allows for the identification of stakeholders and their concerns, as well as messages to address those concerns based on projected impacts. Message mapping also develops clear, internally and externally verifiable messages that can be used to brief spokespeople as well creating a sharable set of consistent messages (11).

2. Use of new technologies to enhance communications

This chapter provides an overview of how social media platforms can be of use when communicating to the public during an emergency occurrence. A number of EU funded projects such as EmerGent, E2MC, I-React, CRISCOMSCORE, and COSMIC are unveiled as showcases on how to deal with crisis communications by using social media. On the other hand, it seeks to divulge existing technologies tailored to deal with risk communications such as cell broadcast services and SMS alerting services. The goal is to list what solutions are being used and how efficient they proved to be. Moreover, a tour across a number of countries and its current technologies applied to crisis communications will be detailed. After focusing on specific country-technology, the report will deal with the use of new technologies to communicate with volunteers and spontaneous volunteers with the presentation of the Austrian Red Cross project and an introduction to VOST Crowdsourcing, digital volunteering and crowd-tasking. Finally, this section is also dedicated to divulge the EU funded project GALILEO and its potentials in addressing real-time communications with the population.

2.1 Use of social media to provide information to crisis managers

To ensure the adaption of social media in emergency services it is needed to prepare the staff for this new way of communication. Studies showed that a main factor for enabling the use of social media in emergency services were the staffs' skills, interests and the organisational culture. Training the staff would increase their skills and would therefore be a major enabling factor by lowering the entry barrier. As the studies also showed, staff with more experience in using social media was more likely to expect an increased use of it. This could mean that they see the potential of its use, training other staff members could let them see its potential too and reduce negative attitude towards it.

According to Statistics Portal, in 2019, it is estimated that there will be around 2.77 billion social network users around the globe, up from 2.46 billion in 2017. As more and more people own a smartphone or are simply connected to the World Wide Web, it is vital to start regularly using technology for the benefit of the public in times of crisis.

In fact, the use of social media is a fairly easy tool to be implemented within organisations, and, at the same time, keep younger generations abreast of imminent disasters. Yet, there are a number of segments in the population that have zero experience whatsoever with the use of social media and this factor should be taken into consideration.

When faced with a crisis, organisations are also preparing the lessons learnt from a crisis, taking lessons from what has worked and what needed to be improved.

After the terror attack in Brussels in 2016, millions of people opened up Facebook to check in on friends, and Twitter to share their grief and support. Once again, social media proved to be a valuable tool for connecting people after tragedy. In fact, with mobile networks overloaded, people in Brussels were urged to use social media to communicate. Even wireless carriers Proximus SA and Mobistar SA asked customers to communicate via text messaging or social media via Wi-Fi networks. Belgium's then Deputy Prime Minister, Alexander De Croo recommended certain apps — WhatsApp, Facebook, Twitter — as he urged Belgians to avoid phone calls. When the tragedy happened, Facebook activated its "Safety Toll" check, inviting people in the region to mark themselves and friends as "safe," "unsafe," or "not in the area." The notification appeared as an alert in their friend's news feeds. Facebook unveiled Safety Check in 2014, using it just for natural disasters until the Paris attack in November. Facebook said that "more than 950 million people received a notification that a friend or loved one was safe in a crisis last year. Our hearts go out to the people of Brussels and everyone affected by today's tragic events." On Twitter, people shared cartoons and images to express grief and solidarity, many with the red, yellow and black of the Belgian flag. The hashtags #WeerbaarBelgie (Resilient Belgium) and #JeSuisBruxelles surfaced a call-back to the #JeSuisCharlie hashtags after the Charlie Hebdo attacks in Paris over a year ago. #Brussels and #PrayForTheWorld trended and Twitter's lead

"Moments" — curated stories based on tweets, were all about the attack. People also turned to Twitter to offer help to strangers. The hashtag #ikwilhelpen – "I want to help" trended as Twitter users reached out to those stranded by the airport and trains shutting down. With the hashtag #OpenHouse people offered a place to stay.

It is also worth noting that Member States have to adapt rapidly and choose the best effective way to communicate with the public. The French case is striking and shows that best intentions are not always working. In May 2016, the French authorities launched the SAIP (System of Alert and Information of Populations). However, this method had limitations that were strong enough to abolish it: only 900,000 people had SAIP in the summer of 2017, which greatly limited its impact in a crisis. According to the French authorities, only the people who downloaded the application could benefit from the alert messages and because of the battery consumption it generated, many initial users ended up uninstalling it.

As a consequence, the French government buried the application SAIP and announced agreements with social networks and public broadcasting to alert the population of potential terrorist risks. The new scheme has come into effect since 01/06/2018. The alert and prevention messages of the French Ministry of the Interior is set to be broadcasted, from the 01/06/2018, on Twitter, Facebook, Google, the communication channels of the RATP and Vinci Autoroutes, Radio France and France Televisions. Therefore, a special banner can appear at the top of the thread tweets of each logged in user to inform him of the situation. The Ministry of Interior advised the population to activate notifications under the twitter account @Beauvau_alerte. The Ministry will also be able to communicate via Facebook's "Safety Check" tool, which has 35 million active users in France.

Research at EU level focuses also on the use of social media in crisis management. The project EmerGent (49) sets guidelines to increase the benefit of social media during emergencies. These guidelines are tailored for all types of users – starter, intermediate or advanced – and their goal is to provide useful information, mainly in the form of recommendations, prior, during and after a crisis. The integration of social media into existing organizational structures can help to increase the efficiency of emergency management. Particularly, as digitization is mounting, social media can act as a connecting mechanism, improving the communication between public authorities and the younger generations.

Some of the recommendations that EmerGent proposes for the citizens cover general aspects on the use of social media: how to use it before, during and after an emergency. EmerGent seeks to prepare the general population ranging from those less apt to the use of social media to the more advanced users. As such, EmerGent recommends citizens to know the social media accounts of citizens' local and national Emergency Services so they can follow them and find real-time information during an emergency. During an emergency, it is recommended for citizens to always mention the Emergency Services account or include any already used hashtags, and when possible, to report a location and use photos. After an emergency, citizens are welcomed to give feedback to the authorities and restore missing contact with family and friends.

2.2 How to make information generated by social media useful to crisis managers?

E2mC (50) is a project that is designing and developing a prototype of the innovative and scalable S&C Platform, technological enabler of the new Copernicus Witness Service Component. Amongst its aims and objectives, E2mC seeks to demonstrate the operational usefulness of the Copernicus Witness, the new Copernicus Emergency Management System (EMS) Component. Also, this project is trying to demonstrate the tangible benefits of the S&C platform to the Copernicus EMS within realistic and operational scenarios while assessing the quality and credibility of the information generated through the analysis of social media data or gathered through crowdsourcing mechanisms.

2.2.1 E2mC

E2mC (Evolution of Emergency Copernicus services) project aims at demonstrating the technical and operational feasibility of the integration of social media analysis and crowdsourced information within both the Mapping and Early Warning Components of Copernicus EMS. The project will develop a prototype of a new EMS Service Component (Copernicus Witness), designed to exploit social media analysis and crowdsourcing capabilities to generate a new Product of the EMS Portfolio. The purpose of the new Copernicus Witness Service Component is to improve the timeliness and accuracy of geo-spatial information provided to Civil Protection authorities, on a 24/7 basis, during the overall crisis management cycle and, particularly, in the first hours immediately after the event. This will result in an early confirmation of alerts from running Early Warning Systems as well as first rapid impact assessment from the field. The Witness prototype was activated for Hurricanes Florence and Michael which struck the United States in September and October 2018. The Tweet messages can be selected based on their location and visualised, including its message and media. Each Tweet can be selected and visualised, including its message and media. The relevance of the shared photos is analysed through automated image recognition and the results are displayed. Moreover, it is shown if the Tweet was verified through the crowd. The Tweet location can also be visualised in Google StreetView.

Moreover, the relevance of the shared photos is analysed through automated image recognition and the results are displayed. Moreover, it is shown if the Tweet was verified through the crowd. The Tweet location can also be visualised in Google StreetView.

The technological enabler of the Copernicus Witness is the innovative and scalable Social&Crowd (S&C) Platform, developed by E2mC. Heterogeneous social media data streams (Twitter, Facebook, Instagram, and different data: text, image, video), will be analysed and sparse crowdsourcing communities will be federated (crisis specific as Tomnod, HOT, SBTF and generic as Crowdcrafting, EpiCollect).

Additional information is thus provided to operators working in rapid mapping activities based on satellite data in the Copernicus Emergency Rapid Mapping Service. Rapid mapping has the goal of providing rescue teams and operators with information about the current situation of the area being interested by the emergency. The information ought to be provided in a rapid, systematic, and organized way, with the main goal of making mapping faster. The extraction of information from social media has been studied by several authors in the literature, in particular in emergency and crisis situations and also with ad-hoc initiatives (8).

The E2mC project has taken further the explorative approach to retrieve social media information related to an emergency. In addition to the basic location layer for tweets, additional information will be provided such as analysing hotspots, developing image analysis tools to compare and classify images, multilingual support for topic extraction, and crowdsourcing functionalities, which are going to be integrated in the continuation of the project.

2.2.2 I-REACT - Improving Resilience to Emergencies through Advanced Cyber Technologies

As described on its dedicated website (http://www.i-react.eu/), the I-REACT – Improving Resilience to Emergencies through Advanced Cyber Technologies - project aims to develop a solution through the integration and modelling of data coming multiple sources. Information from European monitoring systems, earth observations, historical information and weather forecasts will be combined with data gathered by new technological developments created by I-REACT. These include a mobile app and a social media analysis tool to account for real-time crowdsourced information, drones to improve mapping, wearables to improve positioning, as well as augmented reality glasses to facilitate reporting and information visualisation by first responders. With this approach I-REACT will be able to empower stakeholders in the prevention and management of disasters. Citizens will be involved in reporting first-hand information, policymakers will be supported in the decision making process, and first responders will be equipped with essential tools for early warning and response. Overall, I-REACT aims to be a European-wide contribution to build more secure and resilient societies to disasters.

The EU project running from June 2016 to May 2019, integrates existing services both local and European, into a platform that supports the entire emergency management cycle. In particular, it will implement a multi-hazard system with a focus on floods, fires and extreme weather events, as they are the most impacting natural hazard affected by climate change. To reach this objective, it brings together a multidisciplinary team of 20 partners from researchers and technologists to industry leaders, UN officials, consultants or communicators. These partners are working collaboratively providing their experience and expertise to generate the best solution against disasters.

I-REACT targets all the three emergency management phases. The first one mainly deals with the "preparation" of a community to reduce the impact of future disasters. For this, I-REACT will integrate historical data, real-time reports, weather data and satellites observations to derive detailed statistics and accurate risk maps. These maps, coupled with a decision support system, will allow decision makers to effectively plan prevention measures aimed at increasing the resilience to future disasters. The second is the "preparedness". During this phase, the coordination between governments, civil organizations and citizens will be promoted to be prepared in case of an emergency. To reach this objective, I-REACT will analyse weather forecasts, data from both local and European early warning systems, such as the European Flood Awareness System and the European Forest Fire Information, and warnings extracted from social media or received through crowdsourced reports from authorities and citizens, as well as using the I-REACT mobile application. The third one is the "emergency response", in which an effective reaction, first aid and evacuation are crucial.

Finally, in order to help on-site operators, I-REACT will allow getting a quick and complete operational picture thanks to the ingestion of real-time citizen reporting and its integration in now cast and forecast models. To improve self-protection behaviour and reduce exposure, I-REACT will support public authorities to immediately warn citizens with real-time information and instructions.

2.2.3 CRISCOMSCORE - Crisis Communication ScoreCard

When first launched in February 2008, the goal of Crisis Communication ScoreCard – CRISCOMSCORE – an EU-funded project, was to develop an audit instrument and relevant guides for crisis communication strategies, turning public authorities better prepared to communicate in crisis situations. The project ran from 1 February 2008 to 30 April 2010. In period 1, the theoretical framework was clarified, and many of the data was already collected. In period 2, some additional data were gathered. Then the teams fully concentrated on the interpretation of the data and bringing the results together.

The critical factors in crisis communication were deduced from the data, forming the basis for the guides and the scorecard. To begin with, this was based on the results of an extensive review on disaster management. Next work package 1 added an analysis of interviews with media representatives, spokespeople and other crisis communication experts. An overview of best practices was derived from these empirical data and crisis communication literature. The results were used as input for the scorecard and a strategy guide was written. For work package 2 the empirical data gathered by focus groups, interviews and a survey with civilians were further analysed, while also a supporting literature study on trauma was written. From these results critical factors for crisis communication with civilians were deduced. The research results were summarised in a guide about targeting and message strategies. For work package 3 a digital survey, conducted with open questions for international experts, showed bottlenecks in practice. Its conclusions were combined with the input from other work packages, and after a literature study on scorecards the basis of the crisis communication scorecard was developed. The scorecard framework was reported and the indicators were developed further.

Overall, the main goal of CRISCOMSCORE was to set up many crisis response programmes including crisis communication strategies. Developing a crisis communication "scorecard" (Criscomscore) is developing an audit instrument or scoreboard that enables authorities to measure and improve their readiness for crisis communication. It is also preparing guidelines to facilitate effective media relations and crisis communication

strategies for various public groups. This will improve crisis communication by identifying critical factors in media relations, including relations with civilians, survivors, casualties, victims, first responders and affected communities before, during and after crisis situations. It will help public authorities become better prepared to communicate in crisis situations.

The CRISCOMSCORE project has been looking at recent crisis situations and current response mechanisms to elaborate its scoreboard and guidelines. It has already gathered a significant amount of data, based on the results of an extensive review on disaster management. An analysis of interviews with media representatives, spokespeople and other crisis communication experts was also factored in.

In addition, an overview of best practices was derived from the gathered data and crisis communication literature, which helped to prepare the final scorecard and a strategy guide. Data gathered by focus groups, interviews and a survey with civilians were also analysed, and a supporting study on trauma was prepared.

2.2.4 COSMIC – Contribution of Social Media in Crisis Management

The world of communication and information technology is developing at a vast rate. This is a threat as well an opportunity for risk and crisis managers in government and industry. There are currently a host of existing and emerging new media applications that can contribute to crisis management activities; however, their perceived effectiveness is less clear. COSMIC, an EU funded project running from April 2013 to March 2015, intends to fill the existing gaps in crisis communications and management by studying the effects of such new media in crisis management and in particular:

- To explore new and emerging communication technologies and applications and provide an insight into the most effective ways to utilise them to promote the enhanced safety and security of citizens in crisis situations.
- To assist better communication and information gathering for authorities and first responders.
- To examine the potential roles and ethics regarding citizen participation in emergency response.
- To produce guidelines that will assist authorities and first responders in deploying new and emerging communication technologies and applications to better protect citizens in crisis situations.
- To disseminate the findings to wider audiences and to seek the opinion of stakeholders working in the field via two dedicated workshops.

The structure of the work plan of the project includes addressing of all these objectives during the first reporting period, with final results appearing in the second period (end of the project) in the form of updated reports of existing deliverables and a further round of dissemination workshops and conferences. Overall, COSMIC has achieved important results in the fields of mapping crisis, mapping the use of current and emergent technologies, emergency communication by the public, stakeholder analysis and engagement and finally, in the development of specific guidelines.

COSMIC assisted decision makers, law enforcement and first responders in using new technology to optimise risk communication, information gathering, security communication in times of crisis and communication in relation to humanitarian aid. This assisted the European Community to ensure that optimal use of available and evolving technologies is benefiting European society by looking specifically at how current and emerging technologies could be used in the field of emergency response.

COSMIC also contributed to relevant expected impacts from the security and society activity. For instance, COSMIC increased first responders' preparedness by identifying successful information gathering and communication technologies and applications that can be mobilised in the event of a crisis. It also positively influenced citizens' preparedness by publicising where and how trusted information will be communicated to citizens, and how citizens can assist the authorities and one another by communicating information. As such, it will also improve the communication between authorities and members of the public in crisis situations and raise public awareness around threats. Finally, better communication using new media will

also assist citizens in receiving guidance on internal security threats and assistance systems during and after crises within their local authorities, Member States and at the EU level.

2.3 Presenting the use of mobile technologies in public alerting: Cell Broadcast Service vs SMS

When choosing the right technology to warn the population of an imminent disaster, public authorities have been struggling with the best approach. In fact, there are two dominant technologies on the market which present different characteristics but show the potential to complement each other: Cell Broadcast Service (CBS) and the traditional SMS.

Let's take a closer look at the differences between these two systems: CBS uses a dedicated channel, allowing the delivery to millions in seconds, without being affected by network congestion (and without causing it) whereas SMS use shared signalling channels and network congestion may lead to delays in delivery. Unlike the SMS system, CBS can be displayed automatically with no user interaction and with a special ringtone, making the CBS message instantly recognizable as an alert. Yet, CBS presents one main limitation: it is not supported by all handsets and even when it is; it requires a manual configuration from the user. This means that it does not reach everybody. This need for a manual configuration remains an issue as a lot of people are still not familiar with the procedure, which can further postpone the date at which 90% of the population will actually receive the alerts. For that reason and following recent technology improvements, more and more countries are considering geo-targeted SMS as a viable option for mass-alerting. Australia was the first country to make this choice, in 2009, and today claims a rate of 93% of successful SMS delivery. SMS systems have also been deployed in Norway, Belgium, Portugal, and a Trial in the UK in 2013 concluded that location-based SMS was the preferred solution over CBS. Besides solving the reach issue, SMS offers several advantages such as being less expensive and quicker to implement, as much of the infrastructure is already in place. Additionally, it gives a proof of delivery and it unlocks the possibility to personalize the message (e.g. language) on a per-user basis. However, there are limitations, as previously stated: network congestion may lead to delays in delivery and a standard SMS may not be identified immediately as urgent.

2.4 The Dutch case: communicating beyond a network overload

For the delivery of public warning, there appears to be no single solution that fits all of the requirements for the timely notification of an emergency incident or situation. Therefore, a Public Warning System (PWS) ought to be a blend of the best attributes of all of the existing technologies, adapted to the particular demands of the country or territory in question. The Netherlands was the first country in the world to introduce an emergency alert system nationwide, called NL-Alert. NL-Alert allows the authorities to inform people in the direct vicinity of an emergency situation, by sending a text message to their cell phones. The message will describe the situation and advise people what to do at that very moment. This way, more people will be reached and they will get better information. All cell phones in the relevant area will receive these messages automatically, provided that the phone is switched on, the NL-Alert channel has been activated and the telephone has reception. The messages are not sent by texting but by means of cell broadcasting, which can be compared to a radio signal. They are sent by way of the cell phone providers' transmitter masts. As a result, NL-Alert will still be operating in the event of a network overload. It is not necessary to register and NL-Alert is free of charge.

NL-Alert, based on Cell Broadcast technology as specified in ETSI TS 102 90031 went live in 2012 and has been used tens of times per year since, mostly for fire related emergencies. The Dutch government provides NL-Alert for legacy devices for which Cell Broadcast reception needs to be configured by the owner (see http://www.nl-alert.nl for how-to configure your device) and also for CMAS/WEA compatible devices. Devices that are sold in operator shops are pre-configured. The NL-Alert/CMAS service is available on Android, Windows OS and Apple's iOS devices. Since December 2014 NL-Alert in mobile networks has been mandated under Dutch Telecom law. Support for NL-Alert in LTE networks were implemented in 2015.

2.5 The Israeli case: cell broadcast technology combining TV, radio, sirens and internet

The Israeli Home Front Command and the National Emergency Management Authority "NEMA" have deployed an emergency alert and notification system based on new media age technologies. The Israeli standard has set a requirement where citizens can be reached within less than 20 seconds (on UMTS 3G networks) so that the entire Israeli population can be informed in time, reach protecting shelters and take respective measures. Recent measures show that the system's lead time is 7-8 seconds until the message arrives on the recipients' handsets. Only cell broadcast technology can provide the core foundation for Israel's national alert and notification system. The cell broadcast based solution is now being expanded by existing means such as TV, radio, sirens and Internet. All of which is going to be operated from one central platform. Different sensors and sensor fusion engines are also connected to the system allowing additional input that is sent automatically (in case of an earthquake or Tsunami) or via human interface.

The protocol used for the communication is CAP v1.235. The system allows not only information flow from the municipalities to the population, but allows also using the same platform for interactive information exchange where the citizens can send help requests and information to the authorities over the same central platform by using a dedicated Smartphone application with "Panic" button. The messages from the citizens contain a default help message, created text or even a photo taken at the incident's location. This constellation provides the next evolutionary step where the given alert and notification system is fully integrated into the 112 eco system.

2.6 The Chilean case: bi-directional communication with cell broadcast solutions

In February 2010, Chile suffered from one of the worst earthquakes in its history. The event was even more tragic as the country was hit also by a devastating tsunami right after the earthquake. Although the information was known and the US Pacific Tsunami Warning Center had delivered all necessary information in time, this precious information had not reached the public. Chile didn't have an adequate emergency alert and notification system to alert the target population in time. This has led to it suffering more casualties due to the Tsunami than through the earthquake itself. Following the President's order the Chilean Sub Secretary of Telecommunications (Subtel) issued on January 14th 2011, an official tender for deployment of Chile's next generation emergency alert and notification system.

In 2014, a magnitude 8.3 earthquake hit the Chilean shore but this time, thanks to eVigilo's system, the death toll was just five people. Working together with Chile's emergency authority, ONEMI, eVigilo sends alerts to warn citizens and tourists to evacuate. The Chilean government said the early evacuation facilitated the work of the emergency forces in saving lives and reduced exposure to ash and gas released during these eruptions.

The system's first phase based on cell broadcast technology was handed over to operations in October 2011. It was expanded by further capabilities such as notification over TV, radio and Internet, including push notifications to Smartphones that do not support the cell broadcast technology. The system in Chile was the first system of its kind in the Americas, advancing also the US American CMAS (WEA) project. The system utilizes standard protocols based on OASIS CAP v1.2 (Common Alert Protocol).

The eVigilo broadcast system is the only cell broadcast system worldwide that warns millions of people in less than 20 seconds in case of earthquakes, tsunamis and other imminent threats sensed by people, satellite imagery, seismograph readings or other types of sensors that communicate with the system.

2.7 The Czech case: selective radio signalling system

In Czech Republic, the government has developed the Unified System of Warning and Information (USWI) to guarantee that the public is well informed in case of an emergency.

How does the USWI work? The USWI consists of information centres (nationwide, regional and so-called the level of other operators), a data network, radio networks and warning, information and measuring terminal devices. The tasks of the USWI are not only to trigger a warning signal and deliver emergency information to public, but subsequently also giving information to the public about the character of the danger and regime is provisioned in an affected territory.

The USWI is guaranteed and operated by the General Directorate of Fire Rescue Service of the Czech Republic (GD FRS), which establishes the requirements for individual elements of the USWI. GD FRS ensures, operates and tests the USWI infrastructure, which provides an ability to spread radio signal and organize functional tests of the terminal devices. GD FRS sets out the principles of area coverage of the terminal devices of the USWI on the territory of the Czech Republic.

The USWI infrastructure consists of selective radio signalling system (SRSS) - which provides a remote operation of the USWI terminal devices - and the terminal devices - which ensure the public warning and information transfer. The USWI terminal devices are rotary sirens, electronic sirens and local information systems (municipal radio networks connected into the USWI). The SSRS is closed one-way digital system, which transmits activation orders to the terminal devices (sirens, pagers), and is not able to get a feedback whether the terminal devices carried out expected operations and what is their operational status.

A more sophisticated two-way Monitoring System of Terminal Devices (MSTD) is being developed nowadays in Czech Republic. The MSTD extends the current system and will be able to collect, transfer, process, archive and display information from the warning and measuring terminal devices (e.g. dangerous material detectors).

The Operational Programme Environment of the EU structural and investment fund usually finance the modernization and development of the USWI. For Public Warning only one “Common Warning” signal is used, a fluctuated tone with a duration of 140 seconds. The warning signal of the electronic sirens and municipal radio networks can be followed by a short audio text specifying the danger (floods, chemical accident, nuclear accident, etc.). The warning signal is followed by an emergency audio message for the public, which gives information what happened, where it happened, what is a potential danger and advice to protect lives, animals and properties. TV and radio broadcasting, municipal radio networks and mobile warning devices (mobile sirens etc.) can be also used for the public warning and information about the emergency. The USWI is tested every month in the whole country (Czech Republic), each first Wednesday at 12 am. The possibility of mobile phone warning with SMS usage by the operator’s network is being tested nowadays.

The system is expected to deliver SMS message directly into a selected area and the system would warn the deaf and mute persons too. The PWS is a part of emergency plans, mainly regional emergency plans, external emergency plans of nuclear power plants and external emergency plans of the potential danger providers set by the Act on major accident prevention.

2.8 Presenting wireless public alert system: the Canadian case

As of April 2018, telecom providers became part of the National Public Alerting System in Canada, and will push emergency notifications out to users on their networks. The National Public Alerting System, often dubbed Alert Ready, is a service designed to deliver emergency notifications to Canadians. In the past the system has shared those messages over radio and television networks, but wireless networks were included. How does it work? When an emergency situation develops, a government issuer (for example, a provincial or territorial emergency management agency, or Environment and Climate Change Canada) will deliver an alert to the National Alert Aggregation and Dissemination (NAAD) System, which is run by Weather Network parent company Pelmerex Corp. The system will then push the alert to broadcasters and wireless companies. According to the Alert Ready website, found at alertready.ca, wireless service providers will only relay

messages issued for threat-to-life situations. Regarding data privacy, the Alert Ready website says no data will be gathered about individuals, their wireless devices or their locations when emergency alerts are sent out.

In case of emergencies, officials will be able to send a localized alert that will compel compatible phones on an LTE network to emit an alarm and display a bilingual text warning of exactly what is unfolding. The shrill, siren-like alarm tone is the same one that currently accompanies alerts broadcast via radio and television. The Alert Ready website says individuals will not be billed for messages they receive. The Alert Ready website says alerts sent to wireless devices will be "geo-targeted," meaning alerts will only be sent out to people likely to be impacted by the emergency event. The website offers a comprehensive list of the types of scenarios that could trigger an emergency notification. The broad categories are: fire (such as widespread industrial blazes or forest fires), natural (including earthquakes and severe weather), biological (such as major air or water contamination), terrorist threat, or civil emergency (such as a danger posed by an animal or an Amber Alert for a missing child). Alerts may also be issued if there's a disruption or outage for 911 services.

The Canadian Radio Television Commission has previously stated that the alerts are too important to be optional, overriding preferences from telecom providers that pushed for an opt-out clause. However people dreading the sound of the alarm at odd hours have some choices. If a smartphone is turned off it cannot be forced on by an alert. Similarly, if a smartphone is muted an alert cannot force the device to play the alarm.

2.9 New Technologies used to communicate with volunteers and spontaneous volunteers: Red Cross projects and VOST Crowdsourcing

2.9.1 Volunteers & spontaneous volunteers

Volunteers are "individuals who are affiliated with an existing incident response organization or voluntary organization but who, without extensive preplanning, offers support to the response to, and recovery from, an incident" (14). The need to identify and support the skills and capacities of local people and organizations in disaster response and recovery (for reasons of proximity, speed, efficiency, accountability and empowerment) is increasingly acknowledged (15). It has yet to be widely adopted into formal disaster and humanitarian response, although recent disasters such as the earthquake in Port-au-Prince, Haiti in 2010 have demonstrated the important role of informal aid such as remittances from family members in other countries (16). Other natural catastrophes such as the earthquakes in Aguila, Italy, in 2009, and in Christchurch, New Zealand, in 2011 have been the stage for several interventions from spontaneous volunteers.

What are spontaneous volunteers? It is an "individual who is not affiliated with an existing incident response organisation or voluntary organisation but who, without extensive preplanning, offers support to the response to, and recovery from, an incident" (14). Tens of thousands of volunteers with no disaster training or experience have been referred by volunteer centres and other organisations to volunteer in the aftermath of disasters. Therefore, coordination between volunteer centres, government authorities and community organisations before a disaster occurs will enable agencies to effectively utilise spontaneous volunteers in the disaster response and recovery efforts. Individual's instinct to emerge spontaneously in the aftermath of a disaster is not something new and documentation exhibits this throughout history (15).

Trial Austria, scheduled for September 2019, is set to represent an important landmark for the future processing of communications between civil authorities and volunteers and spontaneous volunteers. The goal of this Trial is to evaluate a selection of solutions contributing to international or national Crisis Management processes, particularly in the field of volunteer management, standardisation for representation of information, flexibility and ability to interoperate and to improve the vertical workflow of information.

The disaster scenario will be the central area of Austria, which will suffer by a heavy earthquake and subsequent heavy rains. The local region of Eisenerz is one of the most affected with missing persons, casualties, collapsed buildings, blocked roads, and endangered industries working with hazardous substances. The Trial will be organised as a multi-day field exercise under the framework and in parallel of a Large Scale European Civil Protection exercise. National emergency organisations will be present with their volunteers and experts while making use of equipment, vehicles and tools in simulated disasters scenarios.

The scenario will require a commitment of stakeholders from every Crisis Management level and from all the agencies participating in the response: Austrian Red Cross, Austrian Fire Brigades, Police, Army, decision-makers and authorities. Other emergency response organisations from neighbouring countries are expected to participate following the procedures from the Union Civil Protection Mechanism (UCPM).

In general, spontaneous volunteers can be a significant resource to survivors and emergency responders as they might save lives, but they are often ineffectively used, which in turn can create health, security and safety problems (17). Spontaneous volunteers often self-deploy to assist in any way they can in an emergency situation. They act independently outside of the official emergency management coordination system of the disaster-impacted authority (8). They can be the first responders, since they are generally local residents and neighbours living in the affected area (18). There are also the spontaneous volunteers who are not from the impacted area. Yet, these spontaneous volunteers can arrive at any time during the response or recovery phases of a disaster. These characteristics differ from the volunteers who are affiliated with an agency or organization and make decisions based on direction or professional training (19). Who spontaneously converges on disasters? Researchers have identified six different groups of people that tend to converge (cf. Table 2.1). The groups differ most notably in the motivating factor behind their convergence (20).

Table 2.1: Types of spontaneous volunteers

Type	Description
Helpers	People who have come to help victims or responders in some way.
Returnees	People who lived in the disaster-impacted area but were evacuated.
The Anxious	People from outside the impacted area who are attempting to obtain information about family and friends.
The Curious	People who are motivated primarily to view the destruction left in the wake of the disaster.
Fans or Supporters	People who gather to display flags and banners encouraging and expressing gratitude to emergency workers.
Exploiters	People who try to use the disaster for personal gain or profit.

2.9.2 Approaches to better manage volunteers

The Red Cross and Red Crescent Nacional Societies, with the support by the International Federation, work with communities to reduce risk, mitigate possible effects from disasters as well as preparing quick responses to crisis. They offer a multitude of support in different areas, from designing common approaches to respond to disasters, to improving cooperation and coordination and finding solutions to bridge gaps. The general trend towards the multiplication of actors involved in international humanitarian response poses both opportunities and challenges to principled humanitarian action. The international role that European countries are playing in the provision of civil protection assistance is growing, and EU institutions and EU Member States are working together to pool resources for the provision of civil protection assistance. In this context, the components of the International Red Cross and Red Crescent Movement seek to manage the risks and opportunities that present themselves when working with civil protection actors, while maintaining

the Movement's identity as a neutral and impartial provider of assistance. In terms of the civil protection activities and services undertaken by the Red Cross National Societies (NS) at domestic level, there are differences in each country according to the national context and the mandate the NS holds. Typically, NS have a core response role to undertake emergency management services and deliver a wide range of humanitarian activities on a national level. These often include first aid, ambulance services, psychosocial support, food and non-food relief item distribution, search and rescue and the establishment and management of evacuation shelters. They support and encourage relevant public authorities to develop effective legislation, policies and plans for disaster management and assist relevant public authorities to use the Guidelines for the domestic facilitation and regulation of international disaster relief and initial recovery assistance (IDRL Guidelines) and the EU Host Nation Support Guidelines.

It should be noted that in Trial France, the Command & Control system developed by MDA (Magen David Adom) which receives and disseminates information to dedicated apps both used by the general public as well as by team members and volunteers was tested. Trial Netherlands and Trial Austria will offer also opportunities to test solutions for the engagement to the stakeholders and the management of volunteers.

2.9.2.1 Austrian Red Cross: the app that warns of imminent disasters while inviting spontaneous volunteers to help

This application created by the Austrian Red Cross - Team Österreich-App - is an example of how new technologies have enabled the interaction of volunteers and spontaneous volunteers in an emergency period. Its dual functioning allows everyone who downloads the app to be timely informed of any crisis situation so that action could be taken in advance. The special feature is the channel of communication used to invite or attract volunteers who may help in a scenario of crisis.

Overall, the Team Österreich-App stands for a new form of neighbourhood help: the willingness to help is registered and then used quickly and purposefully when help is needed. The Team Österreich-App is a digital hub for preparing for, alerting and helping in the event of a crisis. Functions such as interactive preparation assistant, pinpointed alerts in the event of a disaster or the ability to help locally or online will make your life safer and optimally network your existing helpfulness.

Three main features form the whole concept of the Austrian Red Cross application. First, "I want to prepare myself", the app acts as a personal preparation assistant, giving tips that can save people a lot of trouble in the occasion of heat waves or any other extraordinary event that requires immediate action. Second, "I want to be warned", applies to situations where storms or other catastrophic events are looming and people need fast, accurate and reliable information. Lastly, "I want to help", is the feature that allows anyone to become an online helper. How does this work? The Team Österreich-App can assign important tasks that will help the emergency services to better assess the situation and to help more purposefully during a heat wave, snow chaos or after a storm. Some examples are: to measure the temperature in the interiors of the dwelling house, to provide the exact snow depth or to send photos of the environment to emergency response organisations.

2.9.2.2 VOST crowdsourcing

It is suggested that spontaneous volunteers provide a variety of benefits to their neighbours, communities and the emergency response agencies. The association VISOV (International Volunteers in Virtual Operational Support) created in January 2014 but already very active since 2012, is the first French virtual community of digital volunteers in emergency management (civil security). It promotes the increased use of Social Media in Emergency Management, MSGUs. VISOV or VOST – the Anglophone branch - a Virtual Operations Support Team, were created on the basis of crowdsourcing movements with the ultimate goal of providing support in a context of crisis.

A Virtual Operations Support Team (VOST) as applied to emergency management and disaster recovery is an effort to make use of new communication technologies and social media tools so that a team of trusted agents can lend support via the internet to those on-site who may otherwise be overwhelmed by the volume of data generated during a disaster. Most of the times VOSTs are activated to perform specific functions in support of affected organisations and jurisdictions. In those cases, each VOST has a Team Leader that reports directly to the affected organisation/jurisdiction, and other VOSTs may provide additional surge support if needed. Some of the VOSTs can also self-activate on occasions. As additional VOSTs are established, a VOS Group (VOSG) may be established to coordinate the work of the VOSTs to maintain an effective span of control. The VOSG has a Group Supervisor that reports to the affected organisation/jurisdiction. The VOST Leaders report to the Group Supervisor.

Digital volunteers can help by doing Civil Protection on-line, supporting affected organisations & jurisdictions through formal agreements with emergency response organisations and Public Authorities at different levels, and can be self-activated or activated upon request to perform tasks that include Social Media monitoring and amplification, and specially detecting and fighting hoaxes.

During emergencies and disasters, the challenge is to cope with either the lack of information or an information overload. The social media world with its crowdsourcing approach has options to offer to overcome this issue, through the digital volunteers. VOST and other groups can provide support in hoax and abusive behaviour detection, in monitoring multiple channels, in amplification of information, and can perform specific missions and tasks requested by an agency or emergency response organisation (EROs), including sometimes even taking over SM accounts in crisis situations. Building on the relationships and the agreements established with digital volunteers before the emergency can greatly benefit all parties during a crisis.

They can help Emergency Services in several ways:

- Monitor and collect online information, filter, evaluate it and forward it to ERO’s through a person of contact.
- Share useful information with citizens & amplify dissemination of key messages.
- Provide useful advice to both citizens and crisis managers.
- Support in information verification, rumour detection & correcting misinformation.
- Perform specific missions assigned by EROs.
- Helping EROs, if necessary, by taking over their communication with the public during emergencies.

2.9.2.3 Means for crowdsourcing and digital volunteering

Emergency Services and Public Authorities can get valuable support from digital volunteers such as international VOST, the Belgian Team D5, Red Cross and their DiGIDOCs (i.e. "Observatorio digital en el Centro de Operaciones de Cruz Roja Española"), and also Digital Humanitarians such as DHN, SBTF, HR and others. There are of course other types of crowdsourcing efforts to support public safety at different levels, for instance through apps such as GoodSAM that alerts trained volunteer first responders to Cardiac Arrest in their vicinity, or Qwidam that supports public warning activities, or through Waze that can provide valuable traffic information to ES. Recent advances in information and communications technologies have enabled the rapid expansion of new forms of emergence and spontaneous volunteerism in disasters by groups and individuals far away from the disaster site. Such "digital" or "virtual" volunteering and convergence (which is too large and fast-moving a topic for detailed discussion here) focuses on data gathering and exchange in support of crisis response and decision-making, deploying a variety of tools and methods, including online platforms and mapping, crowdsourcing data, microblogging, wikis and social media. The value of such efforts in making response more effective, and in creating and maintaining connections between volunteer responders, is evident. Formal humanitarian or emergency management organizations are keen to use crowdsourced information in a disaster, but they seem to be less comfortable about working with social media tools and far less willing to engage or develop more substantive relationships with groups of virtual volunteers.

2.9.2.4 Crowdtasking – a new concept for volunteer management in disaster relief

Crowdtasking, as initiated by AIT (22), is a comprehensive concept, composed of structures, processes and tools with the goal to build up and maintain an informal community of pre-defined and informal volunteers; to mobilize them when needed; to control their activity and to collect data generated by the mobilized volunteers for enhancing situation awareness of the disaster relief effort as a whole. The approach is to engage with a priori selected volunteers that are managed by processes with low degree of freedoms in process execution. This was also tested as a solution named CrowdTasker and assessed during the first phase of DRIVER+ project as described in D934-121 Experiment 42 – Design and Report

Depending on the selected volunteer management approach the definition of requirements or demands on volunteers can be rather generic, the way of executing tasks can be left to volunteers. This approach has the advantage to provide everybody from the crowd the opportunity to participate in relief activities but the disadvantages that aspects such as qualification, reliability and credibility of the volunteering group are a priori unknown (21). This can lead to several problems such as unknown reliability, but also a hardly predictable number of volunteers available in case of incidents making resource planning challenging.

The management of the network of volunteers is a basic and continuous process. Therefore, a specific role is dedicated to the continuous execution of this process: the "volunteer's community manager". The desired result of the volunteer's community building and maintenance is to have a network of registered potential volunteers that shall be available, which can be addressed for further mobilization, when necessary. In order to achieve this, some steps should be followed:

- **Community building** – the volunteers community manager promotes the idea and motivate persons to register themselves as potential volunteers, efforts which proved to be the most effective when accompanied by different forms of media campaigning. By registering, they become members of an informal online community without the need to join an established response organization and undergo specific training.
- **Registration** – volunteers use a web portal to register to the community by providing specific information on their skills and their availability. During the registration phase specific tools allowing the volunteers to perform their tasks are provided, e.g. downloading of a crowdtasking app for their smartphones.
- **Data maintenance** – the data of the registered volunteers are to be stored, updated and secured.

Further on, in order to mobilize potential volunteers, some tasks ought to be ensured:

- **Crowdtask set-up** – the crowdtask manager defines and describes the specific task to be performed by the volunteers. This crowdtask will be a single effort, which can be executed within a limited amount of time. Examples are: Taking of two pictures with the smartphone out of the window plus answering a set of short and simple questions after an earthquake. Crowdtasking requires definition and description of the tasks in a concise way including a simple and structured form for reporting. Reporting may involve sending of a picture or ticking of a few selection boxes within a multiple choice system. As part of the preparation phase of crisis management, crowdtasks can be configured and stored in a database for later use.
- **Selection of volunteers** – the crowdtask manager selects a group of volunteers from the database according to the area and the type of task to be performed.
- **Initiation of crowdtask** – the pre-configured or newly defined crowdtask is activated and sent to the selected volunteers after release by the authorized official. The addressed volunteers receive the crowdtask e.g. on their smartphone.

Once the crowd is mobilised, how to execute and ensure the control of the activity?

- **Execution of the tasks** – this implies reception and execution of tasks by the addressed volunteers, workflow management of single or multiple tasks and provision of reports. The whole process can be supported by using specific user interfaces provided by dedicated crowdtasking apps on the volunteer's smartphones.
- **Compensation** – Volunteers may receive compensation. "Compensation" in this context is not referring to monetary aspects since this would contravene the concept of voluntarism, but more to aspects directly related to the motivation behind the engagement of the volunteers. The compensation may include specific "insider" information on the development of the crisis-situation (e.g. location based rain forecast), guidance for personal behaviour or measures to be better prepared for an emergency, etc.
- **Information gathering** – all the information gathered from volunteers is collected, stored and processed. The processing of the information has the purpose to derive crisis management relevant knowledge out of the obtained information. This process needs also validation of the obtained information such as plausibility checks.

Finally, when it comes to reporting and visualization, a designated crowdtasking action is set to provide its impact both in the field and on the decision-making of the emergency management organisations and crisis managers. This way, their situation awareness will be enhanced.

The application of the new concept of crowdtasking in the crisis and disaster management is accompanied by several challenges. The processes have to be designed in a way ensuring that tasks are in line with volunteer's capabilities on one hand and do not require activities incompatible with individual ethic values of volunteers on the other. A major concern is the liability in case of accidents of volunteers. Currently, a statutory accident insurance is established to volunteers of one of the Austrian emergency service organizations, when the performed tasks were related either to training, exercise or an operation.

2.10 A European legislative perspective: "Reverse 112": geo-localised technology on the occasion of potential hazards

European institutions recently adopted a revision of the European Electronic Communications Code (EECC), a bulky legislative file that will update telecoms rules within the EU.

Early in September 2018, the Internal Market and Consumer Protection Committee in the European Parliament voted massively in favour of an amendment involving the establishment of a compulsory public warning system to be implemented in every EU country.

The purpose of this system, also known as “reverse 112”, is to communicate information regarding potential hazards - man-made or natural - to EU citizens via their phones, through a geo-localised message-sending technology. This type of warning should allow citizens to evacuate or avoid a danger zone more quickly thereby reducing the chances of casualties. The final EECC document is poised to see an adoption by the end of 2018, after revision from the European Parliament and the Council. If approved with no major changes, all citizens from the European Union who own a smartphone will be listed to receive alert messages in the case of an imminent crisis.

2.11 GALILEO: Based reliable automatic and low latent emergency warning service

GRALLE is a project funded by the European Commission, which started in February 2017. The goal of the project, which will end in December 2018, is to carry out a feasibility study – both technical and in terms of interest from the community of alert message providers – for the realization of a global system for broadcasting alert messages to the population, through the use of the European Galileo satellite system. GRALLE is thus aimed at studying a service based on the GALILEO satellites for the world-wide delivery of alerts. The major features of the service are the ability to reach the population with low-latency, with precise geographical targeting and without the need for being connected to the internet. As such, the fundamental concept underlying the system proposed in GRALLE, which will be called GEWS (Galileo-based Emergency Warning Service), is the availability of a system able to guarantee the distribution of alert messages to the population, even in cases where the means traditional communication and therefore the same Internet network are not available, perhaps as a result of the damage caused by the disastrous event.

Overall, the system aims to ensure, through the use of the Galileo satellite system:

- Low latency warning messages transmission.
- Global geographic coverage, with the possibility of providers of alert messages, to define the area/geographical areas to which the alert messages will be addressed.
- High flexibility and configurability in the distribution of specific instructions to citizens, which may be different on the basis of the different geographical areas and the impact that the calamitous event will have within each of them.

The main actors of the alert system proposed in GRALLE are: the Alert message providers on one side (for instance, the Civil Protection in Italy), and the citizens on the other. The Providers will be able to use the equipment and IT systems already in use for the generation and distribution of the alert messages, appropriately adapted for communication with the GEWS distribution system. In this case, the interfacing between the existing systems and the GEWS will take place through the use of the standard CAP protocol. How will the messages be disseminated? Citizens will receive the alert messages through an APP installed on their mobile devices (smartphones) which, equipped with a GNSS receiver capable of capturing and interpreting the alert messages coming from the Galileo satellites, will be able to recognize if a given message it must be delivered to the user or not based on the geographic location and authority of the institution that distributed it and, if so, display the instructions.

The APP will be able to work completely offline, i.e. without the help of the Internet and no other communication possibilities except for that represented by the reception of messages from the Galileo satellite system.

3. Introducing message mapping methodology to crisis management

Inspired by previous work done by Q4PR (previous partner in DRIVER), this research aims to address the gap by testing the applicability of a scenario- based message map on hard to reach groups, to gauge the efficacy of the warning messages and to add the identification of stakeholder group-specific channels of communication. The message mapping process described originally by Vincent Covello (8) was adapted to include scenario development at the outset and hard to reach groups were identified and recruited for the focus groups. In addition, the steps were simplified to address the limited resources available in many civil protection organisations. The main challenge with developing warning messages prior to a crisis event is the unpredictability of the scale and impact of the event. This section discusses using the method of message mapping to engage with hard to reach groups, to predict the questions and map the answers for these stakeholders and to explore the preferred channels of communication for the warning messages.

Message mapping was appealing as a method to be used in both the pre-crisis and crisis phase because it is designed to deliver clear and concise information in emotionally charged situations to a range of publics, including the media. The message maps can be delivered through a range of communication channels and settings which was also an area of interest that was briefly looked at during the process. This section explains and justifies the development of message mapping as a solution for use in a crisis scenario. The starting point in the research was to list and compare the different technologies currently in place to deal with crisis communications in order to reach out to the public. Finally, the proposed methodologic part aims to understand the step-by-step process of message mapping.

3.1 Message mapping: theory and practice

The presented message mapping approach differed from Covello's original theory because Covello advocated for a seven step approach that began with identifying stakeholders while this research began with scenario development. This was the starting point because a narrative was needed to develop that could express the potential dangers of a large scale flooding event where there were numerous potential outcomes. This was not necessary in Covello´s model as public health messages largely deal with diseases which follow a predictable path. The other major difference with the two models is that Covello separated out the development steps of his models while this adapted model folded the central steps into only three steps which are to identify stakeholders, their concerns, draft the message maps and to support the facts. The final step in this model is to test the maps which will bring the stakeholders back to the initial step of the scenario.

3.1.1 Step 1: scenario development

The first step was to draft a detailed scenario. Scenario development does not explicitly appear in Covello's model for message maps however a sudden on-set crisis has many variables that needed to be drafted as a narrative. Scenario planning was traditionally used for long term strategic planning and enjoyed initial successes in the private petroleum sector. (22). Scenarios are usually short clear descriptions of a situation that provokes an active response from participants that stems from some form of self-recognition in the supplied narrative. Scenarios need to be internally consistent and designed as a process to analyse specific behaviours and responses that can have multiple interpretations (23). In this case, the scenario was going to provide a cause and effect illustration between a sudden onset crisis narrative and the sources of uncertainty that were going to arise without articulating any probability to these uncertainties (24). In other words, the scenario had to be something the stakeholders could imagine happening to them and identify vulnerabilities and uncertainties related to their own specific set of circumstances which would then prompt them to ask questions and respond to warnings based on their personal needs for information. The scenario needed to be based on a crisis with a plausible frequency and impact to make it as universally applicable as possible.

Globally, flooding is the most frequently occurring natural disaster and in the past twenty years it has accounted for forty three percent of all recorded disasters (25). Flooding has also increased in impact in the

same period and it was for this reason that the scenario was based on a wide scale flood event with a severe impact on transport and public services. The process of developing a scenario involved constructing the initial scenarios, verifying the plausibility of the narrative with industry experts, and revising and simplifying the final scenarios. This allowed for the uncertainties to come to the fore and facilitated the next steps in the research process, which was identifying stakeholders and the likely questions they will ask.

Trial The Netherlands is a fit showcase to imagine the first step of the message mapping as the testing features a flood where more than 500.000 are threatened. The scenario created foresees a dyke or sluice breach caused by technical failure or bad weather conditions. A part of the Safety Region Haaglanden, the Netherlands, will be flooded and damaged or destroyed. During the flood, the water level will be about one meter, depending on the exact location of the breach and the altitude of the terrain. The flooding will have significant human and economic impacts. Cascading effects will be: flooded roads and railways; partly power outage; telecommunications failure and shortage in fresh drinking water and food supply for the population within and outside of the affected area.

3.1.2 Step 2: identifying stakeholders

According to Covello, identifying stakeholders is an important starting point in message mapping; however, it is the second of our steps in our adapted process. Stakeholders, in this instance, are any person or group of people who are impacted by the scenario and who in turn would hypothetically have some impact on it (26). Stakeholder Theory has been critiqued and adapted over the years (27). Covello argues that stakeholders are “interested, affected, or influential parties” (28), and more recently stakeholders are largely accepted as a key element in information gathering and exchange in a crisis. This more recent concept of stakeholders as potential active agents of a crisis communication network was an interesting aspect of the project and fed into later decisions to focus on hard-to-reach groups.

Hard to reach groups was any group that does not engage with traditional or conventional services on a societal level and in this instance they were defined as any group who may not engage with mainstream crisis communications and who led independent lives but would be vulnerable in the event of a sudden onset crisis. Some examples of hard to reach groups selected for this research includes full time college students living independently on campus – therefore distant from the comfort of their hometown - aged between 16-25 who had limited resources in terms of finance, transport, emergency supplies. Often their support network is built around family and friends from their hometown. Another group with similar disadvantages were people living short term from abroad who may have even less support networks established and also reluctant to engage with the national or local media. Additionally, another group recruited from a university student body was full time students with a physical or sensory disability that were living independently and the final stakeholder group was a rural population aged over 65 living independently. These groups were deemed less likely or less able to respond to a warning message and most likely to respond to an invite to engage with the focus group research.

Identifying stakeholders in a widespread flooding event ranged from directly affected individuals to emergency response personnel and a comprehensive list was drawn up. One of the initial challenges was the sheer diversity of information needs of the various people and groups that populated the list. The second challenge was the potential volume of message maps that could be generated to accommodate the specific crisis communication needs of each. Stakeholders were categorised by the information they would be expected to seek in the event of a severe and widespread flood. The potential for numerous maps was only marginally reduced and therefore the stakeholders were listed as a reference document and the message maps were designed for a “general public”.

An effective crisis response not only involves a broad range of recognised stakeholder groups but also diverse message strategies to meet the different needs and expectations of each (8). Messages must be shaped by monitoring the perception and expectations of stakeholder groups (29) and this process must happen throughout the crisis phases from preparation to recovery (30). Messages have more impact and are more

effective with stakeholder groups if they match the culture, background, values, needs and experience of the audience (31). In any crisis communication situation, there are usually several stakeholder groups that are not homogeneous and may contain several sub-groups with different interests, agendas and priorities (1). Identifying the stakeholder needs is therefore at the very beginning of crisis communication and it remains at the heart of a dynamic process on ongoing, responsive communication.

The research is described here as a linear process but the reality was far more of a cyclical system of feedback loops that ensured a continuous reflective contemplation and corrections along a spectrum of phases to develop the message maps. Identifying stakeholders was function of the scenario development but it also required consideration of the potential questions stakeholders would ask and categorising them. The next stage in the process was to develop the questions that the "general public" stakeholders would want to or need to know.

3.1.3 Step 3: Identifying stakeholders' concerns

A secondary element of this process was to draft the questions that the scenario would likely cause from the stakeholders. It is generally accepted that a successful crisis response requires a broad range of engagement from stakeholders (1). Developing a complete list of questions that stakeholders would want to know was not an exhaustive process but it did generate a considerable amount of questions. A range of stakeholder concerns then needed research in order to obtain a basic understanding of responses in the past to similar events. This research on flooding events from various sources included media campaigns and analysis of flooding case studies, interviews with Local council emergency managers, document reviews and general desktop research.

Questions were generated to reflect each important stakeholder grouping and then the list was reduced through amalgamation, generalisation and prioritisation of the questions. The questions and concerns were further grouped into overarching, information or challenging questions which follows the message mapping model (29). Overarching questions are general, open ended questions that will generally attempt to get a snapshot of the situation. An example of this type of question would be "How bad is the flooding in this area?". Informational questions are more specific and usually directed at a person, group or topic. An example of this type of question would be "What resources are being ring-fenced to cope with the crisis?". Challenging questions are aptly named and an example of this type of question would be; "Why should we listen to you?". It was important to consider these questions with constant reference back to the perspective of the stakeholders and that was also a key feature of the next stage which was to develop three key messages for each question. Table 3.1 contains samples of drafted questions.

Table 3.1: Sample of drafted questions

	Overarching	Informational	Challenging
1	What areas are affected by flooding?	How has the flooding impacted public services?	What are you doing to deal with the flooding?
2	What area is worst affected?	Will there be more flooding?	How could this have happened?
3	How is the flooding affecting areas?	Am I in danger or is my property or business in danger?	What are you doing to help people affected?
4	What triggered the flooding?	How long will the emergency response last?	How are you keeping the public informed?

	Overarching	Informational	Challenging
5	What measures were in place to prevent this event?	What should people do when their homes are flooded?	Who is responsible for the emergency response operation?
6	Did preventative measures fail?	What should people do when they are at risk of flooding?	When did you start responding to the emergency?
7	Why did flood defences fail?	How can people protect themselves from flooding?	Why did it take so long to declare an emergency?
8	Where did the flood defences fail?	What support is available to people affected?	What are you doing to accommodate those left homeless?
9	What should people do who require assistance?	What will happen to people who don't have flood insurance?	How will people affected be compensated?
10	Who should people contact to get assistance?	How can people apply for relief funding?	Is this flood incident a result of flood plain development?
11	Is there a contingency plan for this type of flooding?	How long will it take for monetary support to come through?	Will you compensate flooding victims?
12	What can communities do to prepare for flooding?	Where will people who have been evacuated be sheltered?	How much money has been approved for relief for victims?
13	Are all roads and train lines still functioning?	What arrangements have been made to transport people to evacuation centres?	Will this fund increase?
14	What warning or sirens will be used to alert local populations of danger from flooding?	How many evacuation centres are there?	Will the relief fund be used to compensate people without insurance?
15	What information is available on the current situation?	What is the capacity of these evacuation centres?	What happens to people who were denied insurance due to the risk of flooding?

3.1.4 Step 4: draft message maps

The message maps contain two major elements namely the key messages and the supporting facts. The key messages are a direct response to the concerns raised by stakeholders in the previous step, while supporting facts are developed from the key message and they explain or expand on them. These elements make up the final message maps that can be used as a crisis communication tool.

Crisis communication emerged from the areas of public health, environmental management, risk and emergency management and its primary focus was to prevent harm through informing people about potential risks so that they could take steps to mitigate the danger. (8). This linear, one-way, push model of risk communication did not always lead to provoking the desired response and the research in this area expanded to try to understand this (32). Two theoretical perspectives emerged to address this gap; mental models and social constructivism.

The mental models approach seeks to identify and bridge the gap between how people perceive risk in comparison to how experts perceive it (33). Drawing from cognitive psychology and artificial intelligence it integrates decision theory and behavioural research to propose that people will interpret a risk event by framing information against their own cognitive framework (33). This paradigm posits that risk assessment information and situational picture must be developed in a scientific and systematic way by experts and that a mental model that makes sense to the risk bearer needs to be developed (34). "Successful integration of risk assessment information with existing beliefs requires creating coherent mental models that allow people to make sense of or in a way "add up" what they read and hear and how they make consistent inferences regarding bearing risks" (34). Insight into mental models of risk and crisis information can be gained through interaction and dialogue with stakeholders who could include how they perceive risk and how that can be related to targeted messages (11).

Social constructivism extends the mental model´s paradigm to incorporate the cultural and social context that risk is communicated and understood (35). "The social construction of a crisis, crisis management, and coping practices are thus contingent on socio-biographic, sub systemic, and cultural factors" (36). Acceptance of the risk message is affected by the message appropriateness for the social situation as well as identification with or similarity to the messenger delivering the risk message (37). This raises the issues of trust and credibility and focuses on interactions between individuals, groups and institutions and it highlights the growing importance of personal information networks and risk bearers being both receivers and senders of information. Infrastructural risk communication is a paradigm that seeks to incorporate aspects of both mental model´s theory and social constructivist theories.

Infrastructural risk communication "…is dialogic and discursive, and presumes the need for effective decision-making institutions and co-created meanings that arise from risk democracy" (38). Decision heuristics and value set combinations are unique to key stakeholder groups which can produce an idiosyncratic response to each risk and risk assessments and communication plans are aware of this (11). This paradigm assumes that scientists are another stakeholder with a collaborative role with all other stakeholder groups however it values the role science has in identifying, quantifying and responding to risks (39). Collaborative processes are enacted to construct meaning at community level while variables such as trust, uncertainty and control impacting on the "communication and management of risk through the lens of rhetorical heritage" (11). Crisis communication strategies must consider societal values, cultural norms, psychological variables and the contradictions and connections between these in stakeholder groups as sites of information acquisition, sense-making and active proxy in interconnected information networks.

In order to follow the process of developing message maps, general communication theory was followed for each key message. 27/9/3 limitation is where messages should be organised into sound bites with a total of three bullets containing a maximum of twenty-seven words that can be spoken in nine seconds. This helps to ensure that spokespeople who adhere to this limitation are quoted accurately and completely in the media (11).

This was the starting point for developing the key messages as it also ensured that the messages were short enough to suit some social media platforms. Mental noise theory posits that when people are upset or stressed they have difficulty in hearing, understanding or remembering information (8). This is one of the reasons for the 27/9/3 limitation but another factor to consider is that the message should elicit trust in the listener. This was a consideration when drafting the key messages as was citing third parties that would be perceived as credible by the receiving audience as supporting or corroborating the key messages may build trust and reduce mental noise. Third parties may be identified in advance through message mapping.

Key messages aim to provide emotional reassurance especially around the areas of perceived risk (40). CCO template is an acronym for compassion, conviction and optimism. The template is used in a brief preamble that does not count in the 27/9/3 message. This preamble to the key messages is often appropriate for establishing trust in high-stress situations and communicating empathy and compassion. Effective use of the CCO template can help to reduce mental noise (8). Negative dominance theory argues that people tend to

focus on the negative rather than the positive in emotionally charged situations. This tendency requires messages to be balanced with positive, constructive or solution orientated key messages (41). The accepted balance is three positive messages for every negative one (1N=3P) (42). Triple T Model applied to message mapping would involve telling the information in summary form such as the key messages, followed by telling them more such as the supporting information and finally telling them the key messages again.

The primacy/regency principle could also be used where the most important messages are delivered first and last as people tend to remember these best (41). Visual Aids are graphics and visual aids can help people to recall a message better and can often be a vehicle for information outside of the 27/9/3 structure as visual and aural information are processed in different parts of the brain. Message mapping allows these aids to be identified or even in some cases prepared in advance (41). The key messages were developed using the broad base of crisis communication research as well as the more specific crisis communication guidelines. The resulting maps were reviewed and edited several times prior to the focus groups.

3.1.5 Step 5: supporting facts

Supporting facts are short statements that support or expand on the initial messages that can be used to give more information or context to the initial message. The process of developing supporting facts follows the same communication principles as were used to develop the key messages. Once drafted the supporting facts are validated by subject experts or professionals and amended based on feedback to ensure a systematic review of the relevance, accuracy and wording of messages and supporting facts. The maps for the sudden onset flooding event were validated by professionals who worked in Ireland in the area of emergency management such as Officers in the Fire Services, County Managers and professionals in the Office of Emergency Management. The feedback from these subject experts precipitated another culling of entire maps and at times drafting one or two new maps based on their feedback. This process reached saturation point when no new information or questions were generated and the maps had been honed to address the final short list of questions which gave us a total of 24 maps (cf. Table 3.2). At this point, the research turned to ways to test the message maps.

Table 3.2: Example of a message map

Question F7: What are the dangers faced by the general public by the flooding?		
Key Message 1	Key Message 2	Key Message 3
Flooding carries many risks and you should be vigilant.	Risks go beyond drowning and include contamination and the impact of debris.	You should avoid flooded areas.
Supporting Fact 2.1	Supporting Fact 2.1	Supporting Fact 3.1
Flood waters are often contaminated with dead animals or sewage which can pose a health risk.	As little as six inches of fast moving water can sweep any vehicle off a roadway.	Downed power lines should not be live. However, avoid water containing downed power lines as a precaution.
Supporting Fact 1.2	Supporting Fact 2.2	Supporting Fact 3.2
Protective clothing should be used if you have to enter the floodwaters to ensure that contact with skin is limited.	Floodwaters often contain hidden debris which can cause damage to anything it encounters as it is swept along.	The condition of road beds is impossible to determine in a flood and may be hiding a sinkhole or a washed away road.
Supporting Fact 1.3	Supporting Fact 2.3	Supporting Fact 3.3

Question F7: What are the dangers faced by the general public by the flooding?		
Boats can be used in floodwaters however they should be washed after the flood subsides.	The central channel of floodwaters is usually where the currents is strongest and should be avoided.	Flood waters contain debris that may be contaminating the water such as dead animals or raw sewerage.

3.1.6 Step 6: test message maps

The messages needed to be tested with hard to reach groups to see if the generated questions were able to accurately predict their concerns and to test the responses with these groups in order to establish if message mapping was a valid method in sudden onset crises. The focus group method was chosen for this study as it affords participants a greater opportunity to take an active role and it allows the acquisition of information through interaction. Focus groups had many features to recommend them as a method for testing the messages. Focus groups are a form of group interview that allows for a good deal of interaction between the participants as part of the method (Kitzinger, 1995). Focus groups have been used in risk research extensively in the past in order to test messages, conduct emergency needs assessments and to understand perceptions (41). Focus groups are qualitative in orientation and this lends itself to depth and richness of research in experience and explanations of participants as well as identifying areas for further research and both of these features made focus groups an appealing method (5). The design of focus groups can vary as the purpose of research projects varies and the focus group structure was adapted to allow for a probing of participant concerns when faced with the scenarios followed by comparing the mapped questions with the questions they raised. The message maps were written for the general public so that they could be adapted for different stakeholder groups but also so that they could be used without adaption for maximum impact with the general population in Ireland.

Five focus groups were conducted with each lasting between ninety minutes and two hours. There were six to eight participants in each focus group as any more may have eroded the depth and richness of responses for each participant and any less may have impacted the quality and quantity of interactions. The focus groups were internally heterogeneous but drawn from a large pool so most did not know each other prior to the study. Four of the five focus groups were recruited from two large college campuses by putting up posters, sending email through clubs and societies on campus and through student support services. The final focus group was a group of over 65s drawn from a rural area in the west of Ireland through local retirement clubs, sports clubs and hobby groups. Refreshments were provided at each session and used PowerPoint on projectors to display the information for discussion. We distributed a printed outline of what to expect during the focus group and what would happen to the information they provided.

The first focus group took place in Trinity College Dublin on the 10/06/2015 with a group of students recruited through the disability office from their registered list of students and the focus group was held on campus in an easily accessible area. Recruitment was through a general email to all students registered with the Disability Office. An email was prepared and it contained the details of the study and information on how to apply as a participant. It outlined the requirements for participation and the reimbursement of twenty five euros for expenses to all participants. Interested students and staff responded directly by email and were then provided with a more detailed brief on the research and its purpose. Participants who were still interested, eligible and available then booked a place on the focus group. All of the focus groups followed this format of recruitment through a third party. Table 3.3 lists information about the different focus groups.

Table 3.3: List of focus groups to test message maps

Code	Date	Details of Participants	No.	Location
FG1	10/06/2015	Students or staff with physical or sensory special needs.[2]	7	Trinity College Dublin
FG2	11/06/2015	International postgraduate students who are living in the catchment area of the university they attend as full-time students.	6	Maynooth University, Co Kildare
FG3	16/10/2015	Full-time students aged between 18-25, living away from home in the catchment area of the university who had graduated from the Irish secondary school system.	7	Maynooth University, Co Kildare
FG4	16/10/2015	Full-time students aged between 18-25, living away from home in the catchment area of the university who had graduated from the Irish secondary school system.	7	Maynooth University, Co Kildare
FG5	12/11/2015	Senior citizens aged over 65 living at home in a rural area.	6	Castlebar, Co Mayo

The focus groups began with a display of a warning message and participants were asked what questions the warning posed for them. The responses were recorded on a digital recorder and were there were two researchers; it was captured on a flip chart also. The researcher acted as moderator to ensure that every participant was afforded the opportunity to speak and voice an opinion. More warning messages were displayed as the scenario unfolded and the questions that the participants had as well as their reaction and critique of the warning messages was captured.

The participants were also asked what channel they would prefer to receive the warning messages and each person explained why they would prefer a particular channel. They were also asked about sources they would trust in an emergency and where they would seek out further information.

The scenarios were presented to each focus group and the questions that they would ask if they found themselves affected were recorded. Each group prioritised the questions they would ask through consensus which provided insight into concerns, motivations and risk information needs for each group. In each focus group the questions that had been mapped out were covered. The groups were presented with some key messages that had been developed for the scenario and they were asked to critique them. The focus groups ended with an exploration of their preferred channels of communication which is the seventh and final step of Covello's model of message mapping. Finally, the research delved into some aspects of trust, personal networks and response triggers. The findings from the focus groups were generally consistent.

[2] This group was carried out in accordance with guidelines for research with people with disabilities published by the National Disability Authority of Ireland.

3.2 Application of new concepts for developing more adapted messages: message mapping in crisis communications

Message mapping can be an effective approach in identifying distinctive information needs. A crisis creates a unique and specific context that is outside of the norm and this then impacts communication activities, which in turn helps to shape and influence the context of the crisis itself (43). An individual will receive crisis communication in or through their own personal context which influences the impact and even perception of the warning. The individual and social context of the recipient of communications has to be understood and reflected in the communication if its impact is to be maximised (10). For example, the 18-25 year olds living away from home tended to focus on public transport information to go "home" to their parents' house without ever really considering alternatives whereas the over 65s wanted information on the local community and how they could assist others. The non-national group wanted information on public health services and emergency protocols whereas the disability group wanted information on the crisis so they could adapt their emergency plans. This concept has substantial implications in relation to the need to engage with individuals over a longer period in order to understand and address the context in which they will receive communications.

The focus groups allowed the same scenario to be tested with a range of stakeholder groups and it demonstrated that each group has the same information needs on the most basic questions but slightly different information needs on more specific situational information which may illustrate value of preparing and testing generic emergency messages in order to find the best or most adaptable responses. This research also helps to prioritise the information needs of stakeholder groups and helps to gauge the vulnerability of these groups. It also demonstrates how vulnerable each group perceives themselves to be. The disability group and the over 65 group would probably be considered the most vulnerable two groups in the experiment, yet they asked questions that demonstrated that they are highly resourceful, knowledgeable and prepared. The both had the highest percentage response to the flooding scenario for questions about the impact on others which suggests altruism but also suggests that they are aware to have a greater capacity for response than they are sometimes credited with. In the case of a pandemic, these are considered the two most vulnerable groups and yet again, they ask about the impact on others as much or more than the other groups.

There were three groups of 18-25 year olds composed of Irish nationals living away from home and international students. The focus groups had value in assessing the resources available to these young people as well as gauging their knowledge and access to information in the event of an emergency requiring an active, physical response. They demonstrated a scant knowledge of what resources were available to them and their support network was either online, elsewhere or casual. They relied heavily on the university and local community for assistance in the event that they could not help themselves. Their financial resources greatly limited their choices and their lack of access to private transport decreased their ability to get out of an affected area.

The three groups of 18-15 year olds (FG2, 3 & 4) were highly discerning consumers of social media and news. They had large appetites for information and none chose a single source. This research allowed us to assess the resources available to various stakeholder groups as well as their access to information sources. All of the participants in the 18-25 focus groups had smart phones, a social media presence and were knowledgeable about seeking out and verifying information. They were all part of various information networks that ranged from school to family to friends and clubs and societies. They would not hesitate to pass on information to all of their groups in a variety of ways but all involved the smartphone as a tool. It also showed that the overwhelming focus at this time is on social media and the response phase (2). The over 65 year old group (FG5) did not all have smartphones and those that did use them in the same way that you would use a traditional mobile phone. Most of the over 65 did not have a social media presence and choose local news sources for emergency information. They claimed to be receivers of information rather than senders or originators except where family was concerned. However the quality of their personal local

networks were arguably richer and better established at local level than the 18-25 year olds who were veritable experts at instant mass communication.

In Figure 3.1 the top five questions which were asked across all focus groups are listed.

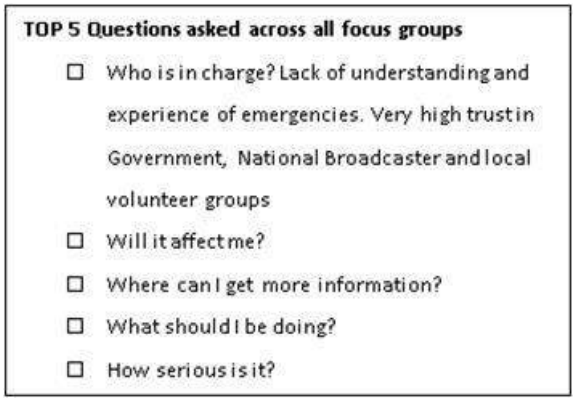

Figure 3.1: Top five questions asked across all focus groups

3.2.1 Preferred channels of communication

The rise of mobile technology has massive implications for crisis communications however in spite of the increasing use of smartphones their role is not well understood (44). Mobile technology allows warning messages to be transmitted through personal networks as well as across a range of social media platforms that are tailored to the individual. The individual and social context of the recipient of warning messages has to be understood and reflected in the message if its impact is to be maximised (13). This concept has substantial implications in relation to the need to engage with individuals over a longer period in order to understand and address the context in which they will receive communications. People will respond to warnings based on their prior experiences, their associated beliefs as well as the social and psychological context of the warnings (1). This presents a challenge to crisis managers as any target audience contains a broad range of diverse publics. Developing message maps is a process and the ultimate product revolves around thinking about stakeholders.

This approach also helps to identify the preferred channels of communication for a variety of stakeholder groups for a range of information and warnings. The over 65s preferred to get emergency information or warnings by radio, television, newspapers or in person by a person of authority such as a local fireman, policeman or medical personnel. Radio and television remain a priority and they retain extensive reach and trust and all groups acknowledged that television and radio crisis communications by someone in authority or a subject expert carried a lot of weight. The over 65 year old group (FG5) had complete faith in local radio keeping them informed and valued it higher than the national broadcaster however this could be a feature of a more rural population as some participants from rural backgrounds cited local radio as a trusted source also. The other focus groups were mainly younger and opted for less traditional forms of communication with WhatsApp, News apps, Twitter and Facebook featuring. The specific difficulty in ensuring sufficient knowledge and expertise in social media is acknowledged (45). These groups would still seek information from national authorities, national newspapers, radio and television broadcasts but chose to access it on their smartphones as most of them had no access to television or radio and almost none of them bought a daily paper.

This method can help to refine the linguistic style for warning messages in order to increase effectiveness for various stakeholder groups and match it to a preferred channel of communication. They were asked to comment on the warning message and feedback their responses. The 18-25 year olds were quite critical of the linguistic style of the messages even though they understood that they could not exceed 140 characters and was therefore quite limited. They still felt that the language used did not communicate a sense of urgency

and was aloof and unhelpful. They felt that the language seemed deliberately vague and did not feel like it was targeting them. The over 65 year olds in FG5 also felt that the language used was too vague but were more accepting of the vagueness in a warning message as they would seek out more information on their preferred source of local news.

Mapping the warning message allowed us to test the tone of the message and its impact on each stakeholder group. The 18-25 year olds in FG3 and FG4 were critical of the tone of the message as they felt that it did not communicate enough urgency to illicit a response. They felt that their demographic age group in the general population needed a warning message with a greater sense of urgency in its tone. They felt that the risk of causing panic was justified but were confident that their age group of 18-25 year olds would likely not panic and may still not react even with a greater sense of urgency in the tone of the message. The over 65s felt that the tone of the messages was fine if the objective was for them to seeking information elsewhere. Where the message asked them to act they said that they would but that the tone could be slightly more forceful. This approach allowed the subtle differences in message preferences between the groups to be noted.

Traditional approaches to risk and crisis communication was for messages that originated with topic experts to be pushed through blanket saturation methods on the whole population (46). Two-way or responsive communication with stakeholders or publics is important as the “meaning” of a message is created jointly between the sender and receivers of the message. This type of engagement is a departure from traditional modes of crisis communication and needs feedback to be successful and engaging. This would require crisis or risk communication to be a two-way system with stakeholders. It is essential to respect the role of stakeholders in relation to preparedness, response and recovery and seek ways in which they can enhance each (12). For example, the growing role of individuals aiding situational awareness is becoming a core theme in after-disaster case studies (47). The empowerment of the public within the emergency management cycle is a growing and important element in work which is specific to Europe (48). Message mapping allowed us to test the preferred channels of communication of the different stakeholder groups.

4. Conclusion

Identifying technologies to bridge gaps when communicating to the public in times of crisis is a challenging task. There is no an all-in-one solution able to fulfil all the needs of civil society authorities when it comes to reach out to the population. While the elderly preferred to get informed through radio and TV, the younger generations are incredibly comfortable with getting information from smartphones and social media. Nevertheless, based on the examples retrieved from different countries, some technologies seem to be more responsive as is the case of Cell Broadcast solutions and SMS. Yet, the ideal scenario would be a combination of these two technologies as they seem to complement each other. Cell broadcast uses a dedicated channel, allowing the delivery to millions of people in seconds, without being affected by network congestion (and without causing it). Contrarily, SMS use shared signalling channels and network congestion may lead to delays in delivery. Cell broadcast became the standard as it can be automatically displayed without user interaction and with a special ringtone, making the cell broadcast service instantly recognisable, unlike the SMS method. On the down side, while geo-targeted SMS is compatible with all handsets, the same does not apply to cell broadcast solutions and even when it is supported, it requires a manual configuration from the user, contrary to geo-targeted SMS. This means that the messages will not reach everybody. Nevertheless, the geo-targeted SMS system has historically been the second-best choice although it has recently been chosen by several countries. This system presents advantages such as being less expensive, quicker to implement and it gives the proof of delivery. Also, it unlocks the possibility to personalise the message on a per-user-basis. However, SMS still keeps limitations like in the case of a network congestion mass-alerting may lead to delays in delivery and a standard SMS may not be identified immediately as urgent.

In parallel, looking at the potentials offered by GALILEO, it appears to be a promising solution to address risk communications and to inform populations in real-time. Specific messages would be transmitted via GALILEO navigation signals, plus a dedicated app for smartphones fitted with a GALILEO receiver, capable of receiving and displaying the message. Everybody at risk will automatically receive relevant information on their smartphone screen. The message sent will contain a limited number of characters, with just the vital info needed: the date, the zone concerned, the type of event and what to do. The findings of the project seem promising and GALILEO could bring a new service for public safety.

Overall, all the technologies that require the download of an specific app on the smart phone before the incident can be popular amongst the younger people, yet many would not download the app, as learnt from the French case. This is a factor that ought to be taken into consideration if desired solutions are to reach out to the whole population. Hence, there is no perfect solution yet but some of the current available can make the difference on the onset of a crisis.

Regarding the methodology, message mapping for crisis communication in emergency management proved itself to be a cost effective approach to prepare highly adaptable communications response strategies. Scenarios, stakeholders, channels of communication and distinctive information needs can all be identified and developed prior to the crisis. Moreover, the flexibility to adapt is a key component built into the process. Adapting message mapping as a method of communication for hard to reach groups was a process that has shown some applicability. It would need further study, testing and refinement to have real world applicability. However it is hoped that a low-cost, low-impact approach such as this can be adapted by many organisations for a range of scenarios. The need to develop expertise in stakeholder research is, however, widely acknowledged. Stakeholder mapping is understood as a reasonable objective but is limited in its development. At present it is not seen as a core competence within responder organisations. Most organisations have identified priorities for vulnerable groups to be reached during a disaster response, but few have developed specific communication strategies for these groups. The idea that challenges and contexts will continue to change has very significant implications for both research and policy. It directly increases the need to build understanding of underlying principles and to have less of a focus on individual technological solutions.

Natural disasters are far too unpredictable to map all of the messages that may be needed. However this approach does help to develop core messages for a range of stakeholder groups that can be adapted in the event of an emergency such as: evacuation instructions, stay-in-place warnings or public services information. Message mapping allows some scalability of the warning messages with the groups so that the message can slightly alter as the impact of the crisis increases or decreases. It could also be used to develop a skeleton message map for predictable events such as evacuation, reassurance, generic warnings, etc. In addition, the DRIVER+ Trials have the potential to increase the preparedness of civil protection authorities as well as to coordinate the dissemination of information amongst the different stakeholders, in particular, as designed by the Austria Trial, first responders or spontaneous volunteers. Despite the unpredictability of emergencies and natural disasters, all the Trials piloted guarantee an added-value to the overall operational approach on how to implement solutions and deliver significant outcomes.

This was a small research to test a large idea with a potentially far-reaching impact and more research would be needed to refine the approach for sudden onset disasters. Testing the message mapping process through focus groups demonstrated that getting the right message to a targeted group using the right language through the right communication channels must be a prepared process in advance of a crisis. This is an area that could warrant further investigation to inquire into the viability of applying a message mapping system to sudden onset disasters given that they are far less predictable than the course of a disease or pandemic outbreak. This research used a natural disaster scenario but the process could potentially be applied to a man-made disaster such as an oil spill or a terrorist attack. In more general terms it was a very useful exercise to engage with a spectrum of the population that is often hard to reach. It was insightful to gauge their resources and ability to cope in the event of a disaster and to see how each group sought out information and how some groups used information as a kind of currency in their communication networks. This research was limited by scenarios that are a self-limiting method and they are never as dynamic an unfolding crisis. It was also limited by the number of focus groups and a greater number of focus groups could have allowed greater sampling of answers. Ultimately applying message mapping as a method to a sudden onset disaster scenario was an approach to crisis communication in the preparation phase that incorporated the complexity of stakeholder considerations in crisis communication.

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Annexes

Annex 1 – DRIVER+ Terminology

In order to have a common understanding within the DRIVER+ project and beyond and to ensure the use of a common language in all project deliverables and communications, a terminology is developed by making reference to main sources, such as ISO standards and UNISDR. This terminology is presented online as part of the Portfolio of Solutions and it will be continuously reviewed and updated[3]. The terminology is applied throughout the documents produced by DRIVER+. Each deliverable includes an annex as provided hereunder, which holds an extract from the comprehensive terminology containing the relevant DRIVER+ terms for this respective document.

Table A1: DRIVER+ Terminology

Terminology	Definition	Source
Affiliated volunteer	Individual, who is affiliated with an existing incident response organization or voluntary organization but who, without extensive preplanning, offers support to the response to, and recovery from, an incident.	Derived from ISO 22319:2017(en) Security and resilience — Community resilience — Guidelines for planning the involvement of spontaneous volunteers 3.1.
Civil society	Part of the population that is linked by common interests, but not part of the professional response and not professionally trained in crisis management.	Initial DRIVER+ definition.
Crisis management	Holistic management process that identifies potential impacts that threaten an organization and provides a framework for building resilience, with the capability for an effective response that safeguards the interests of the organization's key interested parties, reputation, brand and value-creating activities, as well as effectively restoring operational capabilities. Note 1 to entry: Crisis management also involves the management of preparedness, mitigation response, and continuity or recovery in the event of an incident, as well as management of the overall programme through training, rehearsals and reviews to ensure the preparedness, response and continuity plans stay current and up-to-date.	ISO22300:2018 (en).
Disaster	Situation where widespread human, material, economic or environmental losses have occurred which exceeded the ability of the affected organisation, community or society to respond and recover using its own resources.	ISO 22300:2012(en) Societal security — Terminology, 2.4.5 [addition in DRAFT 2017].
Emergency	Sudden, urgent, usually unexpected occurrence or event requiring immediate action. Note 1 to entry: An emergency is usually a disruption or condition that can often be anticipated or prepared for, but seldom exactly foreseen.	ISO22300:2018(en) 10.

[3] The Portfolio of Solutions and the terminology of the DRIVER+ project are accessible on the DRIVER+ public website (https://www.driver-project.eu/). Further information can be received by contacting coordination@projectdriver.eu.

Terminology	Definition	Source
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent or current disasters.	UNISDR: Terminology on Disaster Risk Reduction: A Technical Review. August 2015, p24.
Prevention	Measures that enable an organization to avoid, preclude or limit the impact of an undesirable event or potential disruption.	ISO22300:2018(en) 21.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.	UNISDR: Terminology on Disaster Risk Reduction: A Technical Review. August 2015, p26.
Trial	An event for systematically assessing solutions for current and emerging needs in such a way that practitioners can do this following a pragmatic and systematic approach.	Initial DRIVER+ definition.
Volunteer	Individual, who is not affiliated with an existing incident response organization or voluntary organization but who, without extensive preplanning, offers support to the response to, and recovery from, an incident.	ISO 22319:2017(en) Security and resilience — Community resilience — Guidelines for planning the involvement of spontaneous volunteers, 3.1.