EmerGent

EMERGENCY MANAGEMENT IN SOCIAL MEDIA GENERATION

Deliverable 3.2 **Guidelines for Social Media integration into existing EMS systems**

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Glossary

Abbreviation	Expression
EmerGent	Emergency Management in Social Media Generation
A2A	Authorities to Authorities
A2C	Authorities to Citizens
CAP	Common Alerting Protocol
C2A	Citizens to Authorities
C2C	Citizens to Citizens
C&C	Command and Control
CSV	Comma Separated Values
EDXL-HAVE	Emergency Data Exchange Language - Hospital Availability Exchange
EMC	Emergency Management Cycle
EMS	Emergency Management Services
ESENet	Emergency Services Europe Network
GeoRSS	GeoRSS is an emerging standard for encoding location as part of a Web feed
GIS	Geographic information system
GML	Geography Markup Language
GPS	Global Positioning System
GPX	GPS eXchange Format
JSON	JavaScript Object Notation
KML	Keyhole Markup Language
NG112	Next Generation 112 architecture
OASIS	Advancing Open Standards for the Information Society

OASIS – FP6	Open Advanced System for Disaster and Emergency Management
PFIF	People Finder Interchange Format
POI	Point of Interest
PSAP	Public Safety Answering Point
RDF	Resource Description Framework
RSS	RDF Site Summary
SMS	Short Message Service
URL	Uniform Resource Locator
WFS	Web Feature Service
WMS	Web Map Service
XML	eXtensible Markup Language

1 Introduction

1.1 Abstract

In this task a technical analysis of EMS systems and processes will be performed, with the aim of understanding how to integrate Social Media gathered information into existing tools of EMS in detail and how to disseminate information back to the public. Furthermore existing information flows will be taken into account to guarantee a fluently integration into the processes and to understand the on-going useful procedures

1.2 Purpose of the document

This document is included in the overall work plan of the EmerGent project. Thus its objective is to contribute to the overall EmerGent objectives.

The aim of the document is as follows:

- Technical analysis of EMS tools, interfaces and exchanges in order to detect the technical impact of Social Media on existing software solutions.
- Analyse technical possibilities for existing EMS tools facing new Social Media challenges in order to develop guidelines for new processes, roles and responsibilities within tools of EMS.
- Generation of process models to identify valuable and meaningful information flows for the integration of Social Media data.

In the course of the EmerGent project the flow of information between the different actors, namely Citizens and Authorities, within the Emergency Management Cycle (EMC) is seen as the predominant subset of an effective workflow[1]. Thus the focus of the current deliverable is on the current status, future potential and available tools for the integration of Social Media into the information flow.

1.3 Target audience

- Researchers in Social Media for emergencies
- The deliverable is addressed basically to the European Commission for the purpose of summarising the national organisations/body's initiatives towards Emergency Management in Social Media Generation as well as explaining the current state of emergency communication technologies: capabilities and potentials.
- This document can also be useful for other third parties, such as software/tools manufacturers for the purpose of directing them towards producing devices that will be compatible with the EmerGent guidelines, as well as EMS for the purpose of informing their staff about the advantages of the Emergency Management in Social Media Generation.

[1] *Workflow may be considered a view or representation of real work (ISO/TR 16044:2004) or the "sequence of industrial, administrative, or other processes through which a piece of work passes from initiation to completion (http://www.oxforddictionaries.com/definition/english/workflow).*

2 Current information flow in the Emergency Management Cycle (EMC)

2.1 Methodology

The analysis of the processes within the Emergency Management Cycle is based on the result of semi-structured interviews done with representatives of the main types of EMS (Police, Fire and Rescue Service, Medical Service, PSAP) from Belgium, Germany, the Netherlands, Norway, Slovenia and Poland.

2.2 Scope and Definitions

When analysing the processes within the Emergency Management Cycle with the aim of understanding how to integrate Social Media gathered information into existing tools of EMS one has also to take into account of the various phases of authorities' activities with reference to any situation which has or may have an impact on people, the environment, property or public order. The first 3 phases are defined in Decision 1313/2013/EU on the Union Civil Protection Mechanism as follows:

- **'preparedness'** means a state of readiness and capability of human and material means, structures, communities and organisations enabling them to ensure an effective rapid response to a incident, obtained as a result of action taken in advance;
- **'prevention'** means any action aimed at reducing risks or mitigating adverse consequences of an incident for people, the environment and property, including cultural heritage;
- **'response'** means any action taken (…) in the event of an imminent incident, or during or after an incident, to address its immediate adverse consequences;

The last phase:

- **'recovery'** means any actions aimed at restoring the 'business as usual' condition, e.g. a situation which is managed on a regular basis; it includes minor incidents and routine interventions that do not raise the level of attention or criticality. [ESENet].

The communication departments of the authorities responsible for Emergency Management have already established their various routes for communication to the public in the preparedness, prevention and recovery phases, including Internet and Social Media to some extent. These communication strategies and tools used are quite similar in Public Administrations, both Emergency and Non-Emergency authorities.

While preparedness and prevention messages are conveyed only in one direction, there may also be some minor activities from the public to the authorities in the recovery phase, e.g. searching for missing relatives. By far the most bi-directional communication can be observed in the response phase and has a direct impact on the activities performed by the authorities, e.g. the EMS. ***Because of that we concentrate the analysis hereafter on the response phase only.***

The ESENet approach for the information flow in emergency Management allows a well-structured description of the current workflow in the response phase. The information flow is subdivided in 3 parts:

- When an incident occurs normally citizens notify the authorities (red arrow),
- which further process this information according to their duties and if necessary notify other EMS (blue arrows),.
- The respective reaction of the authority (response / warning) to that incident is reported back to the citizens in various ways one of which could also be Social Media (yellow arrow).

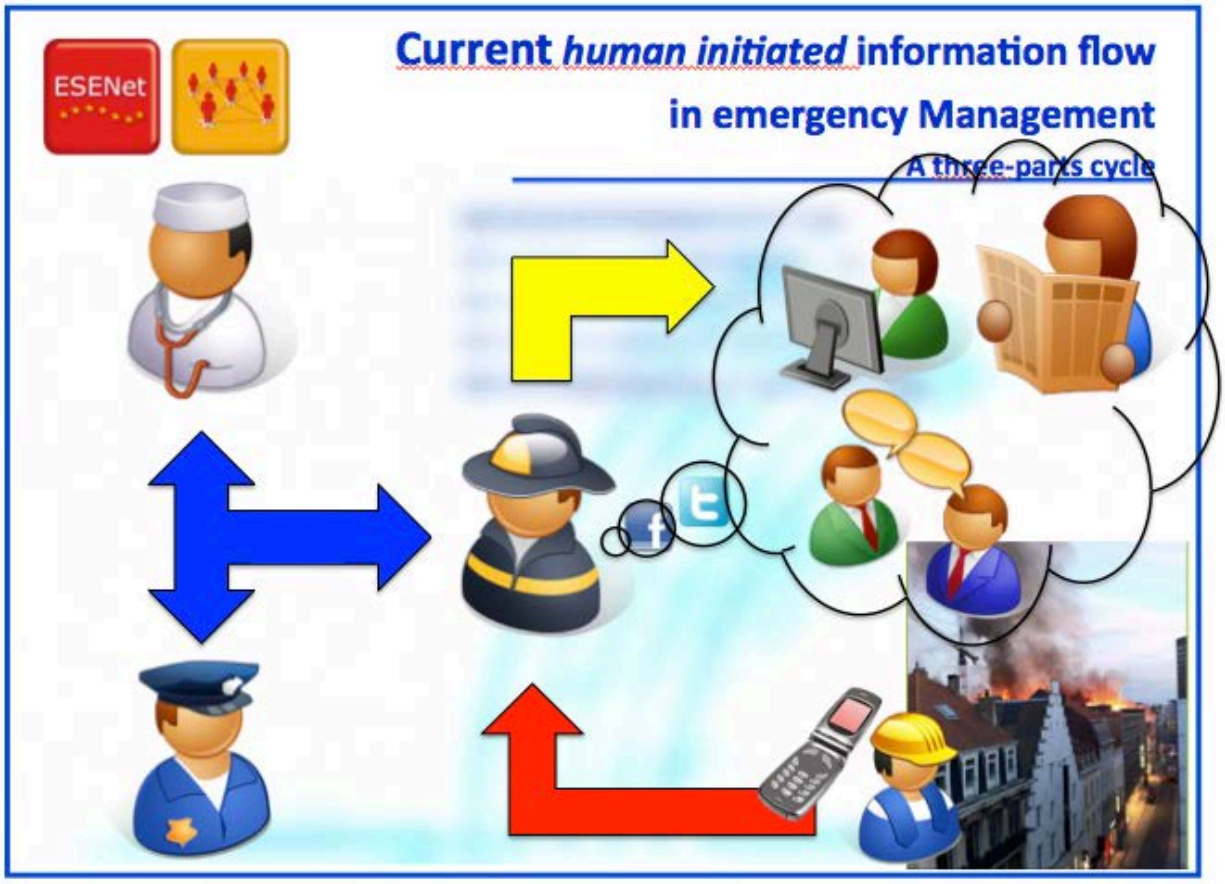

Figure 1: Visualisation of the flow of information in the Emergency Management Cycle after a citizen has reported an incident as described in ESENet - FP7 project 313013

2.3 Workflows

2.3.1 C2A - communication

Trained/skilled operators in the current organizational structure of EMS are receiving and forwarding urgent or non-urgent calls by citizens. The organizational structure of PSAPs differs in European countries but the C2A communication is more or less the same.

In general the call taker asks the caller for the type of an accident, accident location and other basic information regarding the specific type of an accident, as the number of involved people and type of injuries, information about hazardous materials, information about the building, scale of fire, etc. A dedicated user interface provides guidance for an efficient data collection and supports the call taker in creating a new entry ("Incident") in the system, that will be further processed and routed to other functions (e.g. dispatching).

Citizens are able to reach EMS or authorities by a classic telephone call, all over Europe, even in remote rural areas. This one to one communication - telephony, with the analogue or digital connection dominates in the current information flows. It is a mandatory part of a daily business, integrated in every EMS around Europe. Slightly different is the use of the short message service (SMS). It is not a mandatory solution and as a consequence, the percentage of availability to receive a message using this technology in EMS, drops drastically.

Currently only few EMS are able to acknowledge video calls and there are hardly any EMS where the caller is able to reach the authorities via WEB or mobile applicative solutions.

None of the interviewed EMS are able to receive an emergency call via Social Media.

2.3.2 A2A - communication

In the next step crucial information is provided to the specific service (Ambulance / Emergency Medical Service, Police, Fire Service) or to the specific unit, already on the field, via various types of communication channels.

Authorities in order to reach other authorities mostly use analogue or digital radio traffic in one to one communication, especially during the interventions. It is the generally known and trustful technology non dependable of public communication networks. In logistics and planning, basic telephony is also used to communicate between different EMS and/or other authorities. Retained or on-call response personnel is mostly alerted via paging systems or SMS or even both. Basic information about the intervention - event, event location, caller's name and phone number, priority of the accident, etc., is widely exchanged between EMS over the Internet but no common protocols or standards are currently used on European level. Other communication solutions as vehicle and person tracking, live video streaming, live online chat, etc. are scattered throughout Europe. Such solutions are available, as different software is provided across Europe, but standards and exchange protocols are yet to be discussed and drafted.

2.3.3 A2C - communication

Authorities disseminate warning messages to the citizens by using local, regional or national alerting solutions. The warning message is usually conveyed to the public via telephone call which is accomplished by the EMS superior officer or a commander, to the different media channels, online news, TV, radio and even Social Media networks, owned by the local news

stations, or a similar non-governmental organization. Although Social Media activity is more common when authorities are sending out the warnings, information about how to react in the specific accident, etc., is still outnumbered by other communication channels.

2.4 Social Media integration

According to Mergel and Bretschneider [MeBr13] Social Media applications are slowly diffusing across all levels of government. The organizational dynamics underlying adoption and use decisions follow a process similar to that for previous waves of new information and communication technologies. Mergel and Bretschneider suggest that the organizational diffusion of these types of new information and communication technologies, initially aimed at individual use and available through markets, including Social Media applications, follows a three-stage process.

- First, agencies experiment informally with Social Media outside of accepted technology use policies.
- Next, order evolves from the first chaotic stage as government organizations recognize the need to draft norms and regulations.
- Finally, organizational institutions evolve that clearly outline appropriate behaviour, types of interactions, and new modes of communication that subsequently are formalized in Social Media strategies and policies.

Although the interviewed EMS organisations were selected because they are very much interested in the use of Social Media and can be considered as much more advanced than the vast majority of European EMS, their Social Media activities – if any – are still in the first phase of the adoption process.

From the interviews performed one can draw that Social Media is not a common practice in the European EMS. Although there are some PSAPs or control rooms that are already using or at least trying to implement this technology in order to communicate with the public, to react on emergency related posts or even to respond to an emergency call in social networks, the majority of EMS remains in favour of standard technology solutions, that are already present since decades.

From the interviews reveal that EMS expect that Social Media will evolve in the future and will change their approach of communicating with the public. For the time being the use of Social Media for pushing data to the public is more likely to be in Stage 3 of the adoption process than it is for pulling data, because of lack of trust in pulled data and limited policies and related procedures.

All interviewees stated the lack of efficient and user-friendly tools embedded in their current C&C systems for smooth integration of Social Media, which is felt as a pre-requisite for monitoring of, responding to and informing the public via Social Media in the future.

3 Current Tools for receiving and providing information via Social Media

3.1 State of the art technologies

During day by day operations in their control rooms, EMS make use of software solutions and information system to mainly manage incoming calls, incident and resources and, less often, are used to cooperate with other departments, services or other EMS.

3.1.1 C2A - communication

Actually the general approved method that allows citizens to communicate with Authorities in emergencies is via a phone call. In the EU, the single emergency call number is 112 and the article 26 of the Universal Service Directive (Directive 2002/22/EC)[1] obliges Member States to adopt it. During the last years, efforts on both the legislative and the technical side have been made for allowing an easier interaction between Citizens and Authorities.

On the other hand, Social Media may also be perceived by citizens as a way to communicate with Authorities, either with direct messages or indirectly by sharing information and feelings within their communities. This is a subject of great interest for Authorities, given both the expectations from citizens and the growing number of tools implemented and tested by developers. In the US, for instance, the American Red Cross has established a "Digital Operation Center" to listen to Social Media and interact with citizens using them [WWW01].

3.1.2 A2C - communication

For what concerns Authorities to Citizens (A2C) communication, in recent years a number of initiatives (at both national and international level) have implemented automatic systems for distributing information about natural events, forecasts and hazards. Together with official emergency authorities, also research organisations, dedicated to specific disasters, have initiated a communication strategy that could be defined as "Social Media oriented". Good examples are the American USGS[2] and the Italian INGV[3] that regularly publish on Social Media and other web channels alerts concerning natural events like earthquakes, hurricanes and volcanic eruptions.

Although usually built on standards (either de facto or de jure), these automated procedures are seldom integrated in EMS, due (i) to the fragmentation of such information, (ii) the limited use of external data sources by EMS tools and (iii) a general situation of very low adoption of Internet oriented solution within EMS. This is well understood by EMS managers, who often feel the pressure of the growing demand from citizens for faster, more precise and clearer information. On a similar note, the general problem of an "authoritative" source of information for disaster related emergencies has been recently addressed by TWITTER ALERTS [WWW02] that includes a procedure for defining credible authorities to broadcast disaster information (FEMA's twitter

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0022:EN:HTML
[2] http://www.usgs.gov
[3] http://www.ingv.it/en/

account[1] is a good example). These are still relatively young efforts that have not been extended to the whole world (Twitter Alerts is currently very much US-centric). In Europe, for instance, currently, only few authorities use innovative communication channels (like websites or Social Media) to inform citizens about emergency situations, and still the mechanisms used to publish that information are not integrated within the current tools, and often they are implemented as manual procedures. GDACS[2] is a cooperation framework under the United Nations umbrella. It includes disaster managers and disaster information systems worldwide and aims at filling the information and coordination gap in the first phase after major disasters. GDACS provides real-time access to web-based disaster information systems and related coordination tools.

GDACS has recently started to broadcast tweets using a traditional twitter account[3].

3.1.3 A2A - communication

Regarding the communication between authorities (A2A), due to the monolithic structure of the current EMS systems, there are few automatic or semi-automatic mechanisms for interoperability adopted; nevertheless there are software solutions, currently in use by the Italian National Fire Corps, that are able to provide integrated interoperability capabilities that use automated procedures and are based on standards (e.g. Jixel[4]).

These three phases (C2A, A2C and A2A) are part of the information flow in emergency management and each of them, as said above, focus on a specific part of communication during emergencies. The ESENet EU project (FP7-313013) has been widely investigating these different aspects of emergency communications between citizens and authorities and more information is available on [WWW03].

3.2 Current available solutions

Currently, EMS make use of a number of experimental tools for receiving and providing information via Social Media. Generally, they are stand-alone tools used by dedicated personnel of the EMS, who check Social Media trends for spotting critical situation, getting alerts and collecting direct information about on-going events. In parallel, they inform citizens with public warnings and messages.

The situation is quickly changing and his rapid evolution does not allow providing an exhaustive list of possible solutions. In the following, a number of tools and existing software solutions are listed that may be used and are capable, with some limitations, of Social Media interaction.

3.2.1 SAHANA

Sahana Software Foundation [WWW04] provides free and open source disaster management tools. Sahana is organised in software modules that provide different features. With “Messaging module” Sahana can be used to send messages to subscribed users (distribution groups) via Email, SMS and other channels (Twitter, Google Talk, etc.). Currently, Sahana supports multiple

[1] https://twitter.com/fema/alerts
[2] http://www.gdacs.org
[3] https://twitter.com/GDACS
[4] http://www.jixel.eu

Open Standards from the GIS options such as WFS, WMS, GeoRSS, KML, GML, GPX, to domain specific ones like EDXL-HAVE, CAP and PFIF.

3.2.2 USHAHIDI

Ushahidi [WWW05] is a free and open-source software platform used to collect (crowd source) and visualize information. The Ushahidi platform is used for everything from social activism, citizen journalism, crisis reporting, public accountability campaigns, and many other possible uses

Local observers can report incidents via e-mail, web, twitter, facebook or text message; their reports are then uploaded to a website and the incident location is plotted on a map in almost-real time. This collection of information serves as a repository for concerned citizens to view and the aggregated data also act as an archive of events. The Ushahidi project includes another product called SwiftRiver, a free and open source platform that helps people make sense of a lot of information in a short amount of time. In practice, SwiftRiver enables gathering, filtering and verifying of real-time information from channels like Twitter, SMS, Email and RSS feeds, drawing insights from the collected information. It allows people to create buckets of information that are authentic, accurate and, above all, relevant.

It was born out of the need to understand and act upon a wave of massive amounts of crisis data that tends to be overwhelming in the first 24 hours of a disaster.

3.2.3 JIXEL

JIXEL [WWW06] is a suite of web based software applications allowing EMS to manage incidents and exchange information during rescue operations. Therefore, JIXEL is the first web based virtual Control Room for the management of incidents and the interoperability between EMS. JIXEL let EMS with different specialisation (Fire Brigades, Ambulances, Police, Civil Protection, Volunteers) and/or covering different geographical areas have a common dataset, rapidly interoperate on it and share a collaborative view on the same geography.

JIXEL allows interoperability and data exchange using internationally adopted open standards, such as the CAP (Common Alerting Protocol) used worldwide for alerts exchange. In addition to the CAP, whose structure has been defined within the OASIS consortium [WWW11], JIXEL makes use of open protocol TSO (Tactical Situation Object) that has been developed in the FP6 project OASIS (Open Advanced System for Disaster and Emergency Management).

JIXEL supports the EDXL family of standards to facilitate emergency information sharing between government entities and the full range of emergency-related organizations.

JIXEL is, furthermore, in line with the NG112 long term definition [WWW10] that will adopt the CAP Protocol in next generation European 112 emergency control rooms.

In the latest years, Jixel was improved by integrated tools that provide integration with Twitter. Reading data streaming coming from the social network, Jixel is able to monitor the tweets posted by EMS or that contain some relevant hash tags, with the aim to process these information and create new CAP messages that will be introduced into the system.

3.2.4 COOSTO

Coosto [WWW07] is a Social Media monitoring and engagement tool, generally used in different sectors like brand monitoring, campaign monitoring, data research and crisis monitoring.

Coosto offers in-depth insight into conversations on Social Media. Users receive real-time answers to the questions: who, what, where and when? Coosto gives the possibility to execute queries within Social Media with the purpose of obtaining aggregate information and show it inside dashboard, graph, and maps (based on geo-location points). EMS can benefit from that tool for checking the messages trend within a given area.

3.2.5 OBI4WAN

OBI4wan [WWW08] online and Social Media monitoring provides insight into what will be written and said about the own organization, brand, competitors, products and services. OBI4wan collects data from more than 400,000 Dutch sources and make it available within a convenient tool. OBI4wan integrates next Social Media channels like Twitter, Facebook and LinkedIn, including news, forums and blogs.

OBI4wan offers extensive opportunities to report data in a quick and efficient way. By using a drag-and-drop module the user can choose the content of the report. Thus measuring directly

- what is the content of conversations and on what type of online media they occur
- what is the sentiment around particular topics
- who participates in the conversation and what impact they have
- what is the extension of the query and what messages require reaction

3.2.6 TWITCIDENT

Twitcident [WWW09] is a Twitter monitoring tool for emergency services. Twitcident, originates from research done at the Delft University of Technology and TNO, aims to enhance public safety by providing more reliable, accurate and timely information to emergency services from Social Media streams.

Twitcident allows filtering multiple Social Media simultaneously, including Twitter, Facebook and Instagram. This ‘social filter’ can be combined with each other according to the needs of the user to quickly identify and manage risks and incidents. Twitcident also provides an algorithm that instantly alerts the user via mail or SMS about emerging events in his region or area of interest.

Areas of application of Twitcident:

- Incidents and crises: EMS and law enforcement use it to monitor natural disasters, extreme weather, social disruption, and more.
- Large-scale events: Law enforcement, festival organizers and event security use it to mitigate risks during festivals. Typical events attract 20k-2M visitors.
- Vital infrastructures: Public service operators & utilities use it as an additional source to gain actionable insights for their primary processes.
- High risk: Governmental organizations use it to apply early warning about political instability, social unrest, terrorism threats, and more.

3.2.7 SENCEPLACE2

A growing number of Social Media services like Flickr and Twitter allows for the association of locations with digital resources such as photos or text messages. This work tackles the problem of exploiting the abundance of such kind of data, by designing and implementing an application which analyses and visualizes spatial information from different Social Media services. The application provides two different data retrieval modes, the scenarios and the exploring mode. In both modes, information about the returned resources is aggregated on a map and displayed using different visualization means.

The resulting application (GeoEvent) allows users to access resources on the fly using local information [SaMA13].

3.2.8 TWEET4ACT

Tweet4act [CIAA+13] is a system for detecting and classifying crisis-related messages communicated over a micro-blogging platform. This system relies on extracting content features from each message. These features and the use of an incident-specific dictionary allow determine the period type of an incident that each message belongs to. The period types are: pre-incident (messages talking about prevention, mitigation, and preparedness), during-incident (messages sent while the incident is taking place and response), and post-incident (messages related to recovery and reconstruction).

3.2.9 TWITINFO

TwitInfo [MBBK+11] is a system for visualizing and summarizing events on Twitter. TwitInfo allows users to browse a large collection of tweets using a timeline-based display that highlights peaks of high tweet activity. A novel streaming algorithm automatically discovers these peaks and labels them in a meaningful manner using text from the tweets. Users can drill down to sub-events, and explore further via geo-location, sentiment, and popular URLs. More honest sentiment overviews are produced by a recall-normalized aggregate sentiment visualization. An evaluation of the system revealed that users were able to reconstruct meaningful summaries of events in a small amount of time.

4 Potential for Social Media Usage in the EMC

This section aims to present potentials for the use of social media in the EMC. It is structured according to the EMC phases as well as according to the communication relationships.

4.1 Social Media in the Preparedness and Prevention Phase

This phase aims at being well prepared for future emergencies. This means that EMS have to define and acquire the adequate capabilities and try to find ways of reducing risks as well as mitigating adverse consequences. A thorough preparation also includes the citizens' perspective. On the one hand they have to be informed about risks and suitable measures and on the other hand they provide information on, for example, past incidents or potential threats.

4.1.1 C2A - communication

- **Learning from past incidents:** EMS regularly learn from past events to improve their response to future emergencies. This learning process is based on documents and data. Since citizens intensively use Social Media during emergencies, they provide a great amount of data, which reflect the citizens' activities and perspective on the event and the EMS themselves. EMS could integrate these data into their learning processes to, for example, improve public communication or their use of information generated in Social Media.
- **Monitoring Social Media for early detection:** Early detections of potential emergencies help to mitigate the damages caused by disasters. For this, EMS generally try to anticipate emerging incidents as early as possible by capturing data and observing developments. TWITCIDENT [AbHS12a], for example, is a programme which constantly monitors different Social Media sites to detect possible threats to the public. This approach could improve the EMS' ability to foresee dangers and to warn the public in an early stage of an emergency.
- **Integrating citizens' initiatives:** Citizens' initiatives often exist in crisis-proven regions. Their aim is to ensure maximum safety for the population for the long term by offering help as well as engaging themselves in political discussions and processes. In doing so they build up a large amount of expertise in emergency response and have great influence on how citizens react to emergency situations. Social Media could strengthen the connections between those initiatives and the professional EMS to exchange information and knowledge and thus to better integrate them into the authorities' activities.

4.1.2 A2C - communication

- **Recommendations for actions in emergencies:** Especially in regions, which are vulnerable to natural disasters, EMS regularly give advice to the public on how to act in emergency situations. Traditionally those recommendations are distributed in printed form, for example through leaflets, which easily fall into oblivion when an emergency actually takes place. Social Media offer the possibility to present the recommendations in a more dynamic way, so that they are kept up-to-date, can be given in more detail and more emergency-specific, and questions from citizens can be answered [Reut13].

- **Regular information:** EMS and other organizations regularly publish the latest data, which indicate possible threats, such as water levels, weather data, or information on big events, to keep the interested people informed. Social Media could be used to establish information services operated by EMS to gather and publish this kind of information. Interested people could subscribe to such a service in order to stay informed automatically without spending efforts in searching for it.
- **Early warning** [DDAD10]**:** As soon as EMS want to inform the public about emerging threats, they have to find ways to quickly reach the population. Social Media do not only cover a large part of the population but also offer functionalities to share information. That is why they are not only suitable for detecting upcoming threats but for using them as a platform for publishing warnings, directly exchanging information with the public, and giving advice on how to act in certain situations.

4.1.3 C2C - communication

- **Strengthening self-help and collaborative resilience:** In emergency situations, citizens are mostly the first to care for victims and to conduct search and rescue activities [HeRu04]. So-called 'emergent groups' come into existence which are comprised of "private citizens who work together in pursuit of collective goals relevant to actual or potential disasters […]" [StQu85]. In recent years, the Internet has led to the existence of virtual emergent groups which "originate in the Internet and mainly carry out their activities online" [ReHP13]. Social Media could further increase the efficiency of such self-help activities by connecting citizens and offering suitable functionalities before an emergency occurs. Moreover, they could foster collaborative resilience, which means "the ability of a community to prepare for, respond to, and recover from disasters" through "collaboration between the private and public sectors" [Boar11].

4.2 Social Media in the Response and Recovery Phase

Within the response phase an emergency has happened or is already happening. All efforts in this phase have, generally, a singular focus [Bair10] on the speed and effectiveness of initial response. Quick situational awareness is needed to help authorities to initiate an effective response. Because of time-criticality in the response phase, EMS and citizens need to know the right channels to gather and distribute relevant information. From the interviews with EMS (see section 2) reveal that Social Media in Europe has the potential to spread out relevant information to citizens during the response phase.

The recovery function or process is characterized by a complex set of issues and decisions that must be made by individuals and communities. Recovery involves decisions and actions relative to supporting social and psychological needs; rebuilding homes, replacing property (both category "housing"); resuming employment, restoring businesses (both category "economic sector"); rebuilding the environment and permanently repairing infrastructure and lifelines. The recovery process requires balancing the more immediate need to return the community to normalcy with the longer-term goal of reducing future vulnerability [Bair10].

Appropriate management of and collaboration with traditional and new media are critical components of each phase of a given disaster. There is often a gap between response (usually an acute situation) and recovery (a more on-going process). Social Media can smooth the gaps in

the cycle by providing two-way communication between the affected population and both first responders and emergency personnel [CCDN13a]. But Social Media does not provide an inherent coordination capability to coordinate and share information easily [GaBG11]. With the analysis on the impact of Social Media and the development of tools to exchange information between citizens and EMS via Social Media EmerGent will seek to improve the two-way communication and coordination capabilities to share information to the right channels.

4.2.1 C2A - communication

- **Report incidents / request help:** Just before, during and after emergencies, citizens may report incidents to EMS or request help from EMS. Based on the emergency size during and after an emergency, traditional media like telephone may reach its limits very fast, because the communication channels in traditional media are often required to be synchronous. Past events have shown that Social Media with its communication technologies enables citizens to share their observations during emergencies easily. Incidents can by reported through different Social Networks. E.g. Tweets can be connected to, or integrated into Facebook posts and vice versa. Further, the development of different tools encapsulating Social Media methodologies like crisis maps or crisis blogs (e.g. Google Crisis Response[1]) and newsfeeds makes Social Media more interesting for usage during emergencies.
- **Provide information from observations:** During and after emergencies, citizens may be able and willing to provide their observations to authorities. Regardless of the limitation on traditional media, Social Media can provide high information content to enhance e.g. the operational picture in the response phase. E.g. pictures or video material enhanced with geo-data can be sent out easily. In general existing Social Media tools are able to handle different media. Thanks to the broad widespread of smart phones and mobile Internet access, citizens are able to enrich their observations by photo and video from nearly everywhere. Furthermore the use of geo-location may enrich the observations even more. Well-distributed Social Networks like Twitter or Facebook support the enrichment of posts by geo-data. By the development of syntaxes and tools Social Media is getting even more powerful to meet different concerns. The Tweak the Tweet [StSt10] and the Ushahidi project [Okol09] were used to build geo-enhanced crisis maps [McRo12]. Especially during the recovery phase volunteers can identify were help is needed to coordinate rebuild actions. For instance during the big flooding of the Elbe river in Germany in 2013 Google Maps has been used in Dresden to support and inform citizens about crisis relevant POIs[2]. Further developments like **SensePlace2**[3]**,** a map-based web application that collects essential information to allow for swift communication between government and citizens during an emergency. It has been designed to integrate multiple text sources (e.g., news, RSS, blog posts), which are then translated onto a map to allow emergency responders to easily filter through data by place or time, so as to analyse changing issues and perspectives.

[1] https://www.google.org/crisisresponse/

[2] https://maps.google.de/maps/ms?ie=UTF8&hl=de&oe=UTF8&msa=0&msid=207517637844069836346.0004de4dda1c22c9e31d9&dg=feature

[3] developed by the GeoVista Center at Penn State University (U.S.): http://www.geovista.psu.edu/SensePlace2/

4.2.2 A2C - communication

- **Provide Information / spread out warnings:** Social Media may enhance information spread of useful information or warnings. Depending on the provided information citizens could be influenced in their actions in a positive way.
- **Monitor Social Media / Crowd sourced information:** Monitoring of Social Media can be used to extract useful information to improve the situation awareness. Successfulness of emergency response relies heavily on situation awareness [RoKo11]. This could lead into a better overview of the situation. Depending on the size of the emergency, mining and filtering methodologies become necessary. Tools like Twitcident [AbHS12b] can be used to support the monitoring process. Authorities can request citizens to support the information collection regarding different topics. For example, in a National Weather Service (NWS) program[1], Twitter users are asked to report on weather conditions using the hashtag #WX. Through it, users can contribute information that may help the NWS better understand very localized conditions such as microbursts that may be missed by conventional instrumentation and sources. [CCDN13b]

4.2.3 C2C - communication

The communication between citizens via Social Media is not in the focus of the project.

[1] See http://www.nws.noaa.gov/stormreports/ and http://www.nws.noaa.gov/stormreports/twitterStormReports_SDD.pdf

5 Potential use of Social Media in EMS

Previous chapters explain how Social Media can improve communication between citizens and authorities in all EMC phases. In what follow, we focus on how to encourage the use of Social Media inside EMS, highlighting some approaches of gathering and providing information from/to Social Media and how those could be integrated within current workflows adopted in PSAPs & control rooms.

5.1 Potential integration solutions between Social Media and C&C systems

In preparedness, prevention and recovery phases, the information flows that come from Social Media could be handled using external software tools not integrated within C&C systems; however in response phase, that solution would be unsuitable considering that during emergencies a large amount of social network originated data arriving as a burst may influence and delay information analysis.

With external software tools (henceforward named as Social Media tools) we refer to all applications that could be used to search, monitor and analyse information from Social Media (for gathering information, e.g. Coosto), as well as manage multiple Social Media accounts (for providing information, e.g. Hootsuite).

Fostering workflows that may include the use of Social Media, some integration solutions between Social Media tools and C&C systems could be provided, focus mainly on information exchange.

Some approaches have been identified to provide integration:

5.1.1 Take advantage of export/import data from Social Media tools

Social Media tools that are configured for gathering relevant information from Social Media could be able to export these data (after an aggregation) in some suitable format (CSV, JSON, XML, etc.) for information exchange between software applications. These data, after imported into C&C systems could be handled as traditional alerts, observations or requests as expected in current workflows used in PSAPs & control rooms.

Furthermore, C&C systems could be able to produce datasets that can be taken as input by Social Media tools, which will then take care of publishing this information into Social Media.

To follow this approach some important aspects have to be considered:

1. C&C systems should be able to invoke procedures to import data from Social Media tools and then perform their processing; alternatively Social Media tools could automatically export data in fixed time intervals.
2. C&C systems should be able to import and export data into a format readable by Social Media tools.
3. C&C systems should be able to invoke procedures to export data to Social Media tools (e.g. creating reports) with the aim to disseminate information into Social Media; alternatively, Social Media tools could automatically import data in fixed time intervals.

5.1.2 Take advantage of inbound and outbound interfaces of C&C systems

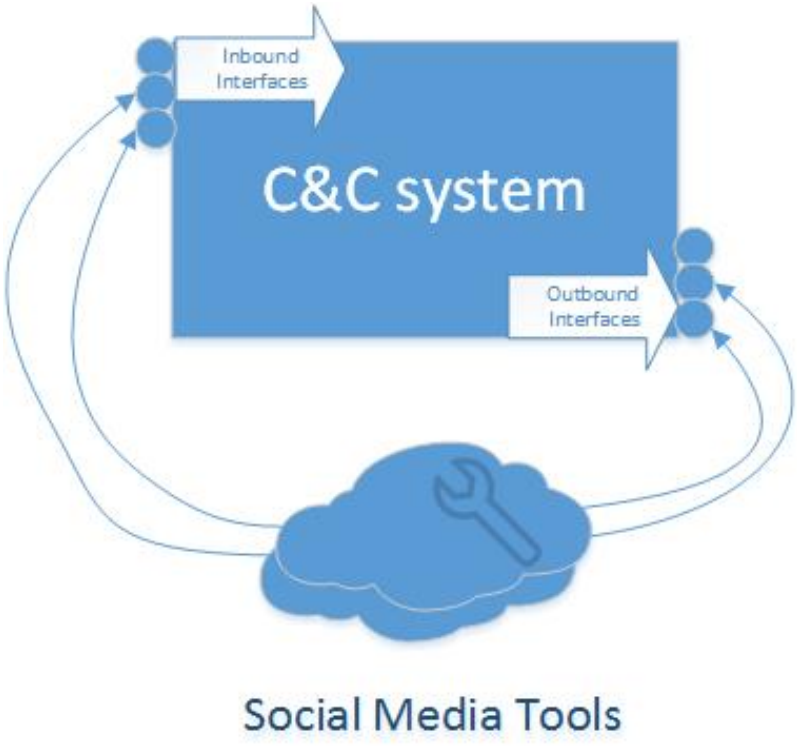

Figure 2: Interaction between Social Media and C&C systems

In information gathering, after Social Media tools have been configured to look for potential emergencies, when relevant data are recognized, they could be able to call an inbound interface provided by C&C systems. Conversely, during information providing, C&C systems generated data will be published on Social Media through their outbound interfaces. When C&C systems provide interoperability solutions, mainly based on standard protocols such as CAP or EDXL, the functionalities of communication could be simpler: it would be enough to develop an interfacing mechanism based on standards that will allow the integration of Social Media tools within different C&C systems.

In this approach, the aspects that could be considered are:

1. Social Media tools get potential emergency information from Social Media, create a message understandable by C&C systems (e.g. using a standard or proprietary protocol) and finally call its inbound services to share information;
2. Social Media tools continuously call outbound interfaces of C&C systems in order to publish relevant information

5.1.3 Integrate the interaction with Social Media into C&C systems

A third solution could be the integration of data collection and dissemination logic within C&C systems, as well as data analysis to obtain relevant information about emergencies.

Among the important aspects of this approach, we could have:

1. perfect integration with the EMC workflows;
2. implementation effort to integrate information flows that come from Social Media into C&C systems, as well as the integration of algorithms that allow the identification of relevant information for emergency situations;
3. on-going maintenance of C&C systems as a result of Social Media innovations, for example due to changes of Social Media interfaces (new API, deprecated API, etc.);
4. more calculating capacity of C&C systems (or scalability) is needed, in order to ensure data processing and management of a large flow of information that come from Social Media.

The possible listed solutions highlight pros and cons of each approach and this analysis could be considered during the design of EmerGent architecture. However, regardless of the type of adopted approach, as shown, it's important to facilitate interfacing between different software modules by using standard protocols during data transmission.

5.2 Future tool capabilities

In this section we look at what future tools should look like to allow EMS to utilise Social Media in the future. We list some suggestions that could be taken into account when developing new tools for the analysis and dissemination of information within Social Media.

It covers the functionalities that may be required to permit the communication flow from Citizens to Authorities (C2A), between Authorities (A2A) and also from Authorities to Citizens (A2C). This is independent from the different phases of the EMC.

In order to increase the use of Social Media by EMS trust needs to be built. Once EMS operators can trust the information/data received from Social Media, then the adoption of it as a legitimate channel will grow more and more.

5.2.1 Integration

One of the key concerns amongst EMS when using Social Media is the fact that any future tools should be fully integrable and interoperable with any existing software solutions that EMS are using, i.e. C&C systems. This is to ensure that any information or data is built-in the workflow of the EMS operator and also to minimize the need for multi-screens to be used to scan all communication channels. Having the Social Media channel integrated into the workflow of the EMS will drive efficiency, effectiveness and accuracy.

5.2.2 Standards

Any future tools should also be developed in conjunction with any technical or functional standards that exist. Any products should also be future-proofed ready to adapt to any changes in new technologies/standards.

The Next Generation 112 Long Term Definition document [WWW10] provides guidelines for to-come EMS, suggesting a design that would enable citizens to reach an authority by calls using

VoIP, text messaging, real-time text, pictures and video. It could also provide EMS with more data, such as location and health data. NG112 enables the delivery of calls, messages and data to the appropriate PSAP and other appropriate emergency entities, and adds significant value to the call handling process. Still a long term definition, not a de-facto running system, NG112 LTD should be surely taken into account as an important pillar of "what is going" to happen next in C2A/A2C communication

5.2.3 Language

Any future tool should be capable of transmitting and receiving Social Media messages in different languages to reflect the multilingual nature of the public at large. In essence, this should be automatically enabled with the capability to select specific language by the EMS operator.

5.2.4 Specification

If an EMS receives a request for emergency assistance or an emergency-related message via Social Media, the EMS operator will need to receive the following information set as a minimum:

- Address and time of the incident,
- Telephone number and/or an alternate means of contact (email address, user identification)
- Type of emergency, e.g. fire, traffic accident, medical emergency
- Number of victims and their current status (conscious/unconscious)
- Hazardous materials / special conditions that may prevail

If pictures or videos are being transmitted, the geo-location of the sender should be automatically transmitted and embedded in the message itself. It will assist the EMS operator in verifying the location of the sender of the message (bear in mind the location of the incident may be different from the location of the person posting the message).

Therefore, any tools developed in the future should have the functionality to read, store, analyse and utilise the aforementioned information/data.

6 Conclusions

From the results of semi-structured interviews (section 2) done with representatives of the main types of EMS (Police, Fire and Rescue Service, Medical Service, PSAP) from Belgium, Germany, the Netherlands, Norway, Slovenia and Poland reveal that only one-directional communication via Social Media, namely from Authority to Citizens, currently dominates the existing information flows. The lack of operators skilled in Social Media and insufficient user-friendly software solutions that would combine gathering and forwarding information to citizens was mentioned. The interviewees stated that better Social Media integration into existing workflows of the EMS would require user friendly, easy integrable software using most common protocols and standards, that will monitor and gather relevant data from the citizens or even disseminate data before, during and after emergencies.

From the state-of-the-art analysis of the current tools for receiving and providing information via Social Media (section 3) results that integration into the current generation of C&C systems could hardly be done. This is due to the fact that the tools, no matter how sophisticated the software is, have technical limitations regarding information exchange with typically monolithic structured C&C systems. Taking this into account a design and development focusing on tightening these two worlds is surely needed (and it's where EmerGent comes well in the picture).

The choice to integrate software at the inbound and outbound interfaces of C&C systems that analyses data and detect relevant information about emergencies could be a sound technical solution to avoid a radical change in currently used C&C solutions. Standard data formats for information exchange between EmerGent and EMS should be a relevant aspect for defining the information routing requirements.

Based on a literature review potentials for the use of social media in the EMC are presented. The first part focuses on "Preparedness and Prevention" and the second part on "Response and Recovery", each section describes the three communication relationships which have been selected before. Within both sections the most promising existing potentials for EmerGent have been chosen. Existing approaches have been investigated and combined to identify directions for the further development within EmerGent.

Based on the presentation of current and potential workflows and tools for social media in emergencies in this deliverable (D3.2) as well as the current use of social media (D3.1) and interaction design patterns (D3.3) in parallel works, the requirements (D3.4 & D3.5) as well as the potentials (D3.6) will be elaborated. For both the requirements and the potentials the current information flows are of high importance.

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