Social Media in Crisis Management: Role, Potential and Risk

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Abstract—**The paper explores the role of social media during large scale crises and disasters, as investigated by the COSMIC project. Based on a typology of crises and on case studies, we examine communication challenges and societal dynamics in conjunction with interactions among new media, officials and first responders, and the public. A number of technology issues associated with new media applications, such as their vast size, fast updates and semantic richness – albeit at semi-structured representations – are considered. Finally, we refer to features of the relationship between social media and the wider public, the associated ethics, risks and benefits and the potential role of citizens as first responders/volunteers, social activists and journalists/reporters.**

Keywords-social media; crises; situational awareness; societal dynamics; citizen journalism; response; preparedness; standard operating procedures; adverse use of social media; semantic models; social media data; new communications media

I. INTRODUCTION

The explosion of social media has, among others, generated new roles for ordinary citizens. These range from journalism (sharing of news, events and oddities globally), to effecting political change [1], [2], to aiding in emergency response during crises and natural disasters.

Numerous examples support this last role. In Japan, for example, social media sites, often accessed through smart phones, enabled individuals to reassure family and friends that they were safe when landline communication was impossible as a result of earthquake and tsunami damage [3]. In the aftermath of the earthquake in Haiti, emergency response officials were reported to have benefited from geolocational information and crowdsourcing regarding outbreaks of violence, while citizens could use it to locate food aid [4].

Despite such advantages, exploitation of social media communication via information technologies does raise a number of issues such as informational ethics, public safety, individual liberties, and consequences of misuse.

In what follows, we intend to explore the opportunities and consequences arising out of social media during large scale crises and disasters. We present findings from the COSMIC Support Action [5], whose aim is to describe the relevant interactions among new media, officials and first responders and the public and to examine the associated ethics, risks and benefits. COSMIC aspires to enhance public authorities', first responders' and citizens' understanding on how these new tools can be best utilised during crisis situations.

II. MAPPING CRISES

Appraising the contribution of social media to crisis management necessitates a classification of the crises faced by European Member States, their impact and the response actions of citizens, emergency services, and public and private organisations. We identified six types of crises that European Member States have been exposed to and which have resulted in a high physical and high societal impact, namely:

- floods
- extreme temperatures
- storms
- wildfires
- earthquakes
- man-made disasters

Case studies on representative examples of each type of crisis revealed [6] that the societal impact in the immediate aftermath fell on citizens, critical infrastructure and the government. Crises affect the safety and security of the citizen in a multitude of ways, including the physical and mental well-being, the destruction of communities and supporting critical infrastructure, the loss of personal property, the loss of life and, historically, in extreme cases, the destruction of entire civilisations. Three interesting findings on the evolution of a crisis were noted by COSMIC researchers:

- Citizens have a strong desire to help those who suffer. Individually, citizens are rarely passive and often exhibit pro-social behaviour during crisis situations. This behaviour is reflected (most of the time) in both organisations and communities and is indicative of the level of work people are willing to do, especially when new technologies (such as social media) are to be introduced.
- Societal dynamics is largely dependent on the time it takes for a crisis situation to develop, the magnitude of this crisis, but not on its type. Consequently, for individual, organisational and societal dynamics it makes no real difference whether society is confronted by, for example, a flood or a storm. This observation can provide insight on the (possible) use of new media technologies, even in the case of crisis types such as earthquakes, which occur without a warning period, with dynamics similar to the so-called flash crises.
- The role of government in the immediate aftermath of a crisis is often limited. Emergency management

agencies are either not present or otherwise occupied with a limited number of citizens, and even sometimes unable to mount an effective response. It is the aspiration of COSMIC to show that this gap can be filled to some extent by citizens deploying new technologies, for the benefit of the whole society under duress.

Turning to response measures with regard to a crisis, findings from the examination of case studies, [7], suggest that in the majority of situations, with the exception of the heatwave in France in 2003, the drafting of Standard Operating Procedures (SOPs) is important for ensuring preparedness of organisations for response. That said, analysis in COSMIC showed that SOPs, although present prior to a crisis occurring, do not always imply optimal or strict application in the field; in fact as the crisis unfolds alternative, non-prescribed response action may be necessary.

Regarding the involvement of the community, situations, where both rescue services personnel and volunteers took part, were dealt with in a more effective way. Still, the general conclusion is that more effort must be placed by authorities on engaging the community in the preparation and subsequent response stages involving different types of crises. Such engagement revolves around effective communication with and by the public. Factors such as transparency, speed, completeness and correctness are all important but they may also conflict each other. Case studies such as the terrorist attacks in London (2005) and during the Boston marathon (2013) demonstrated the lack of adequate information exchange. In the words of researchers at COSMIC, [8]: "whilst the London attacks demonstrated the need for better communication between authorities and members of the public both directly and indirectly caught up in the attacks, the Boston attacks demonstrated the importance of alternative resilient communication strategies, particularly, …the use of social media in opening up communication between authorities and the public".

The table below, abridged from data by COSMIC researchers [9], illustrates "known" stakeholders using new media applications.

A. *Communication Challenges*

Emergency response agencies differ in organisational structure, funding and tasks throughout Europe; however, the challenges they need to overcome in order to benefit from new and emerging technologies and applications are quite universal. To reach this conclusion, COSMIC researchers mapped different response organisations in Europe against the following list of 13 common such challenge areas, [10]; these must be overcome if the potential of new communication media is to be harvested:

- Understanding of disaster management among the public
- Management of information towards the media and the public
- Early warning capabilities
- Acquisition of information from external sources
- Efficient ways to gather data from responders
- Volunteer management
- Harmonisation of language and terminology
- Sharing and implementing lessons and best practices
- Interagency information sharing
- Responder communications in remote areas
- Retention of information and log-keeping
- Psycho-social support, intervention strategies
- Coordination challenges

B. *Crisis Models*

The sheer complexity of a crisis, the diversity of factors affecting it, the uncontrollable power of natural phenomena governing it, and the parallel evolution of many interacting processes result in a considerable degree of indeterminacy, which appears not directly amenable to modelling. That said,

TABLE I. **STAKEHOLDERS' USE OF NEW MEDIA APPLICATIONS**

Name	Primary application	Key dates	Stakeholders using application(s)	Example
Twitter	Social networking	Launched globally - March 2007	Government/Media/CSO's/Industry/Public	Hurricane Sandy (October 2012)
Facebook	Social networking	Launched globally - September 2006	Government/Media/CSO's/Industry/Public	Hurricane Sandy (October 2012)
Google public alerts	Web tool	Post - August 2005 (Hurricane Katrina)	Government/CSO's/Industry	Severe thunderstorm warning (Missouri, August 2013)
Google person finder	Crowdsourcing		Government/Media/CSO's/Industry/Public	Japan earthquake & tsunami (March 2011)
Custom Google maps	Crowdsourcing			New Zealand earthquake (September 2010)
Google fusion tables	Web tool		Media/Industry	The Guardian - London Riots (August 2011)
Airbnb	Web tool	October 2012 (Hurricane Sandy)	Public	Hurricane Sandy (October 2012)
YouTube	Social networking	February 2005	Government/Media/CSO's/Industry/Public	Eyjafjallajökull volcanic eruption (March-April 2010)
Reddit	Social networking	June 2005	Public	Boston Marathon attacks (April 2013)
Ushahidi	Crowdsourcing	2008	Media/CSO's/Public	Crisis Mappers UK - London 2012 Olympics
Ubalert	Web tool	August 2011	Government/Media/CSO's/Industry/Public	Earthquake New Zealand (August 2013)
AMBER alert Europe	Crowdsourcing	March 2013	Government/CSO's	On-going

some concepts and some types of prescribed action (procedures) can be modelled; to this end, COSMIC researchers used a UML based notation to abstract features and dynamics of crises [11] – work in the area is ongoing.

III. THE ROLE OF TECHNOLOGY

Communication in crises is affected by the convergence of ICTs, which has evolved from ad-hoc, focused services to rich, integrated services.

This development also necessitates a conceptual shift from viewing communication technologies as products, to breaking them down into capabilities, which can be used to compose a variety of valuable services or new media applications, [12]. It is to be noted here that when multiple individuals or heterogeneous organisations come together in a crisis, issues which then arise, such as interoperability and roaming capabilities, become critical.

Eight distinct case studies, (Boston Marathon Bombing, 2013; U.K. Heatwave, 2013; Gezi Park Protests, 2013; Sandy Superstorm, 2012; Colorado Wildfires, 2012; U.K. Floods, 2012; Haiti Earthquake, 2010; and Xynthia Storm, 2010) suggested that in the majority of crisis situations, social media were used quite extensively, but that there is generally also a high risk of misuse of such media in crisis situations, [13]. To this end, a number of potential misuses of communication technologies such as misinformation, mis-representation, propaganda, surveillance and censorship were identified. Another finding is the striking shortage of effort on the authorities' side to draw conclusions on the use of social media and to try to incorporate them in their own formal standard crisis response mechanisms. Several cases indicated that organisations and authorities should be advised to utilise both traditional media technologies and social media when communicating with the public.

COSMIC research identified 31 new media applications, [12], primarily classified as social networking websites (6), web tools (9), crowdsourcing applications (4) and mobile tools (12). Each of those applications offers differing levels of supported functionality, ranging from one-way communication to campaign support, to two-way communication, to assistance request. This means that suitability for use in a crisis varies on a case-by-case basis. An example, given by COSMIC in preparing for and responding to a flood, shows that "it is not enough for crisis managers to use a social networking site such as Twitter to share information updates and respond to some individuals' enquiries. Rather, they should also utilise other tools including those offered by Google Crisis Response, such as Google Maps, Google Public Alerts, as well as those tools that enable users to contribute to mapping a crisis, such as Ushahidi. Reference [14] claims that "in the event of the vast flooding of homes, applications such as Airbnb offer individuals a useful way of finding temporary accommodation". The following figure from [15] offers a schematic way to visualise the communication function-alities needed.

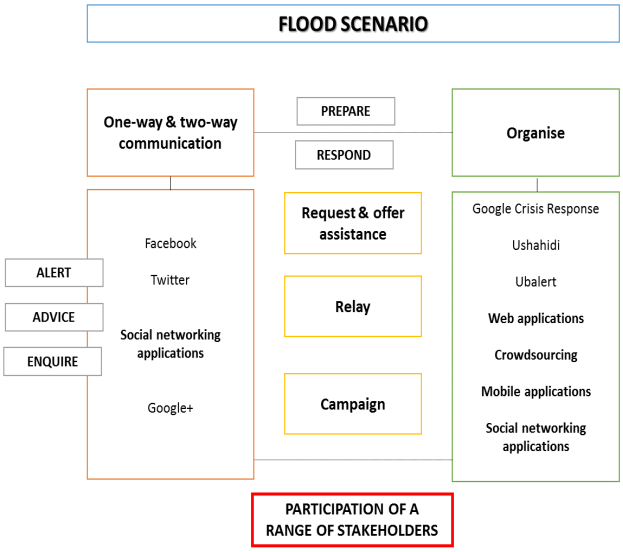

Figure 1. Communication functionalities in a flood scenario

A. *Emerging Technologies*

Emerging relevant technology areas and applications were classified by COSMIC under 27 areas, such as citizen journalism, cloud, crowdsourcing, data mining and big data, decision support, open data, and "organic" or smartphone sensor networks; for the full list we refer to [16]. Risks arising were identified and categorised as affecting the:

- individuals' privacy and sense of identity
- correct allocation of responsibility in crisis management
- occurrence of information overload
- potential creation of conflicts of interest among crisis management actors
- the creation of unintended, negative consequences when a certain technology is employed for crisis management

Despite those, findings showed that social media do contribute to the openness, fairness and speed of communication during a crisis. In addition, we should note the need for policy and standardisation support. For example, the implications of the, as yet unsettled, issue of the lack of an EU-wide imposed minimum bandwidth obligation on a Universal Provider were noted as a pending policy issue potentially affecting social network based communication, especially during a crisis.

COSMIC researchers note that: "social media data is intrinsically inter-referenced: the handling of relationships is the main differentiator between social networking services and the older Web; often, the entities whose relationships are defined in social media data are real-world entities, such as people", [17]. Other features of this data are its vast size, fast updates and semantic richness, albeit at representations which are usually semi-structured mirroring human relationships (via "likes", tags etc.). There are no commonly accepted (standardised) ways to represent such data, although attempts have been made. Linked Data [18] is a

suitable (structural) representation mechanism with the drawback however that it is agnostic to the specific semantics of social media data. It needs to be supplemented with semantic models. In fact, as COSMIC partners note, an, as yet unavailable, complete semantic model of all social media data would be a very powerful tool offering substantial aid in extracting reliable and valid information in emergency cases. Existing solutions include mainly ontologies:

- FOAF Ontology, [19], - describes people and social relationships on the Web. Particularly well suited for describing people on web-based social platforms (Facebook, Twitter, Blogspot, etc)
- SIOC Ontology, [20], - describes online communities such as forums, blogs, mailing lists, wikis; complements FOAF by focusing on the description of the products of those communities: posts, replies, threads, etc
- OpenSocial Data Specification, [21], - supports exploring the social graph and application development for social media applications; the most mature standards-based component model for cloud based social apps
- The SocIoS Object Model and the SocIoS Ontology, [22], - core of the European project SocIoS on the semantic equivalence among social media networks; supports consistent operations (the SocIoS Core Services) to be performed on social media data, regardless of the social networking site from which the data is drawn, suited to cross-platform applications

A number of privacy related issues for stakeholders are associated with emerging technologies, including transparency, legitimate purpose, data protection, anonymity and the impact of data collection on surveillance, as well as the potential impact on citizens' safety. Considerations in COSMIC have illustrated the need for greater emphasis to be placed on organisations, and in some cases, members of the public, to ensure that they take measures to protect sufficiently those with whom they are interacting.

IV. Social Media and the Public

New media allow citizens to assume a variety of roles regarding emergency preparedness and response; these were grouped in COSMIC under three classes, namely first responders/volunteers, social activists and journalists/-reporters. Features of citizens-responders resulting after an in-depth analysis of citizen awareness programmes and volunteer recruitment and training processes in four different countries, i.e. Turkey, Italy, United Kingdom and Greece, were identified as follows, [23]:

- Citizens' use of social media can not only enhance the availability of data on the impact of an emergency but can also help organisations make sense of existing data via crowdsourced filtering
- Although agencies tend to utilise social media extensively to reach out to the citizens, inconsistencies in the extent and types of utilisation were observed in some sample countries
- Despite use of social media, the dominant approach is still "communicating to citizens" rather than "communicating with citizens"

With respect to social activism, citizens' involvement occurs predominantly in political crises, where social activist formations use media to recruit members and/or form networks, communicate ideas, and coordinate action. The findings showed [23] that, with the help of networking technologies, organisations with horizontal structures that allow for direct participation in decision making processes can be created. These structures are highly flexible, forming and dissolving in short periods of time and enabling the formation of affinity groups. A local/global character emerges: while issues may be specific to different localities, the approaches, networks, and communicative actions are often global. Despite these advantages, findings show that mass media still play an important role with respect to the extent to which ideas can diffuse to the larger public.

Regarding the role that citizens may play as reporters (i.e., citizen journalists) during emergencies and crises, a two-pronged analysis of citizen journalism combined results from content analysis of articles published by citizens, who reported on four emergencies/crises, with online interviews conducted with a sample of those citizens. Findings showed, [23]:

- In addition to the ease of creation/sharing of content, one of the key factors that drive the increase in citizen journalistic coverage of emergencies is the dissatisfaction that citizens have about the ways in which mainstream media perform their agenda setting, watchdog, and sense-making duties.
- Coverage of recent emergencies/crisis suggests that citizen journalists may have been, partly, successful in terms of challenging the monopoly of traditional media organisations.
- While in interviews citizen journalists frequently claimed that they could deviate from mainstream reporting conventions, content analysis data suggested the opposite.
- The frequently adopted approach of "publish and then filter", places the burden of filtering out false information on to the readers, with obvious implications on the ability of citizens' journalism to evolve towards becoming a reliable source of information.

Besides the obvious opportunities the new media bring for citizens and their contribution to societies' resilience to disasters, threats and ethical concerns are also present, especially when faced with a crisis. COSMIC research identified and supported with examples the following risks facing citizens-reporters, [24]:

- Invasions of privacy, intentional or unintentional, occurring from the use of digital recording devices and disseminating recorded content via social media or crowdsourcing applications. For example, personally identifiable information, such as license

plates, may put individuals at risk during political crises.

- Online vigilante activity. Incidents in recent crises, such as in the aftermath of the Boston Bombings and the riots that followed the 2011 ice hockey Stanley Cup finals in Vancouver, showed that Internet users have utilized social media to take law enforcement into their own hands based on false information suggesting that certain individuals as being perpetrators.
- Respondents and security officers may be put at risk by citizens inadvertently exposing sensitive information. For example, during the 2013 Kenya shopping mall hostage crisis, tweets by the public may have revealed information that attackers could use to their own advantage.

COSMIC analysis identified ethical issues associated with producing and disseminating information via online networks during crises, [24]. Examples of two case studies, namely (i) the Istanbul Pogrom (1955) during which, as a result of a rumour spread about the bombing of the Turkish consulate in Thessaloniki, Greece, rioters targeted Greek minorities in Istanbul; and (ii) the rumours about an attack on a woman wearing headscarves in Istanbul (2013) highlighted that exploitation of public's sentiment via mass media and/or social media at times of crisis may raise animosity within a society. In other occasions, as exemplified by the Virginia Tech Shootings (2007), the need for sensational coverage of an emergency may create ethical problems when journalists (or citizen journalists) quickly assign blame under weak supporting evidence and exploit the vulnerability of the victims without respect for their opinions, privacy or emotions. Things can be made worse by abuses of power with respect to dissemination of information during emergencies, brought about by acts such as censorship.

V. CONCLUSIONS

Despite risks associated with privacy, human rights, informational ethics, public safety, and general consequences of misuse, social media contribute to crisis response in a variety of ways:

- They provide help towards responders by completing the building of situational awareness
- They contribute to valuable information which can direct rescuers of survivors
- They are a means of publishing information towards the public concerning rescue efforts and other vital to life information
- They add to society's resilience in the aftermath of disasters

On a more general note, social media do contribute positively to crisis management: they empower citizens and communities and they offer a means of personal involvement in mitigating the effects of catastrophic events.

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