Abstract
Social media has become an important factor in crisis response. From an improved situational awareness to facilitating communications; it supports responders in more effective crisis handling. Social media also enables affected communities to express their needs and others to respond directly. At the same time social media also poses challenges for responders; handling communications or data overload. To aid professionals in leveraging the potential and overcome challenges, a better understanding of social media as an integrated part of the response operation is needed.

While previous research focused on individual aspects or challenges, such as rumor spreading, we use a more holistic approach. Providing a group of volunteers, representing a broad demographic, with various profiles based on real-life cases and actual behavior to act as ‘Twitter-simulants’. With these simulants we added a comprehensive, realistic social media component to an extensive crisis exercise. In this paper we present the outline, its design considerations and the initial results, in particular on the achieved realism and added value for responders.

1. Introduction
During crises and disasters, response organizations are in need of accurate, actual and sufficient information to improve the effectiveness of their operations. Social media have become an important additional source for such information and has already played an important role during crises over the past years. For example, pictures and other media shared on social media, combined with other data, provided a more comprehensive picture of the situation when Hurricane Sandy struck New York [1], providing insights in the devastation that followed the hurricane. Enabling responders to remotely assess the impact both on a physical and livelihood level [2]. In one example responders assessed the extent of power outage across the greater New York area, as illustrated in Figure 1.

Social media, in addition to gathering data to improve situational awareness for responding professionals, have increasingly been used by citizens to interact, share and gather information themselves [4]. This relates to the essence of social media: users can directly interact with each other, enabling them to freely share information, connect and communicate with other users. These direct interactions enable users during a crisis to not only report on their own situation, but also actively search for additional information, offer support and advice by establishing a dialog with others. While the public is increasingly embracing the potential of engaging other users directly on social media during crises and disasters, response organizations face various challenges integrating these services and leveraging their potential into their response operations [2].

However, organizations do recognize the potential and efforts are being made by both professionals and scholars to further determine the opportunities as well as the risks associated with the use of social media in crisis response. For example, a disaster simulation exercise was organized by the Arizona State University in 2011. Victims used social media and text messaging to ask for assistance. Professional responders used several systems to track and respond to these requests and included the information in their rescue strategy [5]. Another exercise, conducted at ISCRAM 2012, introduced participants to the field of crisis information management and the use of social media for situational awareness during the response.
Participants acting as Urban Search and Rescue Teams were asked to use twitter messages to locate victims, manage information flows to the teams in the field and ensure effective response operations to assist victims across a wide area [6]. In addition to exercises and simulations many case-studies have been conducted to understand the potential and challenges of integrating social media in crisis response operations. Examples include the analysis of social media use in the response to the Haiti earthquake [7] or in the response to the California wildfires [4]. Many other case-studies and exercises have been conducted and analyzed, illustrating the increasing awareness of the importance and potential of social media during for responding organizations.

### 1.1 Research objective

To study the use of social media for disaster response and crisis management, case studies and exercises in controlled environments are most commonly used. A case study is an often used method to achieve a realistic and comprehensive understanding of the user and the context in which he or she operates [8, 9]. However, conducting case studies in the disaster management field is challenging [10]. Because of the limited access to the real-time data for these studies, researchers have to rely on anecdotal data recounted from memory [11].

On the other hand, exercises, simulations or serious games provide an opportunity to observe behavior and collect data first-hand. While they are designed and conducted to gain a better understanding of the role social media plays in crisis response, their scope is often limited to a specific aspect. Either because of limited resources such as the inability to extend the scope of the exercise context, or insufficient knowledge on how to setup a more comprehensive disaster exercise. Depending on the scope, the social media inserts in an exercise are controlled and/or preexisting data is used, as is this the case in the earlier mentioned exercises. In other exercises the scope is limited in a different way and does not include integration in field operations, as is the case in the example of Abbasi et al. [5]. In short, the use of a realistic human factor in combination with real response organizations and operations in an exercise or simulation setting is limited.

In reality social media, as is implied by the term, are not merely pieces of information or data inserts but rather a social system with individual personal and human elements [12]. They are part of not only complex (crisis) environments with multiple actors and stakeholders but even enable (new) interactions between them [13]. In order to identify and comprehend the challenges and opportunities in this complex system we aim to employ a comprehensive approach towards simulating social media use in a crisis situation [14]. We aim to establish a comprehensive, realistic exercise environment, using experienced victim simulants and unregulated Twitter use. In this environment, participating response organizations can truly experience public behavior via social media during disasters and interact with the public as in reality.

### 1.2 Approach

With the objective to provide comprehensive realistic environment for the use of social media the scope of an exercise needed to include several elements. To create a comprehensive environment required for our research, a realistic social media component is needed which would be connected (integrated) to a real and realistic exercise context. Figure 2 shows the various components of this setup and their relation. Starting from the overall exercise scenario we created two (connected) ‘exercise environments’: the social media exercise taking place online and the in-field exercise in a dedicated training facility. The two environments are connected through the scenario, while participants and responders would engage with each other through Twitter.

![Figure 2. Exercise scope](image)

To create the social media component, we have introduced ‘Twitter-simulants’, akin to victim-simulants, these people would act out a certain role based on an assigned profile. These profiles in turn were based on the overall scenario of the crisis simulation. From the exercise scenario we created various profiles and roles that will be assigned (A) to the both simulants online, and victim simulations onsite. Informed by their profile the simulants engage on social media with responders and each other (B).
Vice versa, responders act out their ‘normal’ roles, responding to the incident on-site (D) but at the same time would (be able to) use the social media platform to engage with the simulants (C) as part of the wider operational environment and affected area. Finally, simulants in the field (participating onsite) also participated in the online environment, for example sending pictures from the incidents site (E).

To ensure a realistic environment was provided, we first determined generic types of social media users during disasters, related to the extent that a user is affected by an incident or crisis situation. Next, using several case studies, we identified general types of behavior for these different user groups. While specific behavior depends on local crisis characteristics (e.g. connectivity or crisis type) we identified several categories of typical social media use, especially when focusing on a specific type of crisis [15]. Based on the different behavior types, groups of affected users and specific scenario elements, we created various profiles that were provided with instructions to the ‘Twitter-simulants’.

Prior to the exercise, a demographic survey was conducted in order to determine the best fitting profile for each participant. As per instruction, participants were free to engage with professionals as well as each other during the exercise. For reasons of data-collection (tracking) we asked participants to use Twitter as the social media platform during this exercise and to use a specific hashtag. Data was collected in another survey distributed following the exercise and to use a specific hashtag. Data was collected in another survey distributed following the exercise, in addition to the data collected directly from Twitter and on-site debriefing sessions with professionals. Using the collected data, we examined the social media behavior, verifying this through comparison with case-studies. Finally, we analyzed the data with a focus on the use, impact, challenges and opportunities observed in the exercise, from the perspective of responders and community members.

2. Social media in disaster response

Several groups of social media users can be distinguished on a scale ranging from directly affected to unaffected during disasters [16]. Firstly, directly affected victims are those experiencing the direct effects of a crisis and are often the first involved. Comparably to the other groups the number of people in this category is often limited, however they endure the greatest impact or are the most affected. Secondly, while the situation unfolds or remains unresolved, indirectly affected citizens experience the (secondary) effects of a crisis event, mainly as disruptions in their daily routines or in the availability of services. For example, difficulties in transportation or a limited availability of supplies. The effects on this group are not (yet) as severe as the directly affected, but often affect a larger number of people. Lastly the general public forms a large group, who are not physically affected but engaged at a personal level. However, the size and influence of this group requires considering them an actor as well.

While the behavior itself cannot be strictly classified in these categories, each group has distinct motivations to provide, gather and exchange different pieces of information during disasters. Using these groups as a categorization their respective social media behavior will be derived from several case studies, including Hurricanes Sandy, Gustav, Ike, the Japanese earthquake in 2011 and the 2007 Southern California Wildfires.

2.1 Trends in social media use

Each of these groups use social media in different ways. According to Lindsay et al. [17], five types of systematic use of social media in an emergency can be distinguished:

I. Social media can be used to by victims to post requests for assistance. Although medical support is not often requested, other forms of assistance maybe (implicitly) requested, for example in cases where the loss of power, obstructed roads or collapsed buildings are reported.

II. It can also be used to distribute official warnings, alerts and other critical emergency information. This can be classified as the use of social media to facilitate mass-communication from the point of the professional responders.

III. Social media can also be used to monitor user activity to establish situational awareness. This does not only apply to professional responders, but also to those directly affected by the crisis. Even the general public uses social media to improve their understanding of events unfolding.

IV. Social media also facilitates sharing media (e.g. pictures) across platforms to assist in damage estimation projects. This media provides additional information which can be used to improve the efficiency of recovery operations.

V. Finally, social media provides users, citizens, organizations and responders with the possibility to directly engage with each other. These direct conversations provide user with the possibility to not only share information, but also answer (reply) to the information available. For example, respond to requests for aid, offer tailored suggestions or provide clarification.
These types of social media use, can be mapped to the identified groups of social media users: directly and indirectly affected and the public. It should be noted that the above mentioned trends do not only apply to the citizen-responding interactions but also between individual citizens or organizations.

2.2 Directly affected

During Hurricane Sandy in 2012, directly affected citizens used Twitter to request assistance. In particular when the 911-system became overloaded during the peak of the storm, citizens started expressing their needs online, posting tweets seeking aid [2]. Similar behavior has been observed during the Japanese earthquake and tsunami in 2011 [17]. An important observation is that during the disasters, just a small percentage of Tweets originating from these directly affected users were replies to other users. Also, during both events about 50% of the tweets contained URLs linking to further information or visual data [2, 16]. These observations indicate that the directly affected users, mainly used Twitter in two of the five trends mentioned: to send information (IV) and to request assistance (I). More specifically, this group provides the earliest and most factual information due to their immediate involvement and vicinity to the incident. In short, directly affected citizens send requests for assistance to response organizations and provide onsite information for situational awareness (acting as a sensor) [18].

2.3 Indirectly affected

The indirectly affected citizens and users not only distribute information, but also monitor social media to gather information and increase their situational awareness [19]. The main goal of improving their situational understanding is to assess and minimize the impact on their personal life’s, for example by finding information about alternative routes when roads are blocked (III). In general this group is also engaging in more conversations on social media as the previous group [4]. Research conducted following the Southern California Wildfires also found that many respondents have shared information relevant to others, thus not only using social media for improving their own situational awareness but actively offering advice (IV, V) [20]. Summarizing, indirectly affected citizens distribute important, actionable information to help others and monitor social media to increase situational awareness regarding their own situation.

2.4 General public

Besides those directly or indirectly affected, there is a large group of people who are not personally affected but who are still engaged in online conversations during and after a crisis situation. This type of interactions generates the majority of messages related to an incident, although the resulting information has a limited direct value for professional responders. Nevertheless, the posted updates represent the general sentiment of the public, which is useful for policy and decision makers, such as politicians and/or government officials [4, 21]. For example, communication advisors can anticipate certain questions and provide information. The general public can serve as mediator, providing information or even aid to those (in)directly affected [22]. In short, the general public contributes to the generation of large volumes of information with limited immediate value but help gauge the public opinion (III). The general public can also make an active contribution to the crisis response by offering remote assistance, or support in-field operations (V) for example through fund-raising events or rallies.

2.4 Professional responders

In addition to these three groups of citizens engaging on social media, professional responders are increasingly integrating social media in their crisis response operations [23]. According to various (case) studies, professional responders and decision makers employ social media mainly in two different ways. First social media provides an additional channel to disseminate public information (II), for example alerts on (potentially) upcoming events, advice on handling common situations and/or status updates [18, 24]. Secondly social media provides responders with a wide human-sensor network providing them with additional information, as such social media is used as a data-source to improve the situational awareness of professional responders (III and IV) [7, 25].

![Figure 3. Common Twitter use in crisis response](image-url)
3. Exercise design

Campus Vesta is a school and training facility of the province of Antwerp, Belgium, providing courses, training and post graduate programs for professionals in the field public safety, health and security. In addition to training police officers, firefighters and paramedics, the school offers a program to train executives of different organizations, such as the police or fire department, on managing large-scale incidents. The program consists of different modules spread over two years. One of these modules is a multi-disciplinary, complex disaster exercise organized by the school. The exercise serves not only as an exam of the students enrolled in the disaster management program, but also involves other students of the school as part of their training. The exercise itself is a full-scale disaster exercise, and includes a physical incident site, on-site (professional) victim-simulants and various responding agencies [26].

3.1 Scenario

For the 2014 exercise, as scenario was constructed to would require participants to build a situational understanding and assess the incident, coordinate various responding agencies to attend to the victims and take action to reduce the impact on the environment [27]. These objectives were translated into a scenario with an accident between a passenger train and a truck carrying hazardous goods. To ensure the scenario did not only contain directly affected citizens, the scenario was expanded to include two (virtual) train stations on either side of the incident which at the time of the incident were dealing with the rush-hour. A nearby residential area was added, where the local residents were getting ready for neighborhood get-together. As such the responders also had to take into consideration these indirectly affected groups, as the truck was leaking gas, with the wind pushing the gas-cloud towards the residential area. At the same time passengers got stranded at the adjacent train stations and were in need of both alternate routes and information.

In addition to the rescue services (fire department, police and paramedics), the exercise also included scenario specific agencies. Since the scenario involved a train incident two additional agencies, using a fictive name in the exercise, were invited to join. A Belgian train operator serving the main passenger rail network and responsible for passenger transport, ticketing and service. Furthermore, the agency responsible for the developing and handling disruptions on the Belgian rail network joined the exercise. In addition to their staff participating in the field-part of the exercise, both agencies deployed their Webcare teams; a group dedicated to handling information requests and providing individual feedback through the use of web 2.0 technologies, namely via social media [28]. As these teams are tasked with online customer care service, they also play an (increasingly) important role in crisis response and management. The exercise itself ran on May 24th 2014 from 10:00 to 12:30 and involved over 50 in-field simulants, around 40 participants (responders), and 30 support staff (including exercise control).

![Exercise control](image)

Figure 4. Exercise participants and organization

3.2 Social media integration

In addition to the exercise elements mentioned above, we added a dynamic social media component using Twitter. While social media encompasses a lot of different platforms, Twitter was chosen because it allowed participants to easily create a new profile if desired, at the same time it allowed easy interaction between those participating in the exercise without first establishing a link (as it would on Facebook). Finally, the open nature of Twitter allowed the researchers to collect all tweets and interactions.

Volunteers were recruited to fulfill the role of a so-called online ‘Twitter simulant’, through professional and personal networks. Next, an online questionnaire was distributed among those who responded to gather demographic data, including their daily use of Twitter. Obviously participants of the professional responders (potentially) participating in the exercise were excluded. The resulting pool of volunteers consisted of individuals with mixed ages, varying familiarity with crisis response, and a
different use of social media in their daily life. The average age of the respondents is 36 years old, with a minimum of 15 and a maximum of 70 years old. Furthermore, the respondents have mixed Twitter experience and usage, ranging from 1 Tweet a week to 300 and from a handful of followers to thousands. This resulted in a pool of 153 participants covering a wide demographic range.

For the exercise several profiles were designed, using three constructs. The location of the victim (1): directly affected victims on the train involved in the incident, indirectly affected citizens who were either on the two nearby stations and the residential areas, and the general public. As a second construct we defined different objectives (2). For example, a student trying to get to class, or a citizen in need of information. Finally, we included a motivation/role (3), such as a concerned family member, a journalist etc. The combination of these constructs resulted in 48 different profiles, which were distributed among the volunteers. Each profile was matched with a volunteer using their demographic data, keeping a balance of 10% directly affected, and 30% indirectly affected and the majority being the unaffected.

General instructions regarding Twitter usage during the exercise were provided such as the required use of a hashtag for data collection purposes. Safety instructions were also included as the messages were posted publicly on Twitter. Volunteers were required, for instance, to clarify that they were participating in an exercise if there was any indication of confusion. Participants received several example Tweets based for their specific profiles to serve as inspiration. Finally, a select number (10%, based on the earlier mentioned cases) of profiles received a specific Tweet with factual information to be copied and posted. These Tweets contained relevant information for responders and allowed us to track the penetration of vital information. Other than these instructions participants were free to use Twitter in any way they deemed fit, there were no restrictions on the clients used, the possible interactions or the scope of the exercise. However, the online environment was carefully monitored by a team in the exercise control.

### 3.3 Data collection

Following the exercise, an online survey was sent to participants, with the goal of evaluating how participants experienced the exercise and how they perceive the use and value of social media during a crisis. In addition to the survey, all Tweets regarding the exercise have been extracted from Twitter using the tool DataSift and the predefined hashtag. Finally, a semi-structured debriefing was held with the responders on-site, discussing their experience.

### 4. Results

The exit-survey returned 70 responses, whereof 59 fulfilled the role of an online Twitter simulant. Eight respondents were part of the social media team of the involved agencies. In total, 2086 Tweets posted by 193 users were extracted from Twitter. The additional 40 users on top of the original 153 participants consisted of the agencies and responders engaging with the Twitter simulates as well as a few ‘spontaneous’ participants. Furthermore, about 1321 user mentions (Tweets containing one or several usernames in the content) occurred. The presence of a URL, either to documents or pictures was detected in 309 Tweets. During the exercise the hashtag of the exercise was trending in both Belgium and the Netherlands, the location of the majority of the participants. The exercise itself also generated a lot of media attention and was covered various news agencies referencing the social media component of the exercise.
4.1 Twitter participants survey

Over half the participants indicated themselves that their general Twitter behavior during the exercise was not or only slightly different than their normal usage pattern. The majority (54%) also indicated that their behavior during the exercise did not significantly differ from their potential behavior during a real crisis. Although this is based on a hypothetical question and produces highly speculative answers, it should be noted that -in the scenario- most participants were not directly affected, just like they likely would not be in reality. Also, the vast majority of respondents (including the professional responders) experienced the exercise and scenario as realistic. On a 5-point scale ranging from ‘Very unrealistic’ to ‘Very realistic’, the respondents answered with a mean of 4.19. Interestingly, more than half the participants indicated that participating in the exercise helped them to better understand the value and use of social media in crisis situations. Over 90% indicated willingness to participate again.

4.2 Tweets

The breakdown of the collected tweets according to the type of message, show that about 105 of the collected Tweets are retweets, 882 Tweets replies to other users and 1321 user mentions occur throughout the Tweets. Tweets categorized as "Mention" contain one or several usernames in the content of the Tweet, with the exception of Tweets starting with a username as these are replies. All remaining Tweets are free of user mentions and only contain information followed by a hashtag. These have been categorized as “Tweet”. The presence of a URL, either to documents or pictures has been observed in 309 Tweets. In addition to the messages themselves the recorded Tweets were analyzed using NodeXL [29] to examine the interactions within and between the various groups. We further examined these interactions and messages, according the five types of social media use, manually classifying them, although some messages can belong to none, one or multiple classifications. We distinguished the results in the interactions between users (all groups) and between the users and professionals.

4.3 Interactions among the population

As expected the majority of the messages posted by the ‘Twitter simulants’ contained general remarks, and opinions about the incident. These messages could be classified as opinion formation and sharing, and played a crucial role in the perception that user had on the governments performance. Of the total of 2086 tweets, about 68% percent to build and share their opinions, providing a limited value direct value to other users and professionals, although it is likely relevant for government officials. The next main use of social media was to directly engage with other users to offer them generic advice (about 12% of the cases) referring to either other tweets or external information sources. An almost equal number of messages (10%) offered specific (tailored) advice or assistance to other users. When analyzing the interactions using NodeXL, it showed that a number of users become prominent members in the online community: their messages were often shared, responded and referred to.

4.4 Interactions with professionals

Of the collected tweets, 294 originated from the professional organization partaking in the exercise. These tweets originated from 10 different twitter accounts which could be grouped into: emergency responders (police, firefighters, etc.), (semi-)private organizations (rail infra and operator) and government (municipality). About 25% of the tweets posted by these organizations provided ‘emergency information’: generic information regarding the cause and extent of the incident. A similar percentage (24%) contained communication information: references to additional information such as websites and phone-numbers. A smaller percentage of tweets (12%) offered generic advice to groups of citizens. All these messages are related to the use of social media to communicate warning, advice or general messages to a wide audience.

Looking at the active, direct engagement of the professionals with users the numbers are different. The most prominent example is when one of the organizations asked victims to submit pictures and videos to help build situational understanding. However, the direct response to users was limited: only 14 replies to users were sent out. And even in those cases the response was limited to an acknowledgement. It should also be noted that of the 294 tweets organizations only used additional hashtags in 10 tweets. Hashtag providing additional information such as #warning or place names were used rarely. Generally speaking, the overall professional response used the social media to improve their situational understanding, including actively seeking out information from users. Furthermore, social media was used disseminate public information. However, limited personal replies and advice were given, and those given were mainly debit to the Webcare teams of the rail operator.
4.5 Information penetration

As mentioned in the scenario introduction, several participants were provided with specific pieces of information with a direct value for responders. We asked participants to post this information at certain moments which were aligned with the timeline of the field exercise. Next we tracked the time between this insert and the inclusion of the information in the decision making process. We conducted 3 such inserts, one of which was never picked up, one was dismissed by the initial assessor as it was not relevant to his mandate. The third insert (map) was transferred to the command center and used in the decision making process 15 minutes after it was posted.

5. Discussion

The analysis of the post-exercise survey indicates that the interactions and behavior felt realistic to the respondents. With the majority of the respondents being the online Twitter simulants these results indicate that, even without the onsite experience, volunteers felt engaged. The number of replies and mentions demonstrate a high level of engagement and interaction between the users. These communications were mainly between users belonging to one of three simulant groups in the form of discussions, or between victims and response organizations in order to ask for assistance or provide information. Furthermore, the large number of mentions illustrates that users have mentioned other users in certain Tweets in order to inform them. This was mainly done to distribute information to a targeted audience. The presence of URLs in Tweets displays how Twitter has been used to share pictures by directly affected victims and to refer to additional information by other users. In short, the various types of behavior found in case studies, depending on the level of involvement, can be identified in our exercise through the twitter and survey data. The following sections describe the combined results of the twitter and survey data regarding the actual and perceived use of social media by volunteers (representing the population) and professional responders.

5.1 Social media use by population

As also observed in the case studies, exercise participants in the role of directly affected victims requested for assistance via Twitter. Specifically, the directly affected (on-site) simulations, acted as “first eyes on sight” by immediately sharing pictures of the situation and wounded individuals on the train and requesting immediate assistance. The indirectly affected citizens showed a strong focus on improving their own situational awareness, and determining their options or course of action. Those stuck on train stations seemed out alternatives, while nearby residents expressed concern about their own safety and the planned neighborhood party. The general public also contributed to information generation and distribution during the exercise. They were engaged in conversations, shared information with various degrees of accuracy. However, the majority of the public was looking for information to inform their opinions, the lack thereof turned them critical towards the governments and responders.

Additionally, our data show that some users established themselves as “hub” and became very active during the crisis, fulfilling the role of an information broker. For example, one user posted many replies and frequently mentioned other users which indicated an active communication with others. Vice versa information shared by this person was also quickly picked up by other users and disseminated rapidly. Furthermore, users were not only providing information to each other, but also established collaborations. For instance, citizens created an online victim or carpool list using tools such as Google Drive. These interactions demonstrate a great potential of social media to empower citizens during times of crisis, especially for those indirectly affected and (understandable) not a direct priority for responders. Twitter simulants indicated that they valued these initiatives.

5.2 Use by responding organizations

Large amounts of unstructured data (Tweets) are a challenge for response organizations during disasters. However, the importance of the ability to analyze and utilize this data became clear to them as was mentioned during the debriefing. Even with the predefined hashtag employed in this exercise to facilitate data collection, it proved challenging to find useful information. Not in the least because it depended on the specific organization what would classify as useful. Officials from the municipality required different information than the responding fire department, for example. We noticed how professionals look to tweets individually, addressing all of them with equal importance which will quickly lead to an overload of incoming messages. Only after the exercise it became evident to the professionals that several users established themselves as an informal information hub. Direct engagement with these users might have had a bigger impact on the overall perception of the ‘Twitter-volunteers’, and maybe should have been handled with priority.
The exercise also showed how communication needs have changed with the introduction of social media. The first Tweets and information exchange took place 45 minutes before communication was initiated by the official responders. As a result, some users became the de facto news source, being retweeted and followed more than the ‘official’ (exercise) accounts. Lastly, users mentioned that they considered Tweets sent by agencies as important but usually arrived too late, decreasing their value.

These above examples illustrate the importance of the changing perspective of social media for responding organizations; social media (and other interactive information technologies) are not a single-data point that can be used to augment situational awareness, nor is it solely a mass communication (broadcast) platform. Rather social media enables, and requires, continuous engagement. New relevant information, questions and initiatives arise over time and when unattended might lead to missed opportunities, increase the workload for responders or even increase the risk of discontented citizens. As a result of the exercise, the organizations recognized the value of organized citizens, most evidently through initiatives such as the carpool system. More generally, the fact that response organizations were able and even needed to make use of a real and dynamic Twitter environment, including their own tools provided them with a comprehensive experience and a way to examine the integration of social media in their response operations.

5.3 Safety

It is important to note that several precautions have been taken to ensure the safety both on- and offsite. Since the exercise was conducted using the Twitter-platform, including existing and personal Twitter accounts, special measures have been put in place to ensure that no confusion would arise whether or not the incident was real. Every participant placed a Tweet at the start of the exercise indicating that he/she would be participating in an exercise and the following Tweets were part of it. The official Twitter accounts from various government agencies posted similar messages and indicated a clear hashtag with the word ‘exercise’ in it. Finally, part of the exercise control team was monitoring Twitter in order to respond quickly to any confusion that might arise. While no incidents occurred, the precautions proved necessary as the hashtag became ‘trending’ (popular) within 15 minutes after the start of the exercise.

6. Conclusion

In this paper we presented a new disaster response exercise with the inclusion of a realistic Twitter simulation component, using profiles based on the behaviors of three groups of social media users identified in past cases. The combination of a real and realistic Twitter setting with an on-site disaster exercise provided a comprehensive environment enabling both researchers and professionals to explore the challenges and opportunities when including social media in crisis response. This paper presents the first step of ongoing analysis of the exercise, including network analysis and comparing timelines. From the collected quantitative and qualitative data, several initial lessons learned have been identified, such as the need for further integration of social media in the operational routines or the opportunities for citizens to provide support to each other directly. Further analyses and potentially similar exercises could aid in identifying more opportunities and ways to improve crisis response using social media. Also, since the (continuous) interaction aspect of social media plays an important role in the response and leveraging the potential we also recommend looking beyond the Twitter platform and explore the potential of other platforms. From our literature research we found that Twitter is very commonly used in simulations and research, for the same reasons we employed in this exercise. Although they might be more closed and pose a challenge in terms of data collection, verifying and exploring the role of other platforms is an important next step.

Whatever the platform, many studies have mentioned the potential and importance of social media in crisis response, there is limited study in the actual integration of social media in rapid deployments. Our study shows that social media remains a somewhat disconnected part of the response, used for improving situational awareness or disseminating public information. Integrating social media, basically considering the online environment part of the response would not only improve the overall sentiment of citizens towards responder, but also opens opportunities for a more effective response as citizens can actively engage and participate in the response and reducing the impact on their life. However, this is not an easy task to accomplish as it requires a reorganization of crisis response organization, but more importantly to recognize these digital citizens as stakeholders. And while the technical possibilities and potential have been proven before, true integration remains difficult for example because of organizational and political aspects.
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References