Community coordination: Aligning social media use in community emergency management

Rob Grace
Pennsylvania State University
wrg123@ist.psu.edu

Jess Kropczynski
University of Cincinnati
jess.kropczynski@uc.edu

Andrea Tapia
Pennsylvania State University
atapia@ist.psu.edu

ABSTRACT

Emergency managers continue to struggle with a lack of staff, information processing tools, and sufficient trust in citizen-reported information to coordinate the use of social media in their communities. To understand possibilities for overcoming these barriers, we conduct interviews with emergency managers using scenarios describing the projective activities of community volunteers disseminating and monitoring social media. We find that coordinating social media use in communities requires alignments with local incident management systems and, in particular, existing sociotechnical infrastructure for managing citizen-reported information. These alignments open limited roles for community volunteers, notably coordinating the redistribution of official information; and stand to reshape the workflows and infrastructures of incident management systems by pushing emergency dispatchers to proactively process indirect reports of incidents obtained on social media, and integrate tools that can access hyperlocal data, curate incident and situational reports, and facilitate sensemaking among officials confronted with multiple information sources.

Keywords

social media, emergency management, community informatics

INTRODUCTION

Studies of social media (SM) use during crisis have arrived at two general conclusions. First, by circulating information resources, SM can support cooperation among crisis responders, and directly and indirectly-affected citizens during disasters (Palen et al., 2010; Reuter et al., 2018; Starbird et al., 2010). When someone uses SM to send warnings and updates, request or provide aid, or describe the situation around them, they contribute to information flows that both citizens and crisis responders depend on during disaster. As a result, the nature of these flows shapes the possibilities and requirements for cooperation among citizens and officials during disaster response.

Second, due to the volume, variety, and velocity of information flows, cooperation among distributed citizens and crisis responders using SM requires coordination (Dailey and Starbird, 2017; Starbird and Palen, 2011; Ludwig et al., 2015; Kaufhold and Reuter, 2016; Reuter et al., 2013). For the tweet of an affected citizen to reach a crisis responder, or vice versa, requires articulation work performed by assembled technologies and, increasingly, digital volunteers who disseminate official notices and curate information resources that support situational awareness and decision-making (Cobb et al., 2014; St Denis et al., 2012). This "articulation space" in which digital volunteers use SM to align the situated actions of citizens and crisis responders, represents a primary focus for Crisis Informatics research motivated by the evolving coordinative requirements for cooperation among crisis responders and citizens in disaster response (Hughes and Tapia, 2015).

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Kees Boersma and Brian Tomaszewski, eds.

Yet while Crisis Informatics continues to explore how digital volunteers can coordinate disaster response, the corresponding articulation space of Community Emergency Management (CEM)- ongoing incident and emergency management work that takes place in geographic communities during periods of stability *intervening* crises- remains relatively unexplored (FEMA, 2011; Schafer et al., 2008). In contrast, prior studies observe that community emergency managers struggle to make use of SM at all, finding they lack staff, tools, and trust to effectively utilize SM (Hiltz et al., 2014; McCormick, 2016; Plotnick et al., 2015; Reuter et al., 2016). On one hand, these barriers resemble those crisis responders encounter during disaster yet now engage digital volunteers to overcome, raising the possibility that emergency managers might similarly engage citizen, "community volunteers" to coordinate the use of SM in their communities.

On the other hand, community officials working within local Incident Command Systems (ICS), remain wary of citizen participation in highly-structured workflows designed to centralized authority and accountability in incident and emergency management work (Hughes, 2014; Hughes and Palen, 2012). CEM involves cooperation among emergency services (police, fire, medical); citizens who experience and report incidents using emergency numbers (e.g. 9-1-1) monitored by local call centers or Public Safety Answering Points (PSAP); and county or municipal-level emergency management agencies (EMA) responsible for emergency operations planning and risk mitigation surrounding large-scale community events (i.e. festivals, parades, and sporting events), and local response operations during natural (i.e. flooding) and man-made (i.e. protests) emergencies (Quarantelli, 2000). Importantly, CEM workflows centralize monitoring and dispatch of citizen-reported information across municipal agencies, typically within the PSAP, and strictly control the dissemination of public information. In this respect, the nature of cooperative work in CEM, organized around the single organizational and operational structure of the ICS, suggests existing barriers to the use of SM— a lack of staff, tools, and trust— result from coordinative requirements that differ from those observed in disaster response, and require aligning within existing incident management systems.

Through scenario-based interviews with community emergency managers, this paper builds on the aforementioned literature by examining the coordinative requirements for SM use in CEM, and the extent to which community volunteers might fulfill these requirements by disseminating and monitoring SM in communities.

COORDINATING COMMUNITY SOCIAL MEDIA USE

During a disaster, cooperation among people who have information and people who need information can be coordinated by digital volunteers disseminating and monitoring SM. Social Media Dissemination (SMD) involves distributing information resources (e.g. warnings, procedures, updates, etc.) to guide the situated actions of crisis responders and citizens preparing for, responding to, and recovering from crisis. SMD also includes redistributing (e.g. sharing, retweeting) information to facilitate the accessibility, and visibility of information during disaster (Chauhan and Hughes, 2017; Hughes and Palen, 2012; Starbird et al., 2010; Starbird and Palen, 2010; Starbird and Palen, 2012; Sutton, 2010).

Social Media Monitoring (SMM) involves collecting, processing, and curating information reported on SM to support situational awareness and decision-making (Hughes and Shah, 2016; Starbird, 2013; Starbird and Palen, 2011). Remotely-located digital volunteers, sometimes organized as regional Volunteer Operations Support Teams (VOST), can provide crisis responders with needed human and technical resources to cope with the volume of SM generated during a crisis (Cobb et al., 2014; St Denis et al., 2012). As the relationship between digital volunteers and crisis responders evolves, crisis response organizations increasingly institutionalize workflows around open-source platforms and information anticipated from digital volunteer communities (Soden and Palen, 2016). Taken together, the use of SM during a crisis involves a) distributed and interdependent activities— or cooperation; and b) requires dissemination and monitoring work, often performed by digital volunteers, to align— or coordinate— the distributed activities of officials and citizens engaged in disaster response (Schmidt and Simonee, 1996).

Whereas the coordination work of digital volunteers disseminating and monitoring SM has long been recognized to enable cooperation among crisis responders and citizens during times of disaster (Cobb et al., 2014; Starbird, 2013; St Denis et al., 2012), the forms of cooperative work and associated coordination requirements characterizing SM use during intervening periods of stability, the context of CEM, remain relatively unknown. While prior research finds that emergency managers serving county and municipal-level jurisdictions often lack the staff, tools, and trust necessary to make effective use of SM (Hiltz et al., 2014; Plotnick et al., 2015), the cooperative tasks and activities these barriers impede, or how they might be overcome by coordinating community actors and resources, require exploration.

Lack of Staff

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

In a survey of over 200 emergency managers, Plotnick et al. (2015) found that only half made any use of SM, with a lack of personnel and time most often reported as the primary obstacle to adoption and use. As Zhang et al. (2015) observed among county emergency managers preparing for Hurricane Sandy: "limited SM usage at this stage was due to the fact that staff, resources, and first responders were doing all they could to stay on top of the more traditional forms of communication" (p. 4). Complicating staffing challenges is the lack of experience, training, and policy and procedures for utilizing SM among EMA staff (Hiltz et al., 2014; Plotnick and Hiltz, 2016).

Lack of Tools and Information Overload

In addition, the volume, velocity, and variety of SM data provides additional challenges for officials seeking to utilize SM for situational awareness and decision-making (Cobb et al., 2014). A lack of technical tools to prevent information overload, or the inability of humans to effectively make sense of large quantities of data, persists as barrier to the use of SM (Hiltz and Plotnick, 2013; Plotnick and Hiltz, 2016). Despite needs for technologies to assist resource-strapped agencies collect and filter SM data, technical tools remain scarce or unaffordable for most community EMAs (Plotnick et al., 2015).

Lack of Trust

While community officials do monitor SM for needed information in certain situations (Dailey and Starbird, 2017), many emergency managers approach SM as an untrustworthy source of information, to the extent that trust represents "a barrier that… prevent[s] the use of SM for information collection at this time" (Plotnick and Hiltz, 2016, p. 267). Concern arises over the credibility of people using SM, and the accuracy of information they post, such that many officials view SM as unfit for use in decision-making processes (McCormick, 2016). Consequently, research seeking to facilitate trust in SM has identified "trustworthy" content features as a basis for automated filtering techniques (Halse et al., 2018). Tapia and Moore (2014), however, find that officials utilize SM when provided by trusted sources, observing that "trust in people trumps trust in information" (p. 508). In this regard, trust rests on the credibility of the information source: "trust in a person, trust in an organization and trust in a network, all of which produce data that can be seen as more accurate because of the human agents involve" (p. 504). An important corollary is noted by Dailey and Starbird (2017), who observe that officials will utilize information reported on SM when it has been corroborated by information obtained from trusted sources (p. 1283).

Research Questions

The lack of staff, tools, and trust among community emergency managers, points to breakdowns in the coordination of SM use in CEM that might be overcome through the articulation work of community volunteers disseminating and monitoring SM. We therefore address the following questions:

What tasks guide emergency managers' use of social media? While SMD and SMM have been generally understood to support situated action and situational awareness (Palen et al., 2010; Vieweg et al., 2010), respectively, the particular tasks that SMD and SMM might be deployed to accomplish remain poorly understood in the context of CEM.

What cooperative activities and resources must be coordinated to effectively utilize social media? With respect to accomplishing tasks guiding the deployment of SM, we examine the coordinative requirements for the distributed activities of officials and citizens, and the social and technical resources they employ for these activities.

How can communities coordinate the use of social media in emergency management? Understanding the coordinative requirements for SMD/M, we examine how communities might (re-)align the use of SM around available actors, including community volunteers, and technical infrastructures in the community to overcome barriers of staffing, information overload, and trust now facing emergency managers.

RESEARCH DESIGN

As the focus of our study concerns how emergency managers employ SM in CEM, we sought interviews with U.S. county-level emergency managers as they direct the operations of local EMAs in cooperation with PSAPs, emergency services, and various community services and citizens' organizations within a geographic jurisdiction. Participants were solicited by contacting EMAs in the state of Pennsylvania to arrange phone or in-person interviews with emergency management staff. Altogether we interviewed 26 participants representing 16 county EMAs, including 14 EMA directors, 6 EMA planning and operations managers, four PIOs, and two

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

PSAP supervisors.

Populations served by each EMA represented vary widely. In Pennsylvania, counties are classified from 1-8 based on population size, with Class 1 and 2 counties located in urban centers with populations over 1.5m and 500k respectively, while Class 8 counties feature less than 20k people living in very rural areas (Table 1). In their survey of U.S. county-level emergency managers, Plotnick and Hiltz find "few differences in SM use or perceived barriers associated with county characteristics of population size or urban vs. rural composition," to include the size of EMA staff (Hiltz and Plotnick, 2016). However, as we explain in the following analysis, we only observed officials of more populous jurisdictions (Class 2-3) employing SMM.

Table 1. Emergency Management Officials Interviewed by Jurisdiction Population

County Class	Participants	Total
1 (>1.5m)	-	-
2 (>500k)	P11	1
3 (>210k)	P5, 12, 13, 16, 17, 21	6
4 (>145k)	P4, 6-8, 18, 19, 22-26	11
5 (>90k)	P3	1
6 (>45k)	P1, 2, 10, 14, 15, 20	7
7 (>20k)	-	-
8 (<20k)	P9	1
		26

Scenario-based Interviews

Interviews were conducted around use-case scenarios, "short stories about hypothetical characters in specified circumstances, to whose situation the interviewee is invited to respond" (Finch, 1987). Through the use of scenarios, we wanted emergency management officials to consider possibilities of SM use involving community volunteers in concrete situations of use (Carroll, 2000). Before each phone interview we forwarded written scenarios to participants by email. These served as the basis for exploratory, semi-structured interviews that followed emergent topics participants brought up as they reflected on the situations, actors, and activities described in each scenario. Interview data was collected either through written notes or audio recordings that were later transcribed and analyzed.

To construct each scenario, we began with actual situations of SM use described by emergency managers and coordinators serving a Class 3 county that was the site of an early, pilot study, and extrapolated these accounts by integrating activities and technologies observed among digital volunteers in disaster response (Cobb et al., 2014; St Denis et al., 2012; Starbird and Palen, 2011). As an exploratory study, we iteratively modified the three constructed scenarios across our interviews with emergency managers, in order to make each both plausible to interviewees and critical from a design perspective (Carroll, 2000). Each scenario was constructed and modified to facilitate insight into the purposes, cooperative arrangements, resources, and associated coordinative requirements of SM use in CEM. In this sense, we sought to use the constructed scenarios as a form of probe, "a design-oriented way to acquire inspirational glimpses of communities targeted for design" (Boehner et al., 2007).

The three scenarios begin with the prompt: "The following scenarios are set in fictional Laurel County. They imagine how an established group of community volunteers - the "Laurel Watch" (LW) - might support an emergency manager by monitoring and disseminating information on social media." Each scenario (1-3) then proceeds with a statement introducing a potential emergency event: 1. A rally for a national political candidate will be held in Laurel county; 2. Rumors are spreading of contamination to the county water supply; 3. Weather forecasts warn of a severe winter storm. Following Schmidt and Simonee (1996), we analyzed emergency managers' perceptions of these scenarios by coding and analyzing the tasks, activities, and roles defining cooperative work arrangements of SMD/M, as well as the sociotechnical resources (conceptual, informational, and technical) that support the common field of work of these arrangements.

ANALYSIS: SOCIAL MEDIA DISSEMINATION

As prior research observes (Plotnick and Hiltz, 2016), the emergency managers and PIOs we interviewed (n=20) use SM primarily to disseminate information to the public. However, as a task, emergency managers look to SMD to direct and coordinate public action before, during, and after emergencies: "What it comes down to is

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Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

being able to get them the information when they need it, make it valuable to them to make decisions, and be self-sufficient for a certain period of time" (P13). SMD involves sending the right message, to the right people, who can then take the right actions. This requires aligning three interdependent activities: gatekeeping, redistribution, and public response.

Gatekeeping, or the process by which municipal agencies control what information reaches the public (Hughes and Palen, 2012), guides officials' use of SM and constrains the possible roles for community volunteers in SMD. Scenario three begins by suggesting volunteers might disseminate messages to the public:

> Scenario 3a. Before the storm, volunteers disseminate weather warnings, emergency and non-emergency contact information, and preparation advice on SM.

Every official we interviewed rejected this idea out of hand: "We can't have outside people putting out information for us that has not gone through our vetting process" (P14). This gatekeeping process involves coordinating activities often distributed among staff across municipal agencies— information gathering, verification, inter-agency coordination, and message approval— to control what official information reaches the public. Conversely, *public action* involves the situated actions of citizens using official information. This information and the activities they inform can, of course, vary widely: severe weather notifications, traffic advisories, preparation advice (e.g. storm kits), etc. Crucially, however, the possibility of public action hinges on aligning official gatekeepers with the citizens who stand to use official information.

Redistribution

After releasing information to the public, EMA control over SMD- and the role of gatekeeper- effectively ends: "If we would put something on our social media, on Facebook and Twitter, and they take that and retweet it or tell their neighbors, of course we have no control over that" (P18). Here the articulation space of redistribution opens around the activities (i.e. retweeting and sharing) of community volunteers who coordinate information flows between gatekeepers and citizens situated to use official information.

Scenario one describes a local emergency manager directing the distribution of event-related information with volunteers of the "Laurel Watch" during a political rally:

> Scenario 1c. Traffic congestion and police efforts to manage the rival demonstrations have led to significant delays on the main road leading to the rally. You ask LW volunteers to identify and use relevant hashtags to retweet official traffic and safety advisories.

As the scenario illustrates, reaching the right people (e.g. people at the rally) with the right message (e.g. detours to take), likely requires deliberate coordination. For many officials (n=9), SMD can be used to reach more or particular citizens than possible with existing dissemination channels. Considering the role of redistribution, these emergency managers readily acknowledge the role of citizens: "we depend on, at that point… people to go ahead and grab hold of that information and continue to push it out" (P7). However, when considering the role community volunteers might play in redistributing official messages, as suggested in scenario one, emergency managers and Public Information Officers (PIO) often highlight experiences coordinating press releases with local television and radio stations. Officials readily describe the "great relationships" they develop with local media in the community, to whom they can call directly in order to arrange public notifications (P9). In contrast to these traditional activities of PIO work, most emergency managers found the idea of working with volunteer "influencers"- citizens who can voluntarily redistribute official messages to a large or specific group of people in the community- difficult or inaccessible.

While the majority of officials we interviewed actively utilize SMD (n=20), these officials typically neither know who uses SM in the community or take deliberate efforts to reach them. At the same time, however, these officials employ SMD to quickly reach more or particular segments of the population in their communities. Through SMD, for instance, an emergency manager can communicate with the majority of people who do not subscribe to the county's mass notification system: "even with this new system [Everbridge] we have probably less than 5% of the county enrolled in it" (P13). For other officials, SMD provides access to a unique audience: "kids who don't even use email anymore" (P18). "We utilize it for reaching that demographic, because it's a certain demographic that utilizes social media...," explains another, "it is usually the younger generation that is constantly on it, and that is our way of reaching them" (P10).

At the same time, emergency managers understand SMD as a poor way to reach other populations in the community. Among these are people especially vulnerable during emergencies:

> A lot of times the people that need assistance are not the ones on social media because you don't find a lot of the elderly folks on Twitter, you don't find people with access and functional needs on Twitter, and economically depressed people cannot go out and buy a $600 iPhone… (P11)

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

Yet beyond anecdotal evidence, the emergency managers we interviewed rely on assumptions of who actually uses SM in their jurisdictions. Importantly, these assumptions motivate the adoption and use of SMD among the emergency managers in their efforts to reach particular populations in their community.

ANALYSIS: SOCIAL MEDIA MONITORING

What do community emergency managers seek to accomplish through SMM? Prior research describes SMM as a source for situational awareness (Vieweg et al., 2010), however, our scenarios sought further insight into tasks that SMM supports in CEM. Scenario one, for instance, reads:

> Scenario 1b. On the day of the rally, volunteers curate important social media posts for you, including: posts detailing traffic jams surrounding the event; pictures at the rally that show and describe the developing protest; and campaign posts suggesting that the candidate- and the rally- will be delayed multiple hours.

While emergency managers we interviewed appreciated the general usefulness of situational information— "if people have information like that or tell us they are going to send us photos that is fantastic because the more information that we can get the better we can help somebody" (P15)— officials (n=12) often expressed difficulty imagining how community volunteers could support the routine operations of EMAs. Some expressed interest in deploying SMM to identify rumors circulating in the community (n=4), or, in the event of disaster, for rapid damage assessment using information (especially images) citizens post (P7, 24).

However, when generally considering CEM work, several officials (n=8) highlighted the experienced or assumed usefulness of SMM for early warning of incidents before they are reported to 9-1-1, and for situational information that could provide additional details or context to information provided by 9-1-1 callers. These emergency managers approached SMM as a distributed, indirect reporting system for coordinating incident management work, that could be deployed to more quickly report and dispatch emergency services (i.e. fire, medical, police) to the scene of an incident, and provide emergency responders with enhanced situational awareness to plan and conduct a response.

Incident Management: Report, Dispatch, and Response

These emergency managers see SMM as an "immediate source of information" where citizens can report incidents they observe in the community, potentially in advance of reports to 9-1-1 or inter-agency communications (P3). "We know that people will share things on SM and, in some cases, put things up before calling 9-1-1 or calling the power company," explains an emergency manager with SMM experience (P13). Officials observe that citizens often use SM alongside existing reporting channels as people will call 9-1-1 to report incidents they observe on SM (P3), or "put something on Twitter or Facebook and assume that someone has already called it in" (P18). Moreover, officials noted that as multiple people can report information on the same incident at the same time, SM provides a distributed source of situational information that can supplement sparse or incomplete information obtained from individual 9-1-1 callers and on-site emergency responders.

Rather than wait for citizens to report an emergency by calling 9-1-1, these officials seek to proactively *dispatch* emergency services by using indirect reports of incidents- information citizens post on SM surrounding events but not directly communicated to officials. "We are essentially utilizing a resource that we don't have direct access to for information gathering," explains the emergency manager of a Class 3 county:

> Right now, we are dependent on somebody else initiating the share of information with us, whether it's a responder in the street using a radio, a civilian calling 9-1-1 or a posted point of contact number, unless someone sees something and says something there is a delay in us gaining the information. Every second that we are unaware of an event or situation delays, correspondingly, any response that we can provide to whoever is in need in whatever capacity. (P12)

Nearly half of the emergency managers we interviewed, most of whom serve in Class 4 counties or higher, addressed SMM as a way to extend existing incident reporting systems such as 9-1-1 by processing indirect reports for early warning of incidents and situational awareness in order to more quickly dispatch emergency services.

Approaching SMM as an indirect incident reporting system for incident management work carries significant consequences for the progressive potential adoption of SMM in CEM. First, incident management consists of distributed activities: citizens indirectly reporting incidents on SM, officials dispatching appropriate emergency services, and officials responding with on-site fire suppression, medical assistance, security, etc. In the context of CEM, responsibility for coordinating these activities by processing citizen-reported information and dispatching emergency services does not rest immediately with emergency managers, but the staff of Public

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

Safety Answering Points (PSAP). As will be discussed, integrating SMM within a PSAP requires two additional activities- detection and verification- that allow SM to become useful for incident management work by overcoming barriers to staffing, information overload, and trust that have so far hampered SMM when performed among emergency managers.

PSAP Integration: Detection and Verification

Integrating SMM within PSAPs, remains, to our best understanding, extremely rare. Only two emergency managers we interviewed experienced this arrangement as a result of the unique organizational alignments present in their communities. Both were the directors of Public Safety Departments in urban, class three counties that administratively unified the county EMA and PSAP. In most jurisdictions, the EMA and PSAP operate along distinct administrative and operational divisions.

Integrating SM within a PSAP, rather than an EMA, allows distinct opportunities for aligning SMM within existing cooperative work arrangements and technical infrastructures for processing citizen-reported information in incident management. First, the demand for staff to continuously monitor SM has posed a persistent barrier to emergency managers seeking to employ SMM. However, integrating SMM (and SMD) within PSAPs avoids this barrier. PSAP integration proves, "absolutely, beneficial for the emergency management side here, of course during a disaster we are here, but the [9-1-1] dispatch is there around the clock, 24/7, and bodes well for us to get out anything we need to" (P18). Unlike all EMA offices, and most EOCs, PSAPs are continuously staffed and can provide around-the-clock monitoring of incidents detected on SM, as well as the dissemination of official information.

Second, the PSAP already coordinates information flows information between citizens and emergency response and management officials. In most communities, the EMA is often removed from this information: "When those two operations are split [EMA and PSAP], at least in my experience, what I take for granted as information coming out of the 9-1-1 center, there is also sometimes a significant delay in that knowledge rising to the level of EMA operations." (P12). This delay reflects the different operational mandate of the two agencies, with PSAPs primarily responsible for translating citizen-reported information into intra-agency dispatches for all emergency services and EMA personnel.

Detection

Integrating SMM within a PSAP, however, creates new challenges for 9-1-1 dispatchers and supervisors. Foremost among these becomes a shift in posture from reactively processing direct reports of emergencies made by citizens calling 9-1-1, to proactively *detecting* indirect reports of incidents. The emergency managers we interviewed recognize the need for technologies that can access information reported on SM and detect incidents in the community: "The idea was to mine information using keywords for things like power outages, flooded [areas], road closures, that kind of thing would really benefit us greatly," explained another emergency managers (P13). Requirements for detection in SMM follow existing protocols of 9-1-1 dispatch:

> Our primary thing is to not gather as much information from additional sources as we can. Our primary mission is to get as much information from the caller as you can, and as soon as you have the location and incident type, dispatch help, and continue to take information and push it to the help en route through a mobile data terminal. So by the time an officer or firefighter pulls up, if there is anything that would change their posture, upon entry to that event, they have that information before they get there. (P12)

The motivation for an early warning system suggests that useful SMM technologies would support existing protocols of emergency dispatch by prioritizing incident alerts, consisting of incident type and location, for the rapid dispatch of emergency services, and, second, curating relevant situational reports for use by emergency responders.

Detection, however, first requires technologies that can collect and filter hyperlocal SM data: information content (i.e. social media posts) and activity traces (e.g. likes, retweets) created by people using SM within a geographic jurisdiction. One PSAP utilized Geofeedia, a commercial platform for collecting and mapping geolocated information, to monitor SM alongside 9-1-1 calls:

> We would have it running in the background of the 9-1-1 center, and across Twitter and Facebook we had a list of approaching 75-100 keywords…surprisingly a lot of times SM gets posted on an event, particularly a fire or a law enforcement occurrence, and it would hit SM before a 9-1-1 call was made. (P12)

The PSAP was only able to use Geofeedia until October 2016, when Twitter, Facebook, and Instagram denied

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

the platform commercial access to data after reports described its use by law enforcement agencies during the 2014 and 2015 protests in Ferguson, Missouri and Baltimore, Maryland, respectively (Cagle, 2016). As the unified EMA/PSAP director explained, without this access the platform became "no use to us" (P12). Lacking a replacement, the PSAP no longer monitors SM.

Verification

In addition to detection, integrating SMM within PSAPs requires verifying the accuracy of citizen-reported information on SM. As mistrust of SM remains a primary barrier to its use, verifying the accuracy and relevance of information reported on SM becomes essential. The officials we interviewed sought to verify reports of incidents by following, often informal, protocols for corroborating information obtained from SM with information obtained from trusted sources, namely on-site officials and and 9-1-1 callers, or, in some cases, other social media users.

PSAPs provide the sociotechnical infrastructure for verification. "We get the information [SM], we will… vet it and investigate…," one emergency manager explains:

> Let's say they [9-1-1 dispatcher] gets something that someone puts out [on SM], "I just drove by John Doe warehouse and I see smoke and flames shooting out of the roof." They get that information and, hopefully that person has also called 9-1-1, but what they would do is let the supervisor know, they would probably yell it in the room, "hey, I just saw this." They would then send, law enforcement-wise, someone there to verify as soon as possible that there was an issue there (P18).

As infrastructure, the PSAP draws together, in the same room, the personnel and resources needed for verifying incidents reported on SM. These include dispatchers who monitor for incidents detected on SM, supervisors authorized to dispatch officials to investigate incident reports, and on-site emergency responders communicating (non-)corroborating information; as well as the information systems (i.e. radios, CAD) for receiving 9-1-1 calls, dispatching emergency services, and communicating with on-site first emergency responders. The other emergency manager observes the same:

> If we get a report that there are shots fired, and nobody can confirm it, generally most municipalities will send an actual patrol out to check the area, and once they're on the street, because we are a unified operation here- we handle 9-1-1, emergency management, and emergency dispatch- there is no entity in [Pennsylvania] County that we don't have direct, two-way communications with through a secured radio system. So once an officer, patrolman, fireman, regardless, is asked to check a report that has not been verified, we rely on our two-way radio communication… (P12)

This unique sociotechnical infrastructure for detecting and verifying incidents reported on SM enables the PSAP to coordinate the situated actions of citizens and officials during emergencies.

Occasions arise, however, when officials act on SM information before it can be corroborated and verified using official sources. In the case of multiple, original citizen reports or visual evidence of an incident on SM, officials might immediately dispatch aid before verifying the accuracy of the information. In these cases, emergency managers are sometimes willing to corroborate a reported incident on SM using only other citizen-reported information on SM. As an emergency manager explains:

> I'm going to try and validate the source. Is this the only one [tweet] that says this or is there someone else saying it too? I'm going to look to see if people are just retweeting the same thing that I just saw, or are they getting it from someone else? Or, are they all the originators of this information? (P8)

For certain types of incidents, and in the hope of dispatching a response more quickly, emergency managers are willing to substitute "crowd" measures for information obtained from trusted sources as provisional corroboration and verification of information accuracy. "If you get one report you'll probably send one person out there to check it," describes another emergency manager, "If you get ten people, you might start rolling out the fire company." (P18)

REVISITING BARRIERS TO SOCIAL MEDIA USE IN CEM

Our interviews with community emergency managers reveal that using SM is not a simple task. Rather, using SM in CEM involves cooperative arrangements among distributed officials, community volunteers, and citizens. Simply put, we find that to use SM in CEM requires community cooperation and, therefore, community coordination. By approaching the use of SM during periods of stability intervening crises, and as community-based, cooperative work, rather than the work of a single agency (Schafer et al., 2008), we reinterpret barriers impeding SM use among emergency managers- a lack of staff, tools, and trust- as community coordination

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

challenges that can be overcome by aligning SM use among municipal agencies, volunteers, and citizens in a community.

The Right Staff for the Right Task

Our interviews reveal that, taken alone, the availability, experience, and motivation of staff are insufficient for effective uses of SM (Hiltz et al., 2014; Plotnick and Hiltz, 2016): each task requires unique sociotechnical infrastructure to coordinate the use of SM in a community. It is insufficient, for example, for an experienced, full-time PIO working in an EMA to monitor SM, if that information can only be verified and dispatched by PSAP officials. Similarly, the availability of a PIO to distribute official notices on SM remains insufficient if community "influencers" in the community do not redistribute these messages to reach their multiple, intended publics. Overcoming staffing barriers requires aligning the distributed activities of SMD/M among community actors who are not only available and capable to take on SM duties, but appropriately positioned with respect to the sociotechnical infrastructures required for coordinating these tasks.

Consequently, to align tasks of SM use during periods of stability with their required sociotechnical infrastructures, our interviews suggest that the primary users and use context for SMD/M shift from emergency managers and the EMA, to emergency dispatchers and the PSAP, respectively. While EMAs lack staff to regularly monitor SM activity, PSAPs are continuously staffed to disseminate and monitor SM, while also positioned to verify and dispatch information reported on SM using trusted protocols and information sources. Similarly, while the lack of available EMA staff continues to impede SM tasks, community volunteers might not be able to perform them on officials' behalf. While for SMD we find immediate opportunities for community volunteers redistributing messages to the public, coordinative requirements for SMM during periods of stability often preclude volunteer participation.

Tools for Information Access and Overload

While prior research has observed a lack of tools among emergency managers capable of managing high volumes of SM data (Plotnick and Hiltz, 2016), our interviews reveal that barriers of information access often precede those of information overload. Primarily due to a continued lack of SMM tools, officials lack, the ability to collect hyperlocal SM originating from a geographic jurisdiction. As the case of Geofeedia illustrates, access to hyperlocal SM remains controversial and closely moderated by SM platforms, with some providing more opportunities for access (e.g. Twitter) than others (e.g. Facebook). Our interviews find that officials lack tools to even access available information, as well as tools that might expand access beyond the 2% of tweets geotagged within a geographic community (Morstatter, Pfeffer, Liu, and Carley, 2013). Thus, in addition to SMM tools for event detection (Imran, Castillo, Diaz, and Vieweg, 2015), systems that can extend access to hyperlocal SM are required. Grace et al. (2017), for example, infer Twitter accounts associated with a geographic community on the basis of community-associated social network ties. Such geographic inference methods could be leveraged by SMM technologies to access hyperlocal data.

In addition, despite using SM to provide timely information to the public, emergency managers lack access to information about the citizens they hope to inform. Consistent with Dailey and Starbird (2017), we observe that officials approach the use of SM with respect to "imagined audiences" they assume do or do not use SM. To coordinate SMD requires, first, access to community network visualizations that map publics of social media users and influencers who can reach them. Such information would allow officials to utilize the social network topography of a community to deliberately coordinate the diffusion of official information (Grace et al., 2017).

Second, to coordinate the redistribution of messages from officials to citizens vis-a-vis volunteers, as well as increase the speed of message diffusion, applications for automatically redistributing posts by official accounts could be voluntarily adopted by influencers in the community. This suggests a translation of traditional PIO practices: just as officials now develop relationships with local media to broadcast press releases, relationships could be developed with community influencers to automatically redistribute official SM posts in emergency situations.

Trust in Protocol, Not Information and People

Lastly, our findings provide further perspective on how emergency management and response officials come to trust information reported on SM. Rather than characteristics of information content (Halse et al., 2018), or the source of information (Moore & Tapia, 2014), we find trust to be based in protocol, to the extent that information reported on SM becomes trustworthy when officials follow established procedures for verification and dispatch. Trust in protocol is highlighted in PSAP use of SMM, where incidents reported on SM *initiate processes of verification and dispatch without preconditions for trust in the content or source of information.*

CoRe Paper – Social Media Studies
Proceedings of the 15th ISCRAM Conference – Rochester, NY, USA May 2018
Kees Boersma and Brian Tomaszewski, eds.

Our interviews reveal that the accuracy and salience of information reported on SM can be verified when corroborated with trusted sources and, under certain conditions, information posted by unknown SM users. Crucially, whether trusted or alternative sources of corroborating information suffice for verifying and, in turn, using information reported on SM remain situated determinations guided by formal or informal protocols established among PSAP officials.

While citizens play a necessary role in these cooperative arrangements by indirectly reporting information that officials seek to monitor and use, roles for community volunteers remain less apparent during periods of stability than those celebrated for digital volunteers in disaster response. Through our scenario-based interviews, we find that emergency managers look to SM as an early warning system for incidents that have not yet been reported to 9-1-1 and, secondarily, for situational information that can supplement 9-1-1 caller information to provide emergency responders with enhanced situational awareness. In view of such an early warning system, the work processes of digital volunteers processing SM data for use by officials becomes simply too slow; as previously highlighted, SMM technologies for event detection and curation become required.

CONCLUSION

Extending the findings of previous research (Hughes, 2014; McCormick, 2016; Plotnick and Hiltz, 2016), we detail the coordinative requirements for SM use in Community Emergency Management (CEM). The primary contribution of this work is an exploration of the articulation space of CEM to understand how community volunteers can disseminate and monitor social media (SM) to coordinate community activities during periods of stability intervening crises. In this unique context, and in contrast to activities performed by digital volunteers and VOSTs (Cobb et al., 2014; St Denis, et al., 2012; Starbird and Palen, 2011), coordinative roles for community volunteers transform and become less apparent in CEM, when emergency managers prioritize mechanisms for rapid and targeted information dissemination and event detection systems that can be integrated into existing incident management systems.

However, by addressing SM use in CEM as a form of cooperative, community work, our interviews also reinterpret barriers to SM use previously observed among emergency managers- a lack of staff, tools, and trust (Plotnick and Hiltz, 2016)- as breakdowns in community coordination. We suggest that these barriers can be overcome by aligning SM use within existing incident management systems. In particular, our findings recommend integrating SM capabilities within Public Service Answering Points (PSAP), 9-1-1 call centers that already process citizen-reported information and coordinate inter-agency and public incident notification and emergency dispatch. PSAPs are continually staffed and, via trusted protocols, can uniquely detect, verify, and dispatch information reported on SM using existing sources of official and citizen-reported information.

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