The Use of Social Media by Local Government in Response to an Extreme Event: Del Norte County, CA Response to the 2011 Japan Tsunami

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ABSTRACT

Social media has become increasingly important for emergency management. One example is its current use by governmental organizations to disseminate emergency-relevant information. During disaster events, it is imperative for people in affected areas to obtain accurate information. People using social media make a conscious decision to trust, act on, propagate or disregard emergency-relevant information. However, local government, in general, has not developed agreed upon ways to use social media in emergencies. This study documents how emergency management was able to successfully partner with local media and utilize social media to develop important relationships with the affected community via social media in emergencies. The study demonstrates a way to successfully utilize social media during disaster events in several ways: by closing a feedback loop between first responders and the public, by monitoring information flow, and by providing regular updates to the public.

Keywords

Social Media, extreme events, tsunami

INTRODUCTION

Social media provides an easily accessible medium for people to share information. During disaster events, people spend a significant amount of time searching for additional information (Lindell and Perry 2012). Oftentimes, people search for confirmation in order to validate previously obtained information (Lindell et al. 1997). The number of sources propagating disaster warning information has grown significantly over the past number of years. Dissemination sources, which include print and electronic means, are characterized by attributes that impact the rate of information diffusion. An abundance of information sources often causes people in affected area to obtain multiple warning messages, which are often conflicting. In these cases, people often seek additional information from trusted sources. When emergency operating centers are activated during disaster response, it may be very difficult to reach emergency management representatives directly; therefore, people often revert to other sources. Social media becomes one of the sources of information sought out by affected populations. In this paper, we study the effects of social media activation by a local media outlet in partnership with an emergency management office in the community of Del Norte County, CA.

First, we will discuss the relevant literature on warnings during extreme events, followed by the current role of social media in the warning response process. We will then provide a description of the Del Norte County, CA and its community in response to the 2011 Japan Tsunami event. The relationship between the local emergency management office and local radio station will be assessed as well. The relationship between the community and the local media and its use of Facebook will be discussed and evaluated in terms of its permanence.

WARNINGS IN DISASTER RESPONSE

People's response to warnings depends on many factors, including the demographics of the population, social and economic factors (Aguirre 1994), as well as physical, technological, and cultural factors (Golden and Adams 2000; Lindell and Prater 2007; Ding 2006; Sorensen 2003). Effective warning systems address people's

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perceptions as individuals and as a group, people's interpretations of warnings, people's demographics, cultural and societal factors; past experiences with the hazard (Lindell and Prater 2007; Sorensen 1987; Sorensen, Vogt, and Mileti 1987), and the availability of information.

The warning response process has been described in six stages (Lindell and Perry 1987; Mileti and Sorensen 1990):

(1) receiving the warning;

(2) understanding its contents;

(3) trusting its credibility;

(4) personalizing it;

(5) seeking additional information and confirmations; and

(6) taking action in response to the warning.

Lindell and Perry further describe a more integrated model – the Protective Action Decision Model (PADM), which illustrates a decision making process during disaster response (Lindell and Perry 2012). The model combines the information received from social and environmental cues with the messages transmitted through various communication channels to affected populations. The model incorporates various pre-decision processes such as reception, attention, interpretation of environmental and social cues, core perceptions about the risk and protective action, and final behavioral response facilitated by situational factors and inhibited by situational impediments. During an extreme event, people assess their need for information and when they are faced with incomplete information, people will be hesitant to take an appropriate action (Perry and Lindell 2003) and will search for additional information through observation and querying others (Perry and Lindell 1981; Perry and Greene 1983; Mileti 1999; Sorensen 1987; Sorensen, Vogt, and Mileti 1987). Often people will search for confirmations about the information they have already obtained (Perry and Lindell 1981). The information people often require is related to the severity of the hazard, time to impact, protective action information, such as logistics about evacuation routes, shelters, transportation, pet safety and arrangements for people with special needs (Lindell and Perry 2012). People often rely on mass media outlets for information, especially when looking for information about protective actions (Lindell and Perry 1993). People will also propagate warnings and discuss hazards with other members of the community (Lindell and Perry 2012). People form their intentions to perform certain behaviors, which correspond to the protective action prescribed by the authorities, based on social and environmental cues, perceptions of risk, and the information obtained regarding the event. The discrepancy often seen between the intentions to take protective action and the actual behavior is attributed to situational impediments such as the lack of a safe route and a physical inability to take protective action, etc. (Lindell and Perry 2012).

SOCIAL MEDIA AND WARNING RESPONSE PROCESS

Social media has been utilized by the government organizations involved in emergency response and traditional media, as well as by the public (McGinley, Turk, and Bennett 2006; Hughes and Palen 2009; Sutton, Palen, and Shlovski 2008). Numerous researchers and emergency managers have found that social media is an efficient, accurate, timely and usable facilitator for information sharing and propagation (White et al. 2009). For instance, during the Virginia Tech shootings, students were able to use Facebook to communicate with a large population about their safety status (Palen et al. 2009). Additionally, people were able to compile shooting victims' lists, as well as question and eliminate inaccurate information. In Haiti, social media was utilized by digital volunteers who emerged during the event to assist the efforts of the responders and the public to aid the victims of the Haiti earthquake (Starbird and Palen 2011). Moreover, during the Haiti earthquake, U.S. government was able to use the social media such as wiki and collaborative workforces as its knowledge-sharing platform (Yates and Paquette 2011).

Flikr is another form of social media that provides an easy way for people to share photos. Flikr data collected for extreme events that occurred December 2004 and October 2007 encouraged citizen journalism and provided pictures of event development that were eventually used as evidential documents by formal response teams (Liu et al. 2008).

Traditional media outlets also utilize social media, particularly Twitter, in reporting on extreme events (Tyshchuk et al. 2012; Tyshchuk and Wallace 2012). Traditional mass media typically takes on two roles: to first observe and report; and then to warn (Quarantelli 2000), with the second role more relevant to the disaster response process. Traditional media roles to observe and report events, as well as to warm the public, have been

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transcended with the advent of social media.

Despite the proliferation of social media, its use has still not been integrated into warning response processes. Effective integrated warning response processes require an integration of multiple subsystems, including detection and the management of emergency relevant information, as well as public response (Sorensen, 2000). Social media is used by both emergency management and the public; however, there is no official management of the information flow. Although emergency management organizations dispense relevant preparedness information, there is little or no monitoring of the information flow on social media once it is released. Moreover, the public response to the messages released on social media by emergency management organizations is not evaluated. However, social media also provides a medium for informal warning dissemination, which can travel rapidly to wide populations.

METHODOLOGY AND DATA

In order to ascertain the factors involved in the use of social media by local government for emergency warnings, Del Norte County, CA's response to the 2011 Japan Tsunami was selected as a case study, and the methodology employed was qualitative analysis of the data collected at Emergency Management office (Onwuegbuzie, Leech, and Collins 2010) . In order to conduct the qualitative data collection, the researchers contacted the local emergency manager via email to set up an interview. Consequently, the local emergency manager agreed to participate in the interview and invited a local media representative to join. The interview approach taken by the researchers was semi - structured and open ended. This form of the interview enabled the collection of facts as well as the interviewees' reflections on the event and the community. These reflections provided insight into the structure of the community and organization of the disaster response. A clear understanding of the community dynamics facilitated analysis of the behavioral response to an extreme event, the tsunami.

The 'After Action Report' was obtained from Del Norte County Emergency Management, which included the specific event timeline, event descriptions, response description and evaluation. In addition, there was a detailed description of the communication flow among the responders as well as the information flow to the public. Any improvements required in the disaster response plan were carefully examined in the 'After Action Report' and the implementation plans were described.

A member of local media described the flow of information among the Emergency Operating Center, media, and the public. The local media station utilized Facebook as a medium to communicate with the public. Facebook feed details were obtained from the local media representative and the Facebook feed of subsequent events was also obtained. The local media representative also provided an audio clip of the description of Facebook utilization during the event. During the interview, as well as, in the audio clip, the local media representative communicated the reasons for using Facebook, the issues that were addressed through Facebook, the description of the dialogues between the local media and the public, as well as the demographics of public who were engaged on Facebook. Additionally, the representative, who was an active member of the local community, gave her thoughts on the impact of Facebook during community's response.

The local media station representative indicated that after the event, the Facebook account was converted to an organization Facebook account and the data from the event was lost. However, the interview provided a detailed view of the Facebook feed of the local media station during 2011 Japan tsunami. These details included an insight on the contents of the posts, the dialogues with the public, Facebook participants during the event, comments, and updates. The manual content analysis of the currently viewable Facebook feed of the Del Norte County Emergency Services and the local media station for subsequent events aided in analyzing the presence and strengthening of the relationship between the local media station and Del Norte County Emergency Services with the community on Facebook.

CASE STUDY: DEL NORTE COUNTY, CA DURING 2011 JAPAN TSUNAMI

Del Norte County, CA description

Del Norte County is a small community located in the northwest corner of the state of California. The size of the community is 28,659 people (United States Census Bureau 2012). The ethnic background of the population is primarily white – 79.4% of the population. The geographical location of the county makes it highly susceptible to the effects of the tsunamis. Crescent City in Del Norte County has experienced tsunamis 31 times between 1933 – 2008, with the latest tsunami in 2011 (Dengler et al. 2008). Of those, only five tsunamis caused serious

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damage in Crescent City, including the 2011 Japan tsunami.

Per designation by the U.S. National Oceanic and Atmospheric Administration (NOAA), Crescent City, CA is considered a Tsunami-Ready community (National Weather Service 2012a). In order to be recognized as a Tsunami-Ready community, the community must:

(1) establish a 24 hour warning point and emergency operating center;

(2) have multiple ways to receive tsunami warnings and alert the public;

(3) encourage public readiness through educating the community and disseminating relevant information;

(4) develop a formal tsunami plan incorporating emergency exercises;

(5) comply with all TsunamiReady guidelines outlined by NOAA (National Weather Service 2012b).

The Del Norte County Office of Emergency Services (OES) is located in Crescent City, CA. In the next section, the disaster response by the Del Norte County OES, specifically, its tsunami response, will be discussed. The OES conducts frequent training sessions with public involvement to improve the public response to tsunamis.

Disaster Response in Del Norte County

When extreme events such as tsunamis occur, which may potentially affect Del Norte County, the Emergency Operating Center (EOC) is activated. The public is then notified of potential danger via multiple channels, and first responders are activated. If the decision to evacuate is reached, sirens are scheduled to sound at a 15 - minute intervals and the Emergency Alert System (EAS) is activated to warn the public, coordinated with the sirens. There are two public information officers who are located at the EOC and local media radio station. The public information officers provide information to the public and conduct interviews with the media. The public is further warned via door-to-door notifications conducted by first responders' teams, which include fire department and law enforcement officials, including search and rescue teams. Del Norte County OES coordinates its response with first responders, the Pacific and West Coast/Alaska Tsunami Warning Centers, as well as with the U.S. Coast Guard.

Partnership with the Local Media

Through continuous development and improvement of disaster preparedness plans, local emergency management in Del Norte County was able to establish a strong partnership with the local media radio station. This partnership extends as far as co-locating public information officers at emergency operating center and the local media's radio station when emergency operating center is activated. During various drill activities conducted by emergency management officials to improve community disaster resilience, the importance of the radio as a valid disaster information source is communicated to the community.

Del Norte County and 2011 Japan Tsunami

On March 11th, 2011, a Mw 8.9 earthquake occurred off the coast of Japan (NOAA Pacific Tsunami Warning Center, 2011). The earthquake triggered a major tsunami that brought about devastating damage to many communities. The tsunami affected all of the U.S. Pacific coast as well as Hawaii. The magnitude of damage was severe with 15,000 lives lost, including one in United States (in Del Norte County, CA). The effects of tsunami resulted in Hawaii being declared as a disaster area by the governor (Blair 2011).

The tsunami caused major economic damage in Del Norte County, CA, with between $12 and $16 million worth of harbor damage (Ewing 2011).The life lost due to the tsunami occurred near the Klamath River in Del Norte county, where a man was trying to film the tsunami. There were five people at Klamath River who were swept away with only four recovered (Ewing 2011). Multiple evacuation orders were issued across the U.S. Pacific coast and Hawaii. In Del Norte County, the decision to issue evacuation order was reached at 3AM PST. The sirens were to sound off at 5AM PST. The sirens were coordinated with TV and radio stations and were scheduled to go off every 15 minutes. The schools were closed and the school buses were repurposed for transportation of people from evacuation zones to the shelters. The first responders were directed to be out of the evacuation zones by 6:30AM PST. The planning for the response regarding utilities commenced with coordination from Blue Star Gas and Pacific Power. There were no issues with evacuation being reported with most people already evacuated out of the evacuation zones. Once the tsunami arrived, the damage reports began to come in with majority of the damage reported from the harbor where boats were placed on top of each other

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by the waves. There were a number of boats reported stranded out in the ocean with no access to the harbor. The issue was reported to U.S. Coast Guard. Most docks were already destroyed at the Crescent City, CA harbor. The surges continued through the morning of March 12, 2011. However, the threat of substantial inundation passed in the afternoon, and the decision to return the evacuees to their homes was made. Most of the evacuees, except for six, were returned to their homes by 7PM PST March 11, 2011. The advisory to stay off the beaches remained in effect with law enforcement patrolling the area. By 6AM PST on March 12, 2011, all shelters were closed and all evacuees returned to their homes.

Building a Lasting Relationship with the Community on Facebook

The 2011 Japan tsunami presented an opportunity for Del Norte County to integrate Facebook into its warning response process. The local media, a trusted partner of the Del Norte County emergency management office, set up a Facebook account as the means to improve the warning response process during the event. The local media representative stated that it was their job to keep people informed:

"As employees of the local media station it's our job to be at work on the air keeping people informed." as the "Lead PIO was at our station providing the updates"

When a new channel of disaster communication is introduced to the public, it often requires an adjustment time (Castells 2001). In this case, the adjustment time was not significant and the use of Facebook as the means of communication with public expanded rapidly throughout the event. The number of followers increased significantly, from 300 to over 2,100 as indicated by the owner of the Facebook account and the representative of the local media.

"At the end our 18 hour broadcast our fairly new Facebook page that had only around 300 friends shot up to over 2,100 friends, local and out of state, and continues to grow."

The lack of the adjustment time was assumed to result from preexisting relationship between the public and the local media. An additional contributing factor to user acceptance of the new channel was presumed to be the tight-knit culture of the small community where information travels by a word of mouth.

The Facebook account provided a way for the population to engage in information milling through reading and making wall posts relevant to the emergency event. Even with an effective warning dissemination system where people obtain multiple warnings via multiple channels, people still continue to seek additional information, often to confirm already obtained information (Lindell et al. 1997). The local media representative stated that the public also had access to the local media representative via instant message functionality provided by Facebook to inquire about the event and report incidents as it is indicated in the following quote.

"Facebook gave people, who did not have access to the radio or TV signal, up to a minute information about what was happening …" "It allowed me to take individual citizen questions and information that there were just not enough time to address on the air."

The Facebook account enabled a two - way communication between disaster response team and the community. This was accomplished through brokering of the information and aid requests from the community to the disaster response team and providing frequent updates to the community once the issue was addressed.

As an example of such brokering, the local media representative received a report via Facebook that boats were stranded out in the sea with no way to return to the harbor as it has been destroyed.

"Some of these chats", referring to the two – way instant messaging via Facebook, "turned into real issues that needed to be addressed such as where can the boats go to tie up, who have gone out to the sea to avoid the waves, since our harbor was destroyed."

The local media conveyed this report to the emergency manager. This report was relayed to the on site first responders and U.S. Coast Guard, who took appropriate action and relayed the updates back to the emergency manager and eventually to the local media and the inquirer. These actions further strengthened the relationship between local media and the community on Facebook, as the timely response to the inquiries demonstrated to the public that the Facebook, as the channel for warning response, was trustworthy. In addition, the inquiries that were posted on a wall on Facebook provided social cues to others that needed to take appropriate action (Lindell and Perry 2012). The local media representative noted that:

"Social media allowed the community to keep in touch and create a feeling of security of being surrounded by fiends and family during crisis."

Mass news media outlets were important users of off line as well as online media output (Tyshchuk and Wallace

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2012). The information provided by the national news media outlets was propagated rapidly through the webs of social media. As indicated by the emergency management and local media representatives, the information was not always locally accurate. National media outlets were issuing information that tsunami waves were destroying homes, and multiple deaths had occurred, which was not accurate information. This information, however, did generate a many inquiries from people who had friends and family in the area (Holt 2011). Local media was able to counteract the inaccurate information provided by the national news outlets regarding the local situation by calling the national news channels directly to contradict the information, and by regularly dispensing accurate information to the affected public via multiple channels including Facebook. Local media was also able to provide regular updates to the public's inquiries arising from confusion over conflicting messages in the national news via Facebook. As an example of Facebook success, the local media representative stated:

"The many panicked people from out of state that could not reach their friends and family were hearing the erroneous national news reports. Facebook allowed me to address their concerns while keeping the phone lines open for emergency personnel."

The Del Norte County Emergency Manager stated that using Facebook as a communication channel reduced the demand on the cell and wired phone communications systems, which allowed phone lines to be utilized more efficiently, promptly and for true emergencies and filter out non-emergency information requests.

Overall, the Facebook account (1) effectively disseminated the warnings issued by the emergency managers and approved by public information officer (PIO) on site; (2) opened an indirect line of communication between the disaster response team and facilitated on the ground disaster response; (3) addressed the dissemination of inaccurate information issued by the national news; (4) provided the social cues for people to respond; and (5) provided a medium for people to engage in information milling.

Impact of Social Media on the Community's Response

The membership, indicated by the number of likes, of the local media Facebook account grew during the event, and the members of the community became more active participants, not only seeking information from the owner of the page but also sharing their own experiences and observations as well as report incidents. Additionally, the Del Norte Office of Emergency Management Services followed the success of Facebook as the channel of communication with the public during extreme events and created a Facebook account. Following are the examples that were extracted from Kcre Kpod, the local media Facebook account, and Del Norte County Office of Emergency Services Facebook account:


Figure 1. Kcre Kpod Facebook Posts

The example in Figure 1 shows an update provided by Kcre Kpod about an earthquake that occurred off the coast of Oregon. The post suggests that there is no present link and provides a link to West Coast and Alaska Tsunami Warning Center. The members below commented on the post and suggested that this was the original source of the information for this particular event.
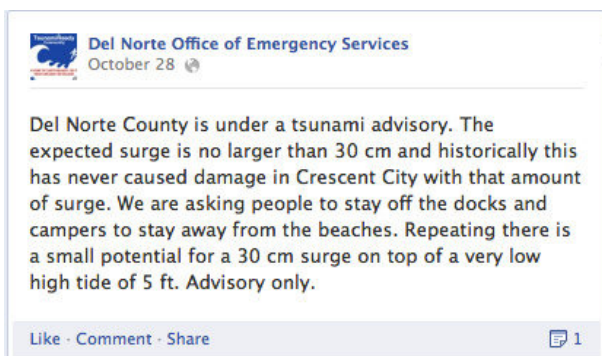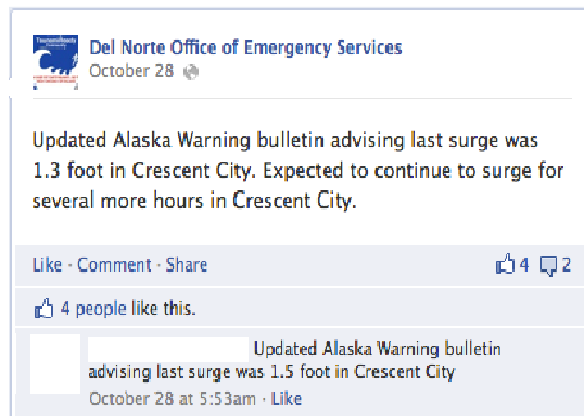

Figure 2 – Del Norte County Office of Emergency

Management Post #1
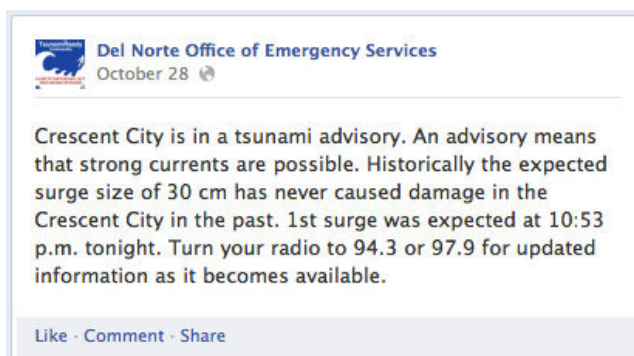
Figure 3 – Del Norte County Office of Emergency

Management Post # 2
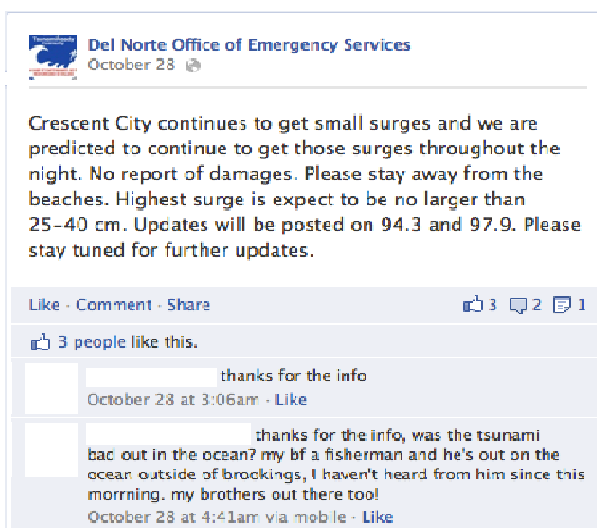
Figure 4 – Del Norte County Office of Emergency Emergency

Management Post # 3

Figure 5 – Del Norte County Office of Emergency

Management # 4

The sequence of the messages in Figures 2 - 5 issued by Del Norte Office of Emergency Service provides information about the tsunami advisory issued by the West Coast and Alaska Tsunami Warning Center. Additional information is provided regarding the definition of advisory and the protective action required as a response to the event. Del Norte Office of Emergency Services also provides a number of updates regarding the event with one update shown in Figure 5. The posts also prompt some response from the community providing additional updates to the posts.

It is clear from numerous posts examined by the authors that the relationship on Facebook between the local media and the Office of Emergency Services and the community strengthened over time. This is evident from examining the number of 'likes', 'comments', and 'number of people talking about it' counts. Throughout the event, the Del Norte Office of Emergency services, Kcre Kpod and Del Norte Office of Emergency Services continued to use Facebook to communicate emergency relevant information, provide updates, and respond to the inquires from the community.

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CONTRIBUTIONS AND CONCLUSION

Social media plays an important role as a communication channel. People utilize social media to obtain and share information. During extreme events, people continue to seek information regarding the risks associated with the event as well as the information regarding the protective action. Moreover, people seek confirmation, in the form of inquiries to others. More importantly people seek information on how to obtain emergency aid.

During the 2011 Japan Tsunami, the impact on the small community of Del Norte County resulted in inquiries for information, confirmations, and aid. Through an established partnership between the local emergency management organization and the local media radio station, Del Norte County was able to efficiently respond to the inquiries. This process was facilitated through the use of social media, specifically Facebook. The local media radio station undertook the initial role of communicating with the public via Facebook. Contact with the community was established partly due to pre-existing relationships with the community off-line. The participants' base grew significantly over the life of the event, and was facilitated by word of mouth, which is prevalent in small, tight-knit communities.

The local media radio station was able to effectively disseminate warning messages via Facebook to the community. The Facebook account provided an additional line of communication of indirect communication between the community members and the first responders. The Facebook account allowed people to engage in information milling, obtain necessary aid, and receive accurate information. The local media radio station was also able to invalidate inaccurate information regarding the event broadcasted by the national news media. Throughout the event, the local media radio station utilized Facebook to enhance public's sense of security by ensuring that their inquiries were answered timely and the updates were provided regularly.

This event provided a basis for a lasting relationship with the community on Facebook. The diligent response provided by the local media radio station during the event provided the community with an ability to view it as a reliable channel of communication during extreme events. Currently, the relationship continues, as the Del Norte County Office of Emergency Services established its own Facebook page as an additional outlet for the emergency relevant information. The participation of the community on Facebook has also expanded. The participants now also report the incidents and provide their own updates on the situation. Facebook, as the channel of communication during extreme events, will provide for Del Norte County accurate and timely dissemination of information, regular updates, and immediate response to the inquires for information and aid.

This study demonstrates that in order to build a strong relationship with the community via social media, the emergency response team needs to provide an open feedback loop to the public. During extreme events, the public craves information and it is vital to provide accurate information to the public in order to facilitate the appropriate protective action. Emergency managers need to continuously monitor the information flow on social media, specifically the emergency relevant inquiries generated by the affected population. When inquiries are specifically directed to the account managed by an organization directly or indirectly responsible for emergency response, there needs to be a knowledge person whose responsibility it is to close the loop between the public and first responders. Additionally, regular updates on public inquiries will allow the public to feel engaged and more likely to take appropriate protective action.

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REFERENCES

1. Aguirre, B.E. 1994. "Planning, Warning, Evacuation, and Search and Rescue: A Review of the Social Science Research Literature." presented at the U.S. - Russia Seminar on Social Research on Mitigation for and Recovery from Disasters and Large Scale System Hazards, Newark, Delaware.

2. Blair, C. 2011. "Update: Hawaii Tsunami Damage in 'Tens of Millions' of Dollars." Honolulu Civil Beat, March 14. http://www.civilbeat.com/articles/2011/03/14/9632-hawaii-tsunami-damage-tops-300-million/.

3. Castells, M. 2001. "Virtual Communities or Network Society?" In The Internet Galaxy: Reflections on the Internet, Business, and Society. Oxford: Oxford University Press.

4. Dengler, L., B. Uslu, A. Barberopoulou, J. Borrero, and C. Synolakis. 2008. "The Vulnerability of Crescent City, California, to Tsunamis Generated by Earthquakes in the Kuril Islands Region of the Northwestern Pacific." Seismological Research Letters 79 (5): 608–619.

5. Ding, A.W. 2006. "A Theoretical Model of Public Response to the Homeland Security Advisory System." JDMS: Journal of Defense Modeling and Simulation: Applications, Methodology, Technology 3 (1).

6. Ewing, L. 2011. The Tohoku Tsunami of March 11, 2011: A Preliminary Report on Effects to the California Coast and Planning Implications. California Coastal Commission Report. San Francisco, CA: State of California - Natural Resources Agency.

7. Golden, J.H, and C.R. Adams. 2000. "The Tornado Problem: Forecast, Warning, and Response." Natural 1 (2): 107–118.

8. Holt, H. 2011. Utilization of Social Media During 2011 Japan Tsunami. Audio Clip. Crescent City, CA.

9. Hughes, A., and L. Palen. 2009. "Twitter Adoption and Use in Mass Convergence and Emergency Events." In Proceedings of the 6th International Conference on Information Systems for Crisis Response and Management (ISCRAM). Gothenburg, Sweden.

10. Lindell, M.K., D. Alesch, D. Bolton, M.R. Greene, L.A. Larson, R. Lopes, P.J. May, et al. 1997. "Adoption and Implementation of Hazard Adjustments." International Journal of Mass Emergencies and Disasters (15) (November): 327–453.

11. Lindell, M.K., and R. Perry. 2012. "The Protective Action Decision Model: Theoretical Modifications and Additional Evidence." Risk Analysis 32 (4): 616 – 632.

12. Lindell, M.K., and R.W. Perry. 1993. "Risk Area Residents' Changing Perceptions of Volcano Hazard at Mt. St. Helens." In Prediction and Perception of Natural Hazards, 159–166. Amsterdam, Netherlands: Kluwer Academic Publishers.

13. Lindell, M.K., and C.S. Prater. 2007. "Critical Behavioral Assumptions in Evacuation Time Estimate Analysis for Private Vehicles: Examples from Hurricane Research and Planning." Journal of Urban Planning and Development 133 (1): 18–29.

14. Liu, S.B., L. Palen, J. Sutton, A. Hughes, and S. Vieweg. 2008. "In Search of the Bigger Picture: The Emergent Role of On-Line Photo Sharing in Times of Disaster." In Proceedings of the 5th International Conference on Information Systems for Crisis Response and Management (ISCRAM). Washington, DC.

15. McGinley, M., A. Turk, and D. Bennett. 2006. "Design Criteria for Public Emergency Warning Systems." In Proceedings of the 3rd International Conference on Information Systems for Crisis Response and Management (ISCRAM), 154–163. Newark, NJ.

16. Mileti, D. 1999. Disaster by Design: A Reassessment of Natural Hazards in the United States. Washington, DC: Joseph Henry Press.

17. National Weather Service. 2012a. "National Weather Services TsunamiReady Sites". List. National Weather Service. http://www.tsunamiready.noaa.gov/ts-communities.htm.

18. National Weather Service. 2012b. "TsunamiReady Information from NWS." National Weather Service. http://www.tsunamiready.noaa.gov/ts-apply.htm.

19. Onwuegbuzie, A.J., N.L. Leech, and K.M. Collins. 2010. "Innovative Data Collection Strategies in Qualitative Reseaerch." The Qualitative Report 15 (3) (May): 696–726.

20. Palen, L., S. Vieweg, S. Liu, and A. Hughes. 2009. "Crisis in a Networked World." Social Science

Proceedings of the 10th International ISCRAM Conference – Baden-Baden, Germany, May 2013
T. Comes, F. Fiedrich, S. Fortier, J. Geldermann and T. Müller, eds.

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Computer Review 27 (4).

21. Perry, R.W., and M.R. Greene. 1983. Citizen Response to Volcanic Eruptions. New York: Irvington.

22. Perry, R.W., and M.K. Lindell. 1981. Evacuation Planning in Emergency Management. Lexington, MA: Heath Lexington Books.

23. Perry, R.W., and M.K. Lindell. 2003. "Preparedness for Emergency Response: Guidelines for the Emergency Planning Process." Disasters 27 (4): 336–350.

24. Quarantelli, E.L. 2000. "Disaster Related Social Behavior: Summary of 50 Years of Research Findings." In Proceedings of 8th International Symposium on Natural and Technological Hazards: Hazards 2000. Tokushima, Shikoku, Japan.

25. Sorensen, J.H. 1987. "Decision-making Uncertainties in Emergency Warning Systems Organizations." International Journal of Mass Emergencies and Disasters 5 (1): 33–61.

26. Sorensen, J.H. 2000. "Hazard Warning Systems: Review of 20 Years of Progress." Natural Hazards Review 1 (2): 119–125.

27. Sorensen, J.H. 2003. "Modeling Human Response to a Chemical Weapons Accident." presented at the DIMACS Working Group on Modeling Social Responses to Bio-terrorism Involving Infectious Agents, DIMACS Center, Rutgers University, CoRE Building.

28. Sorensen, J.H., B.M. Vogt, and D.S. Mileti. 1987. Evacuation: An Assessment of Planning and Research. Technical Report. Oak Ridge, TN: Oak Ridge National Laboratory.

29. Starbird, K., and L. Palen. 2011. "'Voluntweeters': Self-organizing by Digital Volunteers in Times of Crisis." In Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems, 1071–1080. Vancouver, BC.

30. Sutton, J., L. Palen, and I. Shlovski. 2008. "Back-channels on the Front Lines: Emerging Use of Social Media in 2007 Southern California Wildfires." In Proceedings of the 5th International Conference on Information Systems for Crisis Response and Management (ISCRAM). Washington, DC.

31. Tyshchuk, Y., C. Hui, M. Grabowski, and W. Wallace. 2012. "Social Media and Warning Response Impacts in Extreme Events." In Proceedings of 2012 Annual Hawaii International Conference on Systems Sciences. Wailea, HI.

32. Tyshchuk, Y.N., and W.A. Wallace. 2012. "Actionable Information During Extreme Events. Case Study: Warnings and 2011 Tohoku Earthquake." In Proceedings of 2012 ASE International Conference on Social Computing. Amsterdam, Netherlands.

33. United States Census Bureau. 2012. "Del Norte County QuickFacts from the US Census Bureau." http://quickfacts.census.gov/qfd/states/06/06015.html.

34. White, C., L. Plotnick, J. Kushma, S.R. Hiltz, and M. Turoff. 2009. "An Online Social Network for Emergency Management." International Journal of Emergency Management 6 (3-4): 369–382.

35. Yates, D., and S. Paquette. 2011. "Emergency Knowledge Management and Social Media Technologies: A Case Study of the 2010 Haitian Earthquake." International Journal of Information Management 31 (1): 6–13.

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