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Web 2.0 and Social Networking Services in Municipal Emergency Management: A Study of U.S. Cities

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Abstract: Given the increasingly important role social networking services play as information sources during and after disasters, this study aims to investigate how the municipal governments of major U.S. cities and their emergency agencies employed RSS (Really Simple Syndication) or Atom, webcasts, Facebook, Twitter, YouTube, and photo-sharing platforms for emergency management. Our findings reveal that the emergency agencies of San Diego, Los Angeles, and San Jose were the top three performers on the Web 2.0 services. Regarding the social networking services provided by municipal emergency agencies, New York, Los Angeles, and Philadelphia ranked among the top three cities. The San Diego municipal government and its emergency agencies provided the most Web 2.0 channels, and New York City and its emergency agencies provided the most services through Facebook, Twitter, YouTube, and photo-sharing platforms (Flickr, Pinterest, and Instagram). Because large cities can support stronger collaboration and communication during crises by providing more services on social networking services, under-performing cities can enhance their services by learning from top-performing cities like San Diego and New York City.

Keywords: Web 2.0, Web Syndication, Social Media, e-Government, Emergence Management
Categories: A.1, K.4.1, K.4.2

1 Introduction

Large cities are complex, interdependent, and integrated systems in which social and political factors and robust infrastructure interconnect in a densely populated space. Because large cities are vulnerable to threats such as natural hazards, terrorism, energy outages, and disease outbreaks, municipal emergency management should encompass emergency prevention, mitigation, preparedness, response and recovery for all possible threats [Crondstedt, 02]. In contemporary emergency management, building collaborative networks among public sector agencies, non-profit organizations, private sector firms, communities and residents is also an essential component for effective emergency response [Waugh, 06]. Without sufficient tools or channels for collaboration or communication, government agencies are usually unused to working closely with nongovernmental actors and unfamiliar with the networks that respond to natural disasters [Waugh, 03]. If large cities comprise networked social communities and lifeline systems, they would become more resilient by adapting and learning from disasters [Godschalk, 03]. Accordingly, more

municipal governments reported using emerging digital communication channels such as Web 2.0 or social networking services to foster interactions among policy makers, government officials, and their constituencies. These channels can also aid municipal government in receiving feedback from residents and increase engagement with the governance processes [Lampe, 11]. Web 2.0 is a collaborative version of the Web that is based on a set of technologies (e.g., Ajax, JavaScript, and Document Object Model) and aimed at supporting user-generated-content [Rollett, 07]. The service value of Web 2.0 is measured by the number of participants using and contributing to the service [Kuswara, 11]. Meanwhile, social networking service employs mobile and Web-based technologies that help users and communities to share, co-create, curate, discuss, and modify user-generated content [Kietzmann, 11]. Based on the characteristics of the immediate, two-way, and large-scale impact of social networking tools, an increasing number of instances illustrate how to use such a highly interactive medium for emergency management. For example, after Hurricane Katrina devastated New Orleans in 2005, weblogs were used for communication, information sharing, and coordination to maintain a sense of community during the crisis [Macias, 09]. The wildfires around San Diego in 2007 were one of the first disasters for which people used Web 2.0 applications and Twitter in response [Mills, 09]. A community response grid was developed for the residents and web users to share information, communicate, and coordinate activities in response to major disasters [Jaeger, 07]. After the 2010 Haitian earthquake, U.S. government agencies used wikis and collaborative workspaces to coordinate knowledge and action among the U.S. Agency for International Development, the U.S. State Department, and the U.S. armed forces [Yates, 11]. The growing use of social media during crises offers new information sources for the authorities and provides viable solutions for the problems plaguing information dissemination and communications in the emergency domain [White, 09].

Although government agencies are increasingly using Web 2.0 and social networking services to connect with those they serve to improve government services [Bertot, 10], few studies have examined the use of social media for municipal emergency management. Previous research regarding social media applications for emergency management has mainly examined on the individuals or communities affected by the disasters [Yates, 11]. To further understand how large cities use Web 2.0 and social media to enhance emergency awareness and response, this study investigates how the municipal governments and emergency agencies of the 10 most populous U.S. cities employed webcasts, RSS (Really Simple Syndication) or Atom, Facebook, Twitter, YouTube, and photo-sharing platforms (e.g., Flickr, Pinterest, and Instagram). The Web 2.0 and social networking platforms evaluated in this study are reviewed in the next section, which is followed by a discussion of the emergency agencies in the 10 cities. We then illustrate the findings of how Web 2.0 tools and social networking services were used by the municipal governments and their emergency agencies. Furthermore, composite scores are calculated to determine the overall performance of municipal agencies in using Web 2.0 and social media. Our conclusions are presented in the final section.

2 Web 2.0 and Social Media in Emergency Management

Although Web 2.0 and social media are related and may appear interchangeable, they differ in numerous critical aspects. Web 2.0 is a participatory and collaborative platform whereby content and applications are modified continuously by all users in a participatory and collaborative fashion. Social media is "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" [Kaplan, 10]. Hence, Web 2.0 can be considered the platform on which social media evolves.

The most striking characters of Web 2.0 are its ability to bind collective intelligence and enable rich user participation. Because Web 2.0 allows increased user-creator interaction and content syndication [Al-Tameem, 08], the tools and practices of Web 2.0 can help with the improvements of public sector transparency, policy making, public services, and knowledge management [Bonsón, 12]. Content aggregator is one of the most common Web 2.0 service; it uses web syndication to enable users to fully customize the content they wish to access [Constantinides, 08]. Local government can adopt Web 2.0 technologies to facilitate the mass redistribution of emergency alerts during a crisis, and residents can syndicate these alerts using RSS or Atom. Additionally, webcasts is a technology that is evolving with Web 2.0. The content of webcasts takes advantage of streaming technologies for distribution live or on demand. The authorities can make emergency announcements through webcasts, which also allow residents to interact with governments under the Web 2.0 framework [Bonson, 12]. In this study, we discuss how municipal governments and their emergency agencies use web feed services and webcasts in the Web 2.0 environment.

The advent of social media has revolutionized how people communicate and gather information and has adversely affected how public officers interact with the public and media during emergencies. By using social networking services, local government has an increased chance of informing and saving the lives of more members of the public during a crisis [Prentice, 08]. Among social networking services, Facebook is the most popular platform that allows people to communicate with their friends and share information with each other [Bicen, 13]. Facebook has been used to support information sharing, communication, collaboration and co-creation in times of crisis. For example, Facebook was a prominent source of up-to-date information and support for people in the Canterbury region of New Zealand after a 7.1-magnitude earthquake in 2010 [Dabner, 12]. Twitter is another popular social networking service and allows users to share messages of up to 140 characters. During emergency and mass convergence events, Twitter messages can reveal features of information dissemination that support information broadcasting and brokerage [Hughes, 09]. The U.S. Federal Emergency Management Agency has used Twitter "as a means to offer information about the agency's mission, efforts and perspective" [Latonero, 11]. YouTube is a social networking site that enables users to upload, view, share, and comment on videos. Local governments like Broward County, Florida, have used YouTube to communicate and share news during emergencies [Prentice, 08]. Other media-sharing services such as Flickr, Pinterest, and Instagram enable users to share and comment on photos. A study by Liu et al. has illustrated that using Flickr can make "citizen journalism more visible through the cross referencing and convergence of different media sources" in informal crisis

responses [Liu, 08]. To understand how U.S. municipal emergency agencies use social networking services, their uses of Facebook, Twitter, YouTube, and photo-sharing platforms were investigated in this study.

3 Municipal Emergency Agencies in the Major U.S. Cities

According to the 2010 U.S. Census, New York, Los Angeles, Chicago, Houston, Philadelphia, Phoenix, San Antonio, San Diego, Dallas, and San Jose were the most populous cities at the time the census was taken. The objective of this study was to understand how the emergency agencies of these cities utilized Web 2.0 and social networking services. Accordingly, the targets of the investigation included city governments and major municipal agencies related to emergency response. For example, in the case of New York City, we examined the use of Web 2.0 and social networking services by the New York City Government, New York City Fire Department (FDNY), Office of Emergency Management, and Notify NYC (the official source of information about emergency events and vital city services). Similarly, the emergency agencies of Los Angeles include the Los Angeles Fire Department (LAFD), Emergency Management Department, LAFD News & Information, and LAFD Alert, a breaking news notification service from the fire department. Generally, city fire department were included in our investigation because they contend with numerous disturbances, small daily emergencies, and emergency responses to major events [Latonero, 11]. We also considered the Office of Emergency Management because it is responsible for comprehensively planning and responding to all manner of disasters. Table 1 contains the local governments and emergency agencies investigated in this study. We completed collecting the data of the 10 cities in March 2013.

4 Performance of City Emergency Agencies in Providing Web 2.0 and Social Networking Services

First, let us discuss the use of Web 2.0 in the 10 most populous U.S. cities. Figure 1 illustrates the number of real-time webcasts (with feedback interaction) and web feed services (RSS or Atom) of the emergency agencies of the cities. Our findings indicate that the emergency agencies of Los Angeles, San Diego, and San Jose provided the most RSS or Atom services. Although Google discontinued the Google Reader service in 2013, web syndication is still a critical information distribution platform because numerous users still use it to receive updates from their favourite information sources. In real-time webcasts, the municipal government of San Diego and its emergency agencies provided the most streaming media services. Such services allow public agencies to communicate and share information through virtual sessions. Residents can visually understand what is happening in the disaster zone through webcast services; however, the emergency agencies of Dallas and Houston have not supported web feed services or webcasts yet. Although both cities provide other social networking services to respond to hazards and disasters, more emergency communication channels can enhance emergency awareness.

City	Government and Emergency Angencies	City	Government and Emergency Angencies
New York	New York City (NYC)	Philadelphia	City of Philadelphia
	New York City Fire Department (FDNY)		Office of Emergency Management (OEM)
	Office of Emergency Management (OEM)		Ready Philadelphia
	Notify NYC		ReadyNotifyPA
Los Angeles	Los Angeles City (LA City)	San Antonio	City of San Antonio
	Los Angeles Fire Department (LAFD)		San Antonio Fire Department (SAFD)
	Emergency Management Department (EMD)		Office of Emergency Management (OEM)
	LAFD News & Information		Alert SA
	LAFD Alert	San Diego	City of San Diego
Chicago	City of Chicago		Fire-Rescue Department
	Emergency Management & Communications		News Center
	Office of Emergency Management		Stay Connected
	NotifyChicago	Dallas	City of Dallas
	AlertChicago		Fire Rescue
Houston	City of Houston		Office of Emergency Management (OEM)
	Office of Emergency Management (OEM)	San Jose	City of San Jose
	Houston Emergency Center		Fire Department
	AlertHouston		Emergency Services
Phoenix	City of Phoenix		Alert Center
	Office of Emergency Management (OEM)		

Table 1: Municipal governments and emergency agencies in the most populous U.S. cities

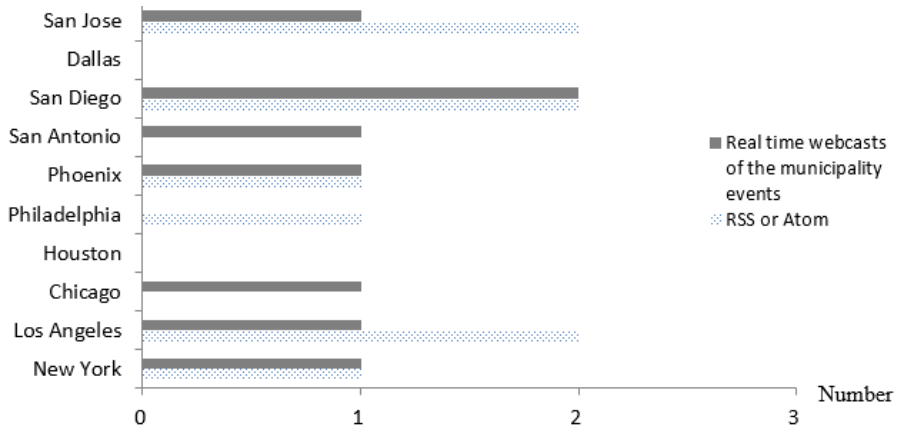

Figure 1: Use of Web 2.0 in the 10 most populous U.S. cities

Next, let us discuss the use of social networking services by municipal emergency agencies. Figure 2 summarizes the numbers of Facebook, Twitter, YouTube, and image-sharing platforms (Flickr, Pinterest, and Instagram) provided by the emergency agencies. Our findings indicate that the emergency agencies of New York City and Los Angeles provided the most Facebook services. Whereas the FDNY Facebook page has more than 150,000 likes, that of the LAFD has only approximately 8,000 likes. On Twitter, the emergency agencies of New York City and Los Angeles also provided the most services. For example, the official accounts of NotifyNYC and FDNY have more than 65,000 and 75,000 followers, respectively. The LAFD has two Twitter accounts, one for alerts and another for general communication. On YouTube, the emergency agencies of New York City, Houston, and Philadelphia provide more channels than the other cities. There are fewer subscribers on the YouTube platform than on Facebook and Twitter. For example, the number of subscribers on the FDNY YouTube account is only approximately 3,500. Moreover, according to the data collected from Flickr, Pinterest, and Instagram, the emergency agencies of New York City also provide more photo-sharing services than do the other cities. However, people usually do not follow these municipal emergency agencies on photo-sharing platforms, which are generally used for personal entertainment and graphic design. For example, the FDNY has accounts on Flickr, Pinterest, and Instagram with only approximately 2,000 followers and 250 followers on Instagram and Pinterest, respectively. Probably because of the low participation rates, we did not find such photo-sharing services provided by San Jose, Dallas, San Diego, San Antonio, Phoenix, Houston, or Chicago.

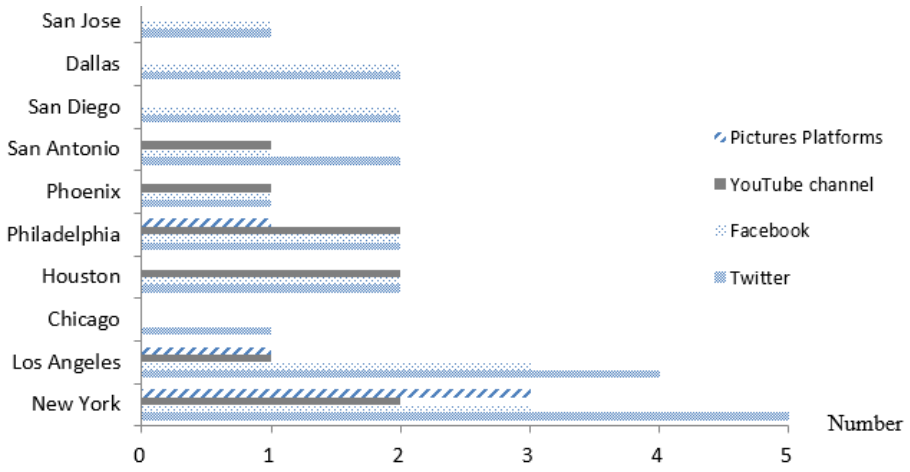

Figure 2: Use of social networking services by the 10 most populous U.S. cities

To understand the overall performance of Web 2.0, this study applied the approach of principal component analysis to derive the component scores from the measurements of web feed services and webcasts. We retained only the first component because it was the only component satisfying the eigenvalue-one criterion. The cumulative proportion of variance explained by the first component was 78.1%. Table 2 shows the principal component scores of the 10 most populous U.S. cities by the number and variety of Web 2.0 services. Our findings indicate that the emergency agencies of San Diego, Los Angeles, and San Jose are the top performers in providing Web 2.0 services, whereas Houston and Dallas are the lowest-performing cities.

Ranking	City	Score
1	San Diego	2.2299
2	Los Angeles	1.1119
3	San Jose	1.1119
4	New York	0.3043
5	Phoenix	0.3043
6	Chicago	-0.5032
7	San Antonio	-0.5032
8	Philadelphia	-0.8136
9	Houston	-1.6212
10	Dallas	-1.6212

Table 2: Rankings of the 10 most populous U.S. cities by Web 2.0 services

Similarly, we adopted principal component analysis to derive the component scores of social networking services from the measurements of Facebook, Twitter, YouTube, and photo-sharing platforms. Because the eigenvalues of the first and

second components were 3.0089 and 0.6040, respectively, we retained only the first component. While the cumulative proportion of variance explained by the first component was 75.2%, the loadings of the first component were 0.545, 0.507, 0.414, and 0.524. Table 3 shows the principal component scores of the 10 most populous U.S. cities by the number and variety of social networking services. Our findings indicate that the performance of New York City was superior to that of the other cities. The emergency agencies of San Jose and Chicago ranked last on the overall performance of social networking services.

Ranking	City	Score
1	New York	3.7219
2	Los Angeles	1.7565
3	Philadelphia	0.8672
4	Houston	0.3280
5	San Diego	-0.6178
6	Dallas	-0.6178
7	San Antonio	-0.6789
8	Phoenix	-1.0930
9	San Jose	-1.5660
10	Chicago	-2.1001

Table 3: Rankings of the 10 most populous U.S. cities by social networking service

5 Conclusion

Because citizen engagement is critical to building and maintaining a resilient city, emergency managers can use social media to disseminate information to the public about impending dangers [White, 11]. Although government agencies understand the benefits of social networking services on emergency management, they have been slow to adopt such services for emergency response and recovery efforts [Jaeger, 07]. According to our findings, the emergency agencies of San Diego have the strongest overall performance on Web 2.0 services. Hence, under-performing cities such as Houston and Dallas can improve their Web 2.0 performance by learning from San Diego. Regarding the social networking services provided by municipal emergency agencies, New York, Los Angeles, and Philadelphia were the top performers. Because large cities can support stronger collaboration and communication during crises by providing more services on social media, the emergency agencies of San Jose and Chicago should enhance the presence of their social networking services. Future studies may examine the activities of municipal emergency agencies on social networking services, particularly because we found that some such the services were rarely used. For example, the City of Dallas Office of Emergency Management has already generated over 2,000 tweets. By contrast, the San Antonio Office of Emergency Management has sent only over 300 tweets. Future studies may also analyse activity data such as posts, replies and retweets to gain more insight of emergency response.

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