Examine the Role of Social Media and Volunteered Geographic Information in 2014’s California Drought

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Examine the Role of Social Media and Volunteered Geographic Information in 2014’s California Drought

by

Ligang Zhang

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Examine the role of social media and Volunteered Geographic Information in 2014’s California drought

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Social media encompasses online communication platforms. Presently, it has been involved in the management and mitigation of crises and disasters. The paper discusses the use of social media and Volunteered Geographic Information (VGI) in the management of the 2014’s California drought. The significance of social media and volunteered geographic information is emphasized in the study. As well as factors that influence the suitability of the two, social media and voluntary geographic information in the whole process of managing the California drought are also explored. The SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis of one-way info-sharing, two-way info-sharing, rumor control, reconnection, decision making, donation and volunteer management is well elaborated in the paper. Various state government departments use social media or social networks such as Facebook, Twitter, Google+ and other websites to interact with citizens and give them first-hand information. They use social media and VGI to deliver information, prepare and train people in combating processes, and generally coordinate in the whole practice. There are various types of social media or social network, including blogs, photo and video sharing, and social bookmarking. All
these, when applied suitably, play a significant role in drought mitigation and management.

Social media communication concerning disaster management and mitigation is completed among emergency responders, governments, non-governmental organizations, the public and journalists. It helps with a timely dissemination of information that is necessary in disaster combat measures. In California drought, social media has played a crucial role in its mitigation and management. The role of social media in California Drought Management includes one-way information sharing, situational awareness, and decision-making.

**Keywords:** social media, Volunteered geographic information (VGI), drought, California, disaster management
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1. Introduction

Social media refers to the online communications intended for interaction, community input and collaboration (Besaleva & Weaver, 2013). Facebook, YouTube, Twitter and blogs are examples of social media. It is significant to draw on an effective social media strategy to fix an emergency as part of preparation and planning. In essence, it can make better disaster responses and allow the affected population to control the situation. Social media is an indispensable aspect of modern disaster management in various types of institutions, principles and practices. It is thus relevant in cases of drought. Social media include diverse modes of Internet-based communication that allow users to share information, concepts, personal messages and a full range of details such as pictures and videos. People get connected through social media through a host of services and the Internet. The U.S. Department of Homeland Security utilizes Facebook, Twitter and YouTube to provide a platform to interact with citizens and provide first-hand responses. The leaders of emergency management departments use social media for personal as well as organizational purposes. For example, the chairperson of the Federal Emergency Management Agency (FEMA) uses Twitter with his pen name as well as with the organizational account to facilitate instance interaction and exchange of short messages in critical situations (White, 2011).

Social media continues to undergo evolution over the years. Before the 21st century, information about disasters was released largely via televisions, media advisories, press releases and closely monitored print and web publication media. In recent years, the
growth in social media has drastically changed the way information relating to crises is relayed to the public (Crowe, 2012).

In the contemporary world, people no longer rely on the information presented on emergency management websites. The emergency department presents information in a technical way that is difficult for the public to comprehend. In addition, the department has a few fully competent staff and a timely dissemination of information cannot be guaranteed. For this reason, the agency fails to offer reliable information regarding emergencies or disasters since such information keeps changing drastically and may serve to warn people of the progression of the disasters. For this reason, social media or social network is one of the tools that normal people use to disseminate information related to emergencies. Crowe (2012) observed that many people forwarded the tweet in a flash and that within a very short time, information directly reached billions of people almost everywhere in the world. The presence of modern social media has altered the way people relay information about emergencies or disasters.

Drought is a natural calamity over which human beings have little control. Like other disasters such as forest fires, floods, hurricanes and tsunamis, there are some measures to deal with such situations. These measures are part of emergency management which has four phases, namely, preparedness, response, recovery, and mitigation. Chan came up with his opinion “There are five key properties of social media that enhance its utilization in management of hazards. The characteristics include connectedness, collaboration, clarity, completeness and collectivity” (Chan, 2013). Social network serves significant functions in hazard management. These functions include “dissemination of information, planning and training about disasters, collaborative solving of issues and decision
making, and collection of details that are used in various hazard management stages of preparedness, response and recovery” (Sahu, 2009). By and large, it enhances crisis communications (Besaleva & Weaver, 2013). In the past, people procured information from local governments. Governments used their official website or SMSs to share information about disasters with everybody or selected persons or groups. This made information able to be disseminated in one way and government agencies were constantly the only controller of disaster information. However, with the development of mobile technology, every single person can get better connection with the rest of the world than ever. With the assistance of social media and mobile devices, people can directly report the condition of a river or where a fire goes. What’s more, agencies can use technology to measure disaster data through the photo or video which normal people share on Facebook or Twitter. This makes it possible for disaster information to be shared in real time. People can obtain information without the slightest time gap.

2. Literature review

Social media is not merely restricted to Twitter and Facebook. According to Fraustino et al (2012), there are various types and examples of social media as follows. First, Fraustino classifies social media into nine types. They are blogs, microblogs, discussion forums, photo or video sharing and podcasting, social networks, social rating, social bookmarking, wikis, and video or text chatting. Twitter and Facebook are just two types of social media.
**Table 1 Classification of Social Media**

<table>
<thead>
<tr>
<th>Types</th>
<th>Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs</td>
<td>Blog and other blog websites are relatively traditional type of social media. Experienced users prefer to use WordPress to create and organize their own blog.</td>
</tr>
<tr>
<td>Microblogs: Twitter, Tumblr</td>
<td>Microblogs are now the most popular type of social media.</td>
</tr>
<tr>
<td>Discussion forum: ProBoards, Live Journal</td>
<td>Another name for a discussion forum is BBS. BBS is also a relatively traditional but also widely used social media type.</td>
</tr>
<tr>
<td>Photo/Video sharing and podcasting: Flickr, Pinterest, YouTube</td>
<td>Photo and video sharing are also very popular type of social media. And Micro photo and video sharing apps like Instagram and Vine are even more popular recently.</td>
</tr>
<tr>
<td>Social networks: Facebook, Google+, LinkedIn</td>
<td>Social networks always stand for social media. This type is the main battlefield of a social media war.</td>
</tr>
<tr>
<td>Social rating: Yelp, TripAdvisor</td>
<td>Social rating is now more used on mobile devices with the development of location based technology.</td>
</tr>
<tr>
<td>Social bookmarking: Diigo</td>
<td>Social bookmarking like Diigo was created with the development of mobile devices. The mixed type social bookmarking app like Pocket has been very successful in these years.</td>
</tr>
<tr>
<td>Wikis: Wikipedia, Wikimapia</td>
<td>Wikis are developed with a group of fans. We can label them as social media. However, Wikis are more likely to be called crowd source.</td>
</tr>
<tr>
<td>Video or text chatting: Skype</td>
<td>This type is also a traditional technology. However, just as Skype brings text function into its app and WeChat incorporates a video talking function, they are mixed together.</td>
</tr>
</tbody>
</table>
Secondly, Fraustino et al. (2012) re-categorizes social media into five groups as follows according to the use of social media or social network, the information sharing type of social media and so on.

Group 1 consists of public media which allows people to interact with and share information among each other. It is inclusive of social networks (Facebook, LinkedIn, and Myspace), wikis (Wikipedia), photo and video sharing sites (YouTube and Flickr), virtual worlds (Second Life) and rating sites like Yelp. Group 1 social media is applicable in the exchange and sharing of information regarding products and brands (Fraustino et al, 2012).

Group 2 enables people to post news and activities like Twitter, RSS and tagging. These tools are, therefore, suitable for creating a buzz and enabling campaigns to go viral (Fraustino et al, 2012).

Group 3 delivers services specific to a particular location. It includes HotSpot, Gowalla and Foursquare. The tool designs allow constant tracking and chances for instant sales (Fraustino et al, 2012).

Group 4 allows individuals to play online games. It includes Zynga, Farmville and Words with Friends (Fraustino et al, 2012).

Group 5 includes coupon websites such as deals.com, Groupon and LivingSocial. These tools enable businesses to observe the influence of consumers on each other while at the same time, selling products. (Fraustino et al, 2012; Gao, Barbier, Goolsby & Zeng, 2011; Goodchild & Glennon, 2010)
2.1 Social Networking

The concept of social media we mentioned today, was start talked about 20 years ago, when “Open Diary” was founded by Bruce and Susan Abelson (Kaplan & Haenlein, 2010.) “An early social networking site that brought together online diary writers into one community” (Kaplan & Haenlein, 2010). Kaplan and Haenlein (2010) gave social media a definition as “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 & Haenlein, 2010). The concept of social networking refers to the relationship between mapping and networks in diverse human organizations which could be small clusters of people or even the entire nation. The theory of social networking helps people to understand that they can evaluate the social capital of different individuals using the links between people. It posits that the “knowledge, power and influence” of a person reflects the person’s connections with other people. Nonetheless, it is for this reason that the power of social media to influence public opinion fascinates organizations and researchers alike (McDougall, 2011).

2.2. Volunteered Geographic Information

VGI is short for Volunteered Geographic Information (VGI). With the development of the Global Positioning System (GPS), the client module becomes increasingly small. The GPS client module can be installed into mobile devices like smartphones. With this technology, information created on mobile devices can be geo-tagged now. With the geo-tagged information sharing via the Internet, geographic information becomes real time which can spread faster and more accurately than ever. The information derived from the three areas is the Volunteered Geographical Information—the comprehensive collection
of geographic information relevant to specific locations that individuals voluntarily share (Elwood, 2008). These individuals are not journalists or on anyone’s payroll but are willing to share relevant details of a particular disaster with the public. The emergence of the Volunteered Geographic Information signifies a change in emergency or disaster management.

VGI involves two main fronts. The first one is geographic portals like Google Earth and other applications that bring geographical and spatial information to people and digital imagery that uses satellite centers and geographic portals to enable individuals to see actual features and locations on the screen. The second platform of VGI designates the coordinates created by the GPS receivers present in a wide range of electronic devices of entertainment and communication (Goodchild, 2007).

In recent years, Personal Navigation Devices (PNDs) have gained in popularity with the advancement of technology and the presence of mature street network data. In the entire world, people are keen on purchasing vehicles with the in-car navigation technology.

VGI has several applications. First, it is real-time in nature and hence suitable for use in the event of emergencies and disasters to show the exact conditions of the area concerned. VGI may be the most critical tool in case other rapid mapping tools are absent. In addition, VGI is necessary where and when traditional geographic information do not exist or are inconvenient for the public to get access.

The reliability of VGI is sometimes controversial and treated with skepticism just like data collected by volunteers. Gollan, Bruyn, Reid and Wilkie (2012) carried out a
study to test if volunteers can collect data comparable to those from professional scientists. They asserted that there is no reason to justify the condemnation of volunteer-collected data as it was in 1993 when volunteers could not participate in the U.S. National Biological Survey. They concluded that data collected by volunteers are very similar to those by scientists. They also ascertained that the degree of consistency in data depends on particular habitat features as well as personal abilities to estimate the feature. However, quality measures should be in place for data to be acceptable in spite of the person in charge of data collection for monitoring.

2.3 Use of Social Media/ Social Network/ VGI in Disasters

Communication concerning disasters involves the government, emergency management organizations, disaster responders, journalists and the public. In addition to traditional modes of communication, social media is essential as it offers an interactive platform for timely dissemination of information about the disaster. Fraustino et al (2012) observed that the public used social media to communicate with each other during periods of crises for the following reasons:

The first and foremost reason why social media can play a significant character in disaster management is the convenience it has. Unlike other traditional technologies, social media is created on the basis of the Internet and developed with the application of web 2.0. Recently, social media has been greatly advanced with the development of mobile devices, which make communication increasingly convenient. Secondly, social media is the basis of social norms (Fraustino et al, 2012). Social media is a platform of
online communication. Now the online version becomes an integral part of social norms, which is an immensely important part in disaster management. Thirdly, personal recommendations are a very vital part of social media and they are very useful during a disaster. They can help a lot in disaster management. Another reason why social media can help disaster management lies in the fact that information from social media can last long and it has an element of fun. People tend to pay more attention to entertaining information and social media can make people focus more on disasters. Fourth, individuals find it not restrictive when they are using social media to post any information. As a result, the information from social media is pretty new. Everybody can post information about disasters on social media so that people around you can receive updated real-time information which may save lives. Fifth, with the development of mobile devices, people now can use social media more voluntarily, which gives them an advantage during a disaster when they struggle for life. Last, social media can promote community aggregation and help people seek emotional support (Fraustino et al, 2012). When people use social media, chances are that they won’t feel that they are alone.

Fraustino et al (2012) also identified factors that deter the public from using social media for communication during disasters. They are (1) lack of knowledge to use them, (2) lack of Internet access and poor network coverage, (3) privacy and security fears and (4) concerns about precision. Moreover, some people do not use social media because they are either young or old, overwhelmed with media, do not like spending a lot of time with electronic gadgets or their culture does not allow (Besaleva & Weaver, 2013).
2.4 Previous Case Studies

2.4.1. Twitter and Hurricane Sandy

Although there are many social media and websites, Twitter has the largest share of users, approximately 500 million in total. Twitter places no restriction on what users can post. They can post news, opinions, photos or responses within a maximum 140 characters. Twitter is popular in the whole world and easy to access through Application Programming Interfaces (API). Researchers utilize Twitter to gather huge chunks of real-time data.

Schnitzer and Williams (2012) analyzed the use of Twitter in the disaster of Hurricane Sandy, one of the largest Atlantic storms that ever hit the northeastern United States. In analyzing the use of Twitter, the researchers developed a live geospatial application using web-based languages and referencing resources from Application Programming Interfaces (APIs) obtained from Google Maps, Google Mappers and Twitter.

The researchers used Crisis Mappers, Google maps, and Twitter to collect data for the Hurricane Sandy Real Time Tweet Mapping. It was possible because Twitter has a limited API that anyone can access. Using the API, the researchers were able to obtain all tweets with the word Sandy. By doing so, they queried the twitter API at intervals and filtered the tweets on the basis of their metadata. However, they ensured that the same tweet did not appear again. Google maps provided some useful data in visualization. It was feasible because the Google map has a public API that is versatile and properly documented, and display of tweets on the map is an easy task. In fact, Google shows the map and executes the user interface. What is more, it works well with external data and in
the absence of an input parser and, hence one can easily build a simple and intuitive process. Finally, the researchers also retrieved data from Google Crisis Mappers. They obtained several data feeds concentrating on relevant details such as storm paths, power outages and shelter location. By combining the map with the tweets, more details were available for analyses.

Schnitzer & Williams (2013) discovered that geotagged tweets were collected and incorporated into their database from 28 October to 2 November 2012. During this period, they received 85,915 unique tweets inclusive of latitude and longitude coordinates, language, username, timestamp and the actual 140 characters of the tweet. Of all the tweets collected, the researchers observed that they originated from 57,202 varying user accounts. However, the researchers were only able to observe simple trends from the data due to time.

As Hurricane Sandy swept, a notable qualitative trend began to appear via the observation of the visualized interface before, during and after it. Many tweets with the word “Sandy” appeared in large numbers from the northeastern US coastline before the storm was about to make landfall. These posts included areas which Hurricane Sandy had already stricken. In the beginning, the tweets were humorous and made in a casual manner but contained the message of “preparing” for the Hurricane. According to the researchers, many of the tweets did not carry feelings of negativity.

As the Hurricane progressed, the frequency and tone of tweets took a different route. Most tweets showed concerns about the storm, and pictures of the current and high rate of retweeting from the accounts of news sources increased. Nonetheless, tweets from different regions other than the affected area began streaming in; the awareness and
discussion of the disaster started to spread from the origin of the calamity to other parts of the world.

After Hurricane Sandy dwindled and became a tropical storm, tweets about the disaster were serious; there were no casual tweets about Hurricane Sandy any more. News sources continued to post tweets, which the public kept retweeting to help spread information about the issue. The number of pictures showing the aftermath of the hurricane increased. Tweets from other parts of the United States also increased. However, global tweets started streaming in after news sources stopped broadcasting the threats of Hurricane Sandy and focused on its devastation and impact (Schnitzer & Williams, n.d).

2.4.2 Volunteered Geographic Information and the Queensland Floods

The State of Queensland in Australia experienced massive floods that caused extensive damage to properties and claimed many lives. The floods affected more than 30 cities, towns and rural communities. During the floods, social media and crowd sourced geographic information became significant in informing people about the disaster especially when the concerned officials failed to do so. Media like radio, television, newspapers and social networks such as Facebook and Twitter became the main avenue of disseminating crucial information regarding the floods. The Australian Broadcasting Commission (ABC) radio created a link to gather reports about the flooding. People who had no Facebook or Twitter accounts opened accounts during this period (McDougall, 2011).

During the Queensland floods, people knew about the events through social networking. Twitter enabled people to tweet and receive updates through micro-blog
about the real-time condition of the floods. When posting tweets, people uploaded photos and videos to accompany the updates. The other social media network used was Facebook. The Queensland Police Department used their Facebook page to disseminate information to any person who had access to it. In addition, people got connected via YouTube by sharing videos. When the floods reached their climax, thousands of tweets per hour streamed in with the ‘qldfloods hashtag’ (McDougall, 2011). The hashtag served to change the condition about the floods better than the former condition. People made more tweets when Brisbane and nearby regions began to get submerged. At this time, agencies and organizations as well as community members took to Twitter to disseminate raw footage and information but chose reliable accounts to follow. The frequency of tweets rose as Toowoomba and Lockyer Valley became flooded on January 10, 2011, and several people lost their lives. On the next two days, tweets about the disaster followed when the waves of water reached Brisbane and began to subside. It is only on January 13, 2011 that the mainstream media regained its relevance in dissemination of information and people went back to the regular sources of media for information (McDougall, 2011).

Burgess and Axel (2010) analyzed the use of Twitter during this time. They identified the geographic origin of the tweet, and plotted the locations to identify the geographic areas under discussion. Social media thus served as a major tool of disseminating information. Even the journalists received first-hand information from their relatives and friends through email messages, Facebook and Twitter.

Continuous commentaries, voice, photographs and videos were replete with information about the disaster so that its coverage was practically real time. In the initial stage of the event, the information was precise and shocking, placing everyone in the
position of the observer. Nonetheless, after some time, several spurious postings appeared, duplication of photographs occurred, and misleading information regarding the floods spread as well.

The fact that some people post misleading or inaccurate information calls for the necessity of information authentication if users are to have trust in the information. Often, people tend to doubt the authenticity of VGI. If there is crowd mapping, users can vote up and down on postings to improve the veracity of the information. It is worth noting that like Wikipedia, information is subject to alteration by anyone, and it reduces the reliability of Wikipedia as a source of information.

2.4.3 Facebook and the Haiti Earthquake

On January 12, 2010, an earthquake a city in Haiti, one of the poorest countries on earth. The country was not properly equipped to combat the damage resulting from the earthquake. The natural calamity affected 3 million people and left them stranded without the necessities of life. The public turned to social media to raise funds to assist those in Haiti. People took to Facebook and Twitter the week when the earthquake struck Haiti. A digital campaign helped raise astronomical funds by providing a number through which the public could donate funds to the victims. People would text a number to give money to the Red Cross. The donation was made online, and people could submit their donation as a payment in their next phone bill. The social media is widely used that within 48 hours, the Red Cross received donations worth three million dollars. Celebrities who enjoyed massive following in social media contributed generously to fund-raising. Facebook users could update their statues regularly to reflect how much money people donated. The spokesperson of the Red Cross described the contribution as “a phenomenal
number” that they have never witnessed in the past (Gross, 2011). In fact, the Red Cross was not the only organization using an online platform to raise money. The virtual world was actively participating in the campaign of raising money for the Haiti earthquake victims. Mainwaring (2011) observed that in Facebook, users could buy virtual goods in the Farmville Facebook game to raise funds. Jeanine Hays, a design blogger, created a sparking idea from a tweet, through which he aggregated bloggers who raised thousands of dollars to assist the victims of the Haiti earthquake. The blogger created a post about Haiti and linked it to a site that facilitated donations from readers. Other bloggers auctioned their artwork, and the money raised went to the assistance of the earthquake victims in Haiti. The bloggers decided to make a donation every time someone left a comment on their blogs. It led to the accumulation of a significant amount of funds by way of these online activities.

Valentino –De Vries (2010) contended that although social media did help in raising funds, scammers soon took to the sites. They exploited this opportunity to collect money from unsuspecting individuals who were willing to donate money to the Haiti victims. The more scammers there were, the more faith the public lost in this online donating platform. This attests to one of the flaws with social media when no monitoring system is in place to scrutinize what is true and what is false. The application of social media in the Haiti disaster shows its potency in uniting diverse groups of people to work towards a common goal—in this case, raising funds for those in Haiti—but also the cons of using social media as it is accessible to malicious people too.
2.4.4 Twitter, Blog and Facebook and the Colorado Flood

A storm struck Colorado on September 9, 2013, and it rained ceaselessly for a whole week. What’s more, it intensified on September 11, 2013, causing flash floods in the Denver-Boulder metro region. The authorities evacuated people in Boulder County while those in inaccessible areas were supposed to seek shelters somewhere else. Federal Emergency Management Agency (FEMA) declared the floods a major disaster on September 14, 2013. In Jefferson County, floods caused considerable damage but compared to other counties, it was relatively less severe. The Department of the Sherriff is in charge of managing all major incidents in Jefferson County. Moreover, Jefferson County has an emergency management—Type III Incident Management Team (IMT), which is part of the Jefferson’s County Sheriff’s Department. The IMT has full-time staff as well as county personnel who join the team if necessary (St. Dennis et al, 2013).

The team uses social media when the flooding disaster occurred. The team has a blog and Twitter account. The blog and the twitter serve as main platforms for communication. The IMT has an “Integrated Social Media Strategy.” During the floods, the team added Facebook to their integrated strategy and the Jeffco IMT engaged in interactive communication with the public. The team showed a higher level of engagement with the public than the one depicted by the police during Hurricane Sandy.

When interviewed, the team claimed that it used Twitter to delivering news, Facebook to talk about the news and a blog to provide details. The Twitter messages sent by the team outnumbered the Facebook messages and the emergency blog too. There turns out to be a consistent result in various researches that Twitter is the predominant tool of communication in most emergencies. Mainstream media sources picked the tweets
made by the Jeff Co IMT. They were precise and could make sense to anyone who had not viewed previous messages.

During the floods, the IMT team provided a platform for the public to share photos of the events. The team standardized the process of submitting these photos, and a person had to identify the ownership of the photo and indicate where and when he or she captured it. The team posted the photos on the Facebook page and the blog. These came in handy in the assessment of the severity of the floods. The Facebook page provided a platform for the public to check on each other, report on personal welfare and converse about the issue. It even allowed for some humor and could have helped the public in coping with the tough situation.

Apart from the Facebook page and the Twitter account, the IMT team also created a Google map to offer public safety information. The maps offered an explanation for the type and extent of the danger in different areas. The fact that people could locate probable hazards by observing the Google map reduced the number of emergency phone calls (St.Dennis et al, 2013).

The application of social media by the Jeffco IMT in the wake of Colorado floods reveals the likelihood of integrating social media with traditional modes of emergency management. It also reflects the need to have qualified personnel to handle social media accounts. The fact that the IMT could monitor the information shared by the public shows that concerned parties can also oversee social media to earn public trust. Furthermore, social media can turn to be a source of news for conventional media in times of emergency and hence the need for the clarity of the information shared on these platforms.
3 Research Objectives

The previous case studies are concerned about the application of social media, social network, or VGI mostly in the management of rapid disasters like hurricanes and floods. Those disasters are intimately related to human life, and people focus more on social media or network. However, very few researches were carried out in the domain of social media/ network and VGI in the management of drought. This thesis seeks to analyze the function, application, pros and cons, and the role of social media/network and VGI in the California Drought in 2014.

The research questions are:

1) What role did social media, social network and VGI play in 2014’s California drought?

2) What are the strengths, weaknesses, opportunities, and threats in using social media/network and VGI in disaster management and planning in the case of the California drought in 2014?

4 Conceptual Framework

4.1 Study Area

California is a state in the west of United States. The land of California is 155973 square miles which ranks third in the United States. The water area of California is 7734 square miles which ranks sixth in the United States. California is the most populated state in the United States, which amounts to 38,332,521 (http://quickfacts.census.gov/qfd/states/06000.html). Drought in this area affects the area where has the biggest population in the United States.
Figure 1 shows the latest drought map (2014.9.9) of the United States and California.
According to an NOAA report, “Drought occurs when water supplies cannot meet demands” (CNAP, 2014). The primary reason for the 2014 California drought is lack of precipitation (CNAP, 2014). Drought conditions persist in California due to insufficient rain over three straight years. According to a report (CNAP, 2014) presented by ACWA (Association of California Water Agency), this drought started in 2011 and now almost 100% of California is experiencing severe drought. 82% of California is under extreme drought conditions, and nearly 60% of California is now in “exceptional drought,” in May 2014. A twitter account @kyleykim tweeted a video (http://www.latimes.com/la-me-g-california-drought-map-gif-htmlstory.html) showing that drought has turned out to be worse and worse since April 2011. This video combined California drought maps from 2011 to 2014. At the beginning, drought merely affected the east of the San Francisco area. But in 2014, literally the whole state suffered from extreme drought and approximately half of the state experienced exceptional drought. This year’s drought is believed to be one of the worst conditions in California on record. It does appreciable economic harm to farmers, ranchers and farm workers. Meanwhile, it also exerts a deleterious impact on the water supplies of towns and cities in California and jeopardizes fish and other animals which rely on water from rivers in California and the Sacramento-San Joaquin Delta. It disrupts life in several ways, including an explosion of wildfires, high food prices and water rationing. Not only does it destroy properties and undermine human activities, but nasty weather also causes food scarcity. Reservoirs become dust bowls, hence causing the severe scarcity of water.

In order to limit the harm of drought, the State of California and federal agencies have worked together to protect water supplies vital to health and human safety. Some efforts
have also been invested in an attempt to provide water for agricultural use.

(http://ca.gov/drought/managementactions.html)

4.2 Conceptual Framework

The paper analyzes a body of literature regarding the use of social media and conducts relevant case studies in order to clarify the function, application as well as pros and cons of social media in the California drought. The extensive literature will be analytically and descriptively sorted out from relevant journal articles and case studies. It will be used to explain how social media is employed. The author’s reason will be established with a view to getting sufficient information on social media use. This paper will give a summary of the relevant literature and comment on their conclusions and recommendations. Information in case studies will be analyzed and translated into a piece of research information that can support an argument for the use of social media. Case studies will be analyzed to provide evidence that will used in developing implications, recommendations and conclusion.

Table 2: The Roles of Social Media in 2014 California Drought Management

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>CADWR Website</th>
<th>CADWR Twitter</th>
<th>CADWR Facebook</th>
<th>YouTube of Cal OES</th>
<th>Save our water Website</th>
<th>Save our water Twitter</th>
<th>Save our water Facebook</th>
<th>Placer County Mobile app</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info-Sharing (one-way)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 shows the use of social media during the 2014 California drought. According to the DHS’s document (DHS First Responder Group, 2013), this kind of analysis helps in understanding the use of social media in disasters, such as drought in California in 2014. Table 2 contains a full range of applications of social media for the public.

It can be seen from Table 2 that emerging technologies have been utilized, say Twitter, Facebook, and Mobile app while traditional technologies, including websites, SMS and mapping, are still in use. Although photo-sharing and video-sharing emerged many years ago, these two technologies appear to be very advanced when they are integrated with mobile apps through new social media such as Twitter and Facebook, due to which people can share photos and videos anywhere and anytime. Many functions provided by Google are also very particular. Google conflates such services as YouTube, Google map, and Gmail by using Google+.
Table 2 shows main applications of social media during a disaster. Specifically, they are information sharing (one-way), information sharing (two-way), situational awareness, rumor control, reconnection, decision making, donations, and volunteer management. This paper will analyze how these functions are fulfilled and what the strengths and weaknesses of each social media and how to manage risk in 2014 California drought in the subsequent section.

5. Methodology

5.1 Data Sources

Data sources are categorized into two major types: government agencies and social media accounts.

Social media is used to deal with drought and its impact. It is an essential tool to prepare the public for the imminent crisis. Various organizations utilize social media to provide the public with beneficial information when responding to disasters. Government and other humanitarian agencies obtain relevant useful information to assist the affected population.

Information posted on government official websites and the governmental official social network from January 2014 to August 2014 is carefully examined. The number of replies, reposts and stars on Twitter or Facebook can be an indicator in assessing what roles social media played in the 2014 California drought.
Source Analysis List

Following is a list of sources which will be analyzed in this paper.

Table 3 Data Sources

<table>
<thead>
<tr>
<th>Websites</th>
<th>Rationale</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal OES (<a href="http://www.calema.ca.gov/NewsandMedia/Pages/Current%20News%20and%20Events/Drought.aspx">http://www.calema.ca.gov/NewsandMedia/Pages/Current%20News%20and%20Events/Drought.aspx</a>)</td>
<td>It is the official website of California Emergency Management Agency. The hyperlink provided here is a page about drought.</td>
<td>Governmental Agency</td>
</tr>
<tr>
<td>YouTube account of Cal OES (<a href="https://www.youtube.com/user/CalEMATV">https://www.youtube.com/user/CalEMATV</a>)</td>
<td>It is the official YouTube account of the California Office of Emergency Services and it is the only social media link available on the official website. The Facebook link is weak while the Twitter link is false.</td>
<td>Governmental Social Network</td>
</tr>
<tr>
<td>Flickr Account: Cal OES (<a href="https://www.flickr.com/photos/calemaphotos">https://www.flickr.com/photos/calemaphotos</a>)</td>
<td>It is the official Flickr account of Cal OES.</td>
<td>Governmental Social Network</td>
</tr>
<tr>
<td>California Department of Water Resources</td>
<td>It is the official website of the California Department of</td>
<td>Governmental Agency</td>
</tr>
<tr>
<td><strong>Website</strong></td>
<td><strong>Description</strong></td>
<td><strong>Agency</strong></td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>------------</td>
</tr>
<tr>
<td><img src="http://www.water.ca.gov/waterconditions/drought/" alt="" /></td>
<td>Water Resources. The link below directly jumps to a page containing drought information in California.</td>
<td>Governmental Social Network</td>
</tr>
<tr>
<td><img src="https://twitter.com/CA_DWR" alt="" /></td>
<td>Official Twitter of the California Department of Water Resources</td>
<td>Governmental Social Network</td>
</tr>
<tr>
<td><img src="https://www.facebook.com/pages/California-Department-of-Water-Resources/95205192448?ref=ts" alt="" /></td>
<td>It is the official Twitter account of California DWR.</td>
<td>Governmental Social Network</td>
</tr>
<tr>
<td><img src="http://www.cdfa.ca.gov/drought/" alt="" /></td>
<td>California Department of Food and Agriculture</td>
<td>Governmental Agency</td>
</tr>
<tr>
<td><img src="http://www.cdfa.ca.gov/drought/" alt="" /></td>
<td>It is the official website of the California Department of Food and Agriculture.</td>
<td>Governmental Agency</td>
</tr>
</tbody>
</table>

This paper will make a comparative study between the Facebook account and the Twitter one.
Save Our Water
(http://www.saveourh2o.org)
It is a program created in 2009 by the California Department of Water Resources.

Governmental Agency

5.1.1 Governmental Agencies

During this drought, many government agencies published information through a centralized portal. The official website of California government provides updates on a regular basis. The California government creates a special website to update information about drought and the California Department of Water Resources also sets up a specialized drought page.

California Drought (http://ca.gov/drought/)

California Department of Water Resources (http://www.water.ca.gov/waterconditions/)

Cal OES
(http://www.calema.ca.gov/NewsandMedia/Pages/Current%20News%20and%20Events/Drought.aspx)

California Department of Food and Agriculture (http://www.cdfa.ca.gov/drought/)

The websites above are two official website of the Government of the State of California. They collect the origins of drought data, combine these data, and provide readable data for citizens. They also offer functions like situation awareness, decision making, and reconnection. They are, so to speak, a non-replaceable part of the 2014 California drought.
5.1.3 Governmental Official Social Network

YouTube account of Cal OES ([https://www.youtube.com/user/CalEMATV](https://www.youtube.com/user/CalEMATV))

Official Twitter of the California Department of Water Resources ([https://twitter.com/CA_DWR](https://twitter.com/CA_DWR))


Twitter Account: @CalDrought ([https://twitter.com/CalDrought](https://twitter.com/CalDrought))

Facebook Account: ([https://www.facebook.com/CAdrought](https://www.facebook.com/CAdrought))

5.2 SWOT Analysis

Volunteered Geographic Information (VGI) is a new technology assisting the general public in disaster problem solving. Compared with traditional techniques, VGI is marked by its fast speed and easy accessibility.

However, one of the weaknesses of VGI has much to do with its data quality. The use of photos and videos may well change this situation.

The information shared by local and state governments undergoes a lag time for at least four to five days. The use of VGI and social media can make it real time and multi-way information sharing. Nonetheless, public motivation can pose a threat to VGI used in such disasters as drought. People focus more on disasters which are intimately related to human life, such as hurricanes and earthquakes.
### 5.3. Measurements of Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Definition</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information sharing</strong></td>
<td>Information sharing describes the exchange of data among organizations, individuals and technologies.</td>
<td>Search for posts on social media and make a comparative study in reposts /retweets /likes /stars and replies.</td>
</tr>
<tr>
<td><strong>Situation Awareness</strong></td>
<td>Situational awareness refers to “the ability to identify, process, and comprehend different elements of information regarding what is going on”</td>
<td>Search for reports and newsletters on given websites.</td>
</tr>
<tr>
<td><strong>Rumor Control</strong></td>
<td>Not obvious in the drought case.</td>
<td></td>
</tr>
<tr>
<td><strong>Reconnection</strong></td>
<td>Not obvious in the drought case.</td>
<td></td>
</tr>
<tr>
<td><strong>Decision-</strong></td>
<td>Decision making can be defined as the</td>
<td>Search for</td>
</tr>
<tr>
<td>making</td>
<td>process of making choices among possible alternatives.</td>
<td>Governor’s reports or statements.</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Donations</td>
<td>Donations are something (such as money, food, clothes, etc.) that an individual or organization gives in order to help others.</td>
<td>Search for donation links. Keyword: Donation.</td>
</tr>
<tr>
<td>Volunteer Management</td>
<td>Volunteer management is, at its core, selecting and supervising volunteers.</td>
<td>Find out whether the websites have a volunteer page and search social media for information about the number of posts using a volunteer tag.</td>
</tr>
</tbody>
</table>

Different government agencies use different social media in the 2014 California drought. Among all the social media, Twitter and Facebook are most frequently used. This paper does a count of the posts from January 2014 to August 2014 by government agencies and official social media accounts. The posts, reposts and likes on Facebook and tweets, retweets, and stars on Twitter will also be counted.
6. Results

6.1 Result Table

*Table 4 Result: The Roles of Social Media in 2014 California Drought Management*

<table>
<thead>
<tr>
<th>Result</th>
<th>CAD WR Website</th>
<th>CAD WR Twitter</th>
<th>CAD WR Facebook</th>
<th>YouTube of Cal OES</th>
<th>Save our water Website</th>
<th>Save our water Twitter</th>
<th>Save our water Facebook</th>
<th>Placer County Mobile app</th>
</tr>
</thead>
<tbody>
<tr>
<td>Info-Sharing (one-way)</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Info-Sharing (Two-way)</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Situational Awareness</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Rumor Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reconnection</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Decision-making</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>Donation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Volunteer Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table change the social media type from table 2 style to this new style. The social media type is specific in each website this paper analysis. This result table shows the result of the full analyze of the websites and governmental social media accounts. Theses crosses means there are some findings in the scan of websites and governmental social media accounts. Compared with table 2 list in the chapter 4, there are lots of difference found in in the decision-making and volunteer management parts, and some difference in
the information sharing section. The results will be completed discussed in the results chapter.

6.2 Results

According to the results of website searching, Facebook is the most widely used social media in the 2014 California drought. The official Facebook account of the California Department of Water Resources has 3490 followers and the official Facebook account of Save Our Water created by the California Department of Water Resources has 101,412 followers. Between January 2014 and August 2014, the official account of Save Our Water had more than 200 posts, and got more than 60 thousand likes and 10 thousand replies and the official Facebook account of the California Department of Water Resources had more than 120 posts and got more than 2000 likes and more than 500 replies. The official Twitter account of the California Department of Water Resources, having 1230 followers, tweeted about 200 posts between January 2014 and August 2014. What is interesting here is that there is no comment under any tweet about the California drought posted by the official account. Cal OES released 79 videos this year about the California drought on YouTube and a total number of 11 thousand people watched them. The number of people who interest in 2014 California drought is not as much as the number of hurricane sandy on social media, but still more than expected. Normally people pay little attention on those long-term disaster, especially disaster do not treat human life. People usually get used to those disaster and blind on them.

6.3 Functions of Social Media/ Network/ VGI in 2014 California Drought

From Government to Public

Government agencies, firms and other stakeholders utilized mobile applications and
websites to deliver information, notices and orders about evacuation. Tweeter was used to provide information concerning the aftermath of a disaster: health threats, challenges and other problems such as power blackouts. The information from the public was confirmed by politicians or other professional leaders, who also directly communicated with the public via Tweeter. More aid information was provided by the private sector to support the government.

From Private Sectors to Public

For example, Twitter’s government account (@gov) provides a list of widely suggested emergency and local accounts for the public to follow. What’s more, Word Press is a wonderful tool or platform for private sectors to share information with everyone.

From Public to Government

Through social media, the public expressed their urgent need for assistance from the government and well-wishers. Information is an important part when situation awareness is operating. Both parties relayed information according to the requests made via social media. Government agencies monitored information on social media in order to determine any threat and confirm it.

From Public to Public

The public used social media to communicate with their friends or strangers. Humanitarian organizations also obtained a direct connection to this source of information.

Comparatively speaking, Twitter appeared to play a more crucial role in disasters such as hurricanes and earthquakes. It could be that people were more willing to use Facebook to
share information about and discuss drought than to use Twitter. As can be seen from the record, more people liked and gave comments under the timeline than retweet or add stars on the information.

6.3.1 SWOT Analysis Result: Info-Sharing (one-way)

From the data obtained from websites, Twitter accounts and Facebook accounts, one-way information sharing served two main functions in the 2014 California drought: to disseminate information and to reach out for the audience. In this drought, the public, donors, NGOs and local agencies made concerted efforts in combating it. Agencies, in particular the California Department of Water Resources and the State Government of California provided timely updates for the public and other recipients. Messages concerning the California drought and combat actions, such as water conservation measures were transmitted to the recipients with an intention of persuading, directing and informing them. In managing drought via one-way communication, information was sent to the recipients whereas no feedback as to whether the message was received and comprehended was obtained from the public, local agencies and other stakeholders. The figure below illustrates this:

Figure 2: One-way communication in California 2014 Drought Management
According to the official Twitter and Facebook accounts of the California Department of Water Resources, Twitter was more involved in one-way information sharing in this case. The Twitter account was followed by more than 1200 accounts and gave approximately 80 tweets about drought from January 2014 to August 2014. However, the tweets by the official account did not elicit any comment, and people just retweeted or gave stars to the information. The most popular tweet was created on July 17th. A video of Conan O’Brien show about the California drought was retweeted about 1.8 thousand times and starred about 2.8 thousand times. Surprisingly, there was also no comment under this tweet.

Strengths

1. It is an effective way of reminding the recipient.

In some instances, the public and local agencies participate in workshops and seminars aimed at empowering them to take active part in combat actions such as implementing water conservation measures. One-way info-sharing has been used as a way of reinforcing their trainings through frequent updates and sometimes informing them to attend workshops scheduled by stakeholders fighting against the 2014 California drought.

2. It helps to regulate communication.

Angry recipients can respond with abusive, insulting, negative and non-informative information. Since one-way communication does not give room for the provision of feedbacks, such information should be supervised. Negative information could demoralize people or stakeholders who were in the frontline in fighting the 2014 California drought. Sometimes, negative information could shun potential donors and well-wishers who provide funds for various projects. In some instances, the public is not
pleased with the response that the State Government of California and the Federal
Government of the United States gave to the crisis. This is enough to trigger abusive and
discouraging comments and feedbacks. Fortunately, one-way communication can prevent
any response from the public.

3. It supports the whole process of crisis management.

Despite the fact that California 2014 drought management faced a number of challenges,
such factors as collaboration, coordination, donations, sharing of ideas and
implementation of regulatory measures could reflect the will and ability of all
stakeholders. This must have been enhanced by one-way communication adopted by the
State Government of California and various departments.

4. It creates an awareness of drought management.

Through one-way communication, U.S. citizens and the whole world were able to know
about the causes, impacts, management and signs of such exceptional drought. With a
body of relevant information, problems were effectively solved and suitable actions taken.
California is not the only state that is at risk of severe crises. In fact, many other US states
are also vulnerable. With the information gathered from the California 2014 drought, the
management of such crises can be more effective. Early planning enables various state
and federal departments in agriculture, water and natural resources, and health to be
grounded up for future disasters. Commodities that should be factored in include water, food
and funds because drought will reduce water due to excessive evapotranspiration and
affect agriculture, hence low yields of crops. In a word, combating drought will be
extremely costly if no preparation is made. It is apparent from previous data that the
California government and other responsible departments were aware of the California 2014 drought and did prepare well for managing it. The figure below shows California statistical drought information from 1999 to 2013. It is convincing that data posted on one of the websites via one-way communication were very helpful in predicting, preparing, planning and responding to the drought crisis.

![California Drought Statistics, from 1999 to 2013 and Areas That Are Exceptionally Affected](source: California Department of Water Resources).

5. One-way communication ensures that information reaches targeted recipients.

In the case of the California drought, information was posted on specific websites familiar to the general public. Unlike other social media sites that are interactive and in which information can be accessed by anybody, the use of websites and newsletters limits the number of recipients. In this case, the targeted recipients were the public, NGOs, donors and local agencies.

Weaknesses
1. It is not open to debate and discussion.

It’s true that this way aided information to reach designated recipients, including the public, local agencies, NGOs, donors, but there was no feedback in return. In most cases, feedbacks stir up discussions that lead to the sharing of ideas in the best way so as to improve decisions and actions. Granted, the public noticed some issues and ideas beneficial in tackling crises. One of the flaws with one-way communication is that it does not allow for any debate.

2. Communication is not complete for lack of feedback.

In one-way communication, feedback is lacking, so this kind of communication is not complete communication in its full sense. A recipient might have an intention to air his opinion after synthesizing and comprehending the message. However, the Department of Water Resources formulated strict regulations on information sharing. The information was sent to various groups of people and organizations that acted and did things differently, but they were not allowed to give their comment even if they wanted to.

3. It is authoritative.

Recipients were informed about and then expected to comply with water conservation policies without any wavering in the California drought. Nevertheless, in some instances, they might be far from feasible, but the government still required everybody to conform to them. As a rule, the general public does not comply appropriately to authoritative information. During the drought, water was supposed to be conserved, but in some areas, cases of violation on water use policies were reported. It is assumed that people’s
propensity to say no to authoritative policies may lead to their inappropriate implementation.

4. It is selective in recipients.

Unlike two-way communication, such as Facebook and Twitter, by which recipients can share information with each other, one-way communication does not provide a platform of sharing. Only if people visit the site will they receive the updates or releases. Thus, it is impractical to inform the public of rules that call for strict implementation.

Opportunities

1. It involves an appropriate and orderly dissemination of information.

The orderly flow of information about the California 2014 drought was created because information originated from one source: the California State Government and the Department of Water Resources. Thus, no information about drought issues would contradict each other and if any alteration was made, it would be imparted to the recipients.

2. Communication is faster.

The Department of Water Resources provided updates and releases concerning the prevailing conditions of the California drought and the progress of combat programs, and they were immediately accessed by those who visited the site or who received newsletters via emails. Speedier communication ensures that people can get information promptly and thus have sufficient time to determine the course of action.

Threats
1. Perception of authoritative information

The public may perceive senders as authoritative because the channel of one-way communication did not allow for sharing opinions and giving comments. However, they may have valuable suggestions, constructive opinions or any other significant information concerning the 2014 California drought. The undelivered information and opinions of the recipients might have made them think that the sender didn’t value their opinions and their efforts were ignored in combating the drought. This might have been one of the factors for the reluctant reaction of the public especially in implementing water conservation measures.

2. It is vulnerable to mistakes.

Feedback involves positive and constructive criticism. It is in the nature of human beings not to alter or improve their decisions when they are provoked into thinking. The Department of Water Resources made decisions on water conservation and kept consumers, the public, local industries and agencies informed of them, but without any direct feedback or complaint via the platform. For lack of direct criticism, the sender may not be able to identify mistakes that have been made in their campaign against drought and there is a higher probability that they may repeat similar mistakes in the future. Should they receive constructive feedback, such mistakes would be avoided.


The State Government of California and various departments sent information to the recipients who received, read, understood and implemented it without any complaint. People who used this channel would assume that every bit of information they sent was
fit for the recipients. In this case, the recipients might be tempted to feel that they are undervalued, thus being denied an opportunity to voice their opinions, which I think is unethical and disrespectful especially in the 21st century. This may be one of the reasons why people did not implement mandatory regulations and policies.

6.3.2 SWOT Analysis Result: Info Sharing (two-way)
Two-way communication is bidirectional. The sender creates and sends a message to the recipient who reads and interprets it and in return gives a feedback in response to it. Two-way communication makes a communication cycle completed. The completeness is attributable to the presence of the feedback which helps the sender know whether the recipient understands and approves of the received message. There are online websites where two-way communication is conducted. For example, Twitter Account: @CalDrought (https://twitter.com/CalDrought) currently has 115 tweets, 5 photos and videos, and 239 followers and is following 15 Twitter accounts; the official Twitter account of the California Department of Water Resources has 479 tweets, 19 photos and videos, 1,333 followers, and 2 stars; the Official Facebook account of the California Department of Water Resources (https://www.facebook.com/pages/California-Department-of-Water-Resources/95205192448?ref=ts) created on 20/05/2009 currently has 3,496 likes and 73 visits. The aforementioned social accounts have many users interacting and exchanging information with each other concerning the 2014 California drought. Some videos and photos include information on areas where water conservation measures are being violated while others contain informative details concerning drought combat approaches. Most of the comments under the posts are discussing how worse the drought is. Only a few comments mention about the locations that government should pay attention. Some comments shows that some people do not know California is
suffering a drought. The official account of Save Our Water founded by California Department of Water Resources sharing a lot of stories about normal people how they save water in daily life. They also post many posters and videos teaching citizens how to save water. The follower on Facebook and Twitter are always discussing the topic the official account posts. It believed that the websites get a good feedback. Two-way communication usually takes the model as is shown in Figure 3:

Figure 3: Two-way Communication in California 2014 Drought Management

Strengths

1. Many recipients receive information.

The official Facebook account of the California Department of Water Resources (https://www.facebook.com/pages/California-Department-of-Water-Resources/95205192448?ref=ts) has 3460 likes and 64 visits, the official Twitter account of California Department of Water Resources (https://twitter.com/CA_DWR) is following 126 tweeter accounts and is followed by 1300 tweeter accounts, the California Drought twitter account: @CalDrought (https://twitter.com/CalDrought) is following 15
tweeter accounts and is followed by 221 and Google+ (https://plus.google.com/u/0/s/california%20drought) has also a number of followers. Once information is posted in any social media, including people’s comments, likes or sharing, it will reach many people within a short time. Additionally, it will also reach non-subscribers who follow or like social media sites.

2. Sharing ideas is democratic.

The feedback from the recipients is not suppressed. Hence they feel free to share their views and opinions, igniting a feeling that they are valued. In the case of the California drought, it enhanced the way that he California drought issues were solved. Meanwhile, it enabled all the stakeholders to derive information from each other. More importantly, it strengthened social aids, which were of the utmost significance in drought combat.

3. It allows for much room for feedback from the recipient.

Feedback helps the sender know whether or not the recipient has understood the information. Many aspects, such as giving positive comments, sharing, liking and giving suggestions on a particular message, are indicative of the fact that the recipient has received, read and understood it. Besides, positive responses encourage people, mainly those who fight against the negative effects of drought in the frontline. When program implementers and operators are appreciated, they get inspired and in turn do their work better. Apart from their better performance, it also enhances learning by sharing ideas.

4. It completes a communication process.
Feedback helps complete a cycle of communication. It is an indispensable element because it shows that not received it but also interpreted it, and helps remove the fear of recipients not receiving the information as it conforms they received the information.

5. It influences behavioral modification.

In the process of two-way communication, people reinforce positive behavior as depicted in updates. Appreciating good behavior motivates a person to act more perfectly while discouraging bad behavior by means of feedback and comments enhances behavior modification.

6. It creates an environment where the sender and the recipient play equal roles.

In the process of two-way communication, both the sender and recipient have equal opportunities to express their ideas. In the case of the California 2014 drought, the sender includes the California State Government and the California Department of Water Resources while the recipient includes local agencies, the public, NGOs and donors. They have the same chance to give their opinions about the drought. They can take either position interchangeably and can send a message in the form of feedback to clarify ambiguous issues.

7. It allows positive criticism.

Well-meaning criticism is usually constructive and positive and it can improve the way an organization organizes its activities. The State Government of California and the California Department of Water Resources promulgated water conservation policies via Facebook and Twitter which allow two-way communication. From the responses of the
public and other local agencies, it is evident that such feedback carried massive significant. The public gave their suggestions on how to implement regulations appropriately. Likewise, the information helped the State Government of California and the California Department of Water Resources to redesign approaches to implementing their actions and look into areas that were neglected. Disapproval of policies and implementation strategies provoked the thinking of policy makers-- the State Government of California and the California Department of Water Resources. They were inspired to inductively and deductively strategize feasible ways that could combat drought more effectively.

8. It triggers creative thinking.

Two-way communication helps stakeholders to debate over and share ideas. Individuals and organizations in Facebook social media share information and discuss over a certain update, which may act as a catalyst for a chain of sparking ideas. In this way, the public set up rapport with the government and various departments and are more willing to participation in combat actions. Through the Twitter account, @CalDrought (https://twitter.com/CalDrought), operated by the California government and the Facebook account of the California Department of Water Resources (https://www.facebook.com/pages/California-Department-of-Water-Resources/95205192448?ref=ts), the public and other local agencies were able to report violations of water conservation measures and other activities likely to worsen or initiate drought implications such wildfires. Criticism and feedback from the recipients enable the sender to rethink actions and programs and eventually come up with better decisions and courses of action.
Weaknesses

Due to the fact it involves negotiation, it usually takes much time to arrive at a satisfactory answer. As a result, two-way communication seems satiating to both parties but it takes time for an idea to gain acceptance as people have differing ideas and opinions. More often than not, people go off track and raise irrelevant issues that diminish the focus and importance a main agenda is supposed to be given. Unless agendas are selectively chosen and comments are geared to the main topic, an appreciable amount of time will be expended in discussing matters, which is apparently inappropriate. One vital initiative in the California drought is water conservation for future use. In this channel people may bring issues that are unfitting.

Opportunities

1. It creates an alternative approach to interviewing with people.

The opportunity for giving feedback in two-way communication provides an alternative way of interviewing. People may want to obtain information on a given topic or elicit opinions on a specified agenda. To procure information from the target population, the sender is required to design a message as a suggestion or a proposal. When others receive it, they will more likely give feedback, which may be beneficial to the sender in making judgments concerning the matter. With the application of social media, the policy makers of water conservation collected information from the feedback of the public and other subscribers and were thus able to make decisive and feasible conclusions.

2. It makes possible focus groups discussions.
Recipients do discuss the information they receive with each other. This happens in two-way communication platforms, such as Facebook. Senders can follow the discussion and eventually know the attitude, knowledge, and action of targeted people concerning the issue in discussion. The discussion of focus groups is also helpful in gaining a more insightful understanding of the given matter. Additionally, it is vital to determine the type of recipients senders are dealing with, which will help them decide upon the optimum approach so as to promote the implementation of relevant policies or regulations, say, in drought combat programs.

3. It provides an opportunity to conduct a situational analysis.

The recipients in two-way communication give feedback that may contain additional information about the crisis. The team in charge of analyzing the magnitude of the problem may be unable to get a whole picture of the whole situation. Hence, they may end up making biased decisions. In the case of the California 2014 drought, the public gave feedback over the updates of the Department of Water Resources and reported the violation of water conservation policies. This kind of feedback was instrumental to the whole process of drought management. Therefore, the information provided by the public, agencies and organizations operating at a community level carries a lot of weight because they give firsthand information concerning the situation of the crisis.

Threats

1. It is prone to negative and destructive criticism.

Negative criticism tends to offend other people and may undermine their motivation. It may also make them think that other people do not have trust in them. Sometimes, if they
are not psychologically strong, they may be resentful to those critics. For instance, the public were dissatisfied with some policies and regulations that were meant to help preserve water. If they had been given an opportunity to give negative feedback, it could have triggered resentment and demotivation. A discouraged individual or organization may not offer satisfactory services. Thus, the whole combat process could have faced more hindrance.

2. Rumor tends to spread fast.

In two-way social media, people have different platform options, such as liking, commenting and sharing updates, by which information will spread to other online friends very fast. If information is neither confirmed nor authentic, its dissemination may lead to tension and panic.

6.3.3 SWOT Analysis Situational Awareness

The State Government of California worked in collaboration with the Department of Water Resources to collect, evaluate and analyze precipitation and soil water content information from 1999 to 2013 and statistics were harnessed to determine the trends of precipitation from year to year and foresee the 2014 drought. The analysis facilitated their awareness of the forthcoming drought. Not only did they know about the drought, but they also learned about the unique feature of the California 2014 drought in the US history. Other significant variables in assessing the situation include the level of evapotranspiration, soil temperature, atmospheric temperature, the nature of wind and the intensity of sunshine.
In conducting a situation analysis, the Department of Water Resources took six steps as follows: identifying an applicable, identifying well-documented and available data, determining relevant information, collecting required data, creating a report and disseminating the findings to various stakeholders, the public, departments, local agencies, NGOs, donors and the federal government, for adoption and implementation.

Statistics show that 30 water conservation plans were shared via the Facebook and Twitter accounts of the California Department of Water Resources from January 2014 to August 2014. To be specific, 93 retweets and 22 stars were found under the tweet while 37 reposts and 66 likes were followed under the Facebook post. 110 photos about the water condition and water conservation plans were posted by the official Facebook account of the California Department of Water Resources. The official Twitter account of the California Department of Water Resources also shared the link to these photos. At present, social media offer an easy connection to ordinary people so that they can get information about what is happening and what will possibly happen.

Strengths

1. It helps in planning.

The situational analysis helped the California State Government and other stakeholders come up with ways of conserving water and preparing for the upcoming devastating effects of drought such as wildfires. The information they obtained after conducting a situational analysis was of much help in allocating their resources according to the demand of specific areas. Where there was a deficit for resources, they resorted to financial aids from donors, NGOs and the federal government. They designed a feasible
structure so that they could respond promptly to drought and minimize its life-threatening impacts. Since it is not the first time the drought has hit California, the California government has been fully aware of its detrimental effects. Therefore, they drew up a plan to minimize the destructive effects of drought on flora and fauna in California. Early and adequate planning aided swift reaction with minimal disagreements and panic during the implementation of the drought combat programs.

2. It aids the implementation of programs.

As is shown in Figure 6, situational analysis is instrumental in the identification of goals, the selection of the available operational options, the implementation of policies and finally the evaluation of programs so as to achieve desired results. Most of the programs operated in California are intended to keep people knowledge about how to adopt new lifestyles in which they consume less water and conserve water.

![Figure 4: Program Implementation Procedure to Combat California Drought](image)

The procedure helps in the identification of deficiencies and their rectification.

3. It is significant in formulating policies.
Conducting a situational analysis enabled the State Government of California and the California Department of Water Resources to identify and document drought problems. Early identification of problems with policies was beneficial in formulating policies and regulations that have helped fight drought impacts. They imposed restrictions on water use in various sectors including outdoor watering, agriculture, businesses and private consumers. The California Department of Water Resources increased the bills of excess water utilization and deployed personnel who monitored how users utilized water and detected any violation. They gave warning notices to those who violated the rule and the offender was thus fined. They didn’t lift the punishment unless the violator was willing to join water conservation workshops.

4. It helps create a drought management team.

In response to the drought, the California State Government and the California Department of Water Resources trained their personnel and equipped them with the necessary knowledge in the implementation of policies and programs. They were assigned responsibilities to deal with problems on the spot. Most significantly, they were trained in how to react to emergencies and resolve problems in a prompt and tactful manner. They also assigned roles to other people who took charge of updating their websites and communicating with the public, stakeholders and the world at large.

5. In helps in the accumulation and allocation of resources.

Extensive publicity was given on various websites: some operated by the California State Government and others by NGOs. After disseminating the information of drought, they collaborated with various organizations, donors, volunteers and stakeholders and updated
their data. Data included the contact information and responsibilities of emergency responders such as the fire department, police officers and health care givers. This is extremely helpful in giving immediate responses in case an emergency occurs.

Weaknesses

1. It fails to give solutions to identified problems.

It helps in identification of problems but does not aid in ranking them according to priority and how the problem should be solved. It only makes one aware of the issue where they are required to apply other approaches to get solutions and prioritize those of great need.

2. It generates a lot of information.

Most of the information is not precise and if people are not keen they end up confusing themselves with large quantities of ideas. Therefore, they need to scrutinize information carefully so as to spot appropriate and beneficial information in combating the drought.

Opportunities

1. It gives much room for intensive and extensive research.

Situational analysis enables individuals or organizations to conduct thorough research. For instance, the researchers in California collected a lot of data, analyzed them meticulously and applied the findings in the entire process of fighting the drought. Statistics revealed a lot of information concerning the drought, the California State, the lifestyle of California residents and relevant initiatives in combating the situation.

2. It gives sufficient convincing information to donors.
Donors and NGOs need a well-organized and detailed description of the situation so that they can provide funds for programs. A majority of donors do not fund infeasible programs; instead, they need a well-organized report that gives a clear picture of the crisis and relevant problems.

Threats

Situational analysis can generate a lot of information which, if not well scrutinized, can lead to the exaggeration of figures. For example, rumor had it that funds were diverted to some programs in California. Had the message not been monitored, there could have been much panic and tension among those who donated money, which may have jeopardize the programs meant to minimize drought effects.

6.3.4 SWOT Analysis Result: Rumor Control

A lot of information was released about the California drought, including preparations for the drought, its implications on human activities and the way the California State Government, government departments and NGOs reacted to it. Most of the information on non-official or personal social websites was neither confirmed nor created by the government or any stakeholder involved in fighting the drought. Despite the fact that it was unconfirmed, it spread at a very high rate in social media sites such as Twitter, Google+ and Facebook. However, it was hard to find rumor in this drought case. Also, no rumor control information was posted on websites or by official social media accounts. In general, rumor control was one of the weaknesses in the 2014 California drought.

Strengths

1. It can reveal unknown activities.
Sometimes rumor may also contain some genuine information. The leaked information reveals something that is concealed. When it is unveiled, responsible parties can act accordingly to rectify problems. For instance, some residents did not install water meters—a kind of device to monitor how water is consumed. The field officers found this information circulating in social media. It helped them come up with an effective solution to ensure that all the residents installed water meters, thus enhancing the monitoring of water use. On the other hand, it revealed the weakness of the California Department of Water Resources.

2. It can lead to an investigation of initiates.

Rumor may be concerned about sensitive information, such as the misappropriation of funds. In this case, relevant authorities have to carry out an investigation to find out the authenticity of this rumor. For example, rumor had it that funds were being misused in combat programs and in response the California Department of Water Resources launched an investigation about this. In the process of this investigation, other unknown things were also identified.

Weakness

When information about the misappropriation of funds was leaked on social media, donors would become skeptical about the harnessing of resources in water conservation programs. Due to this, the California Department of Water Resources was prompted to carry out an investigation to find out the truth and send authentic information to the public.

Opportunities
Rumor tends to spread very fast, thus reaching many people in the twinkling of an eye. However, it’s not obvious in this case.

Threats

When information is not monitored, it can easily be disseminated. The spread of incorrect information can surely mislead the recipients. Sometimes, malicious people can use this opportunity to create tension among the public by diffusing wrong information.

6.3.5 SWOT Analysis Result: Reconnection

The residents of California have a culture of social exclusion where people always conduct their activities without involving many people. However, during times of a crisis, people tend to get reconnected so that they can assist and motivate others so as to minimize the harmful effects of the crisis. Many people get reconnected via social media with the purpose of receiving updates of the drought situation and the progress of various programs. Reconnection was not salient in this California drought case. However, a mobile app released by the local government—PCWA, a mobile app published on Google Play on May 2014 by Placer County Water Agency, California, made it. This app was developed to guild people in Placer County in increasing water use efficiency. However there is no iOS version of this app on the AppStore at present.
Figure 5 is the screenshot of the PCWA app, which is largely focused on drought in this county. What’s more, people can add comments and upload geo-tagged photos to report water waste in Placer County with this mobile app. In this way, the local government can use it to get connected with citizens and citizens can also use this app to provide feedback for the local government.

Strengths

1. It can easily mobilize resources: manpower, funds and ideas.

During the 2014 drought, people in California got reconnected via social media with a common aim of increasing their output because economy was also adversely affected by the drought. They joined business activities in groups and made concerted efforts to find ways to increase the cost effect of crop cultivation and boost its yields. They formed groups to help in workshop training and advising people to conserve water. In these
reconnected social groups, especially social media, they provided updates and convinced each other to adopt water conservation measures and other policies intended to reduce the effects of drought. Meanwhile, many people in California started to minimize water consumption.

2. It creates a wider network of communication.

People and other parties in California created a vast communication network efficient enough to relay information to many people within a short time. It helped in publicizing policies aimed to cultivate a habit of consuming less water. The Department of Water Resources and the Fire Department informed people about their plans in combating drought. The formation of connections contributed to a quicker and faster spread of information in CA, in other states and globally.

Weaknesses

When a large number of people with mutual interests disagree with the decisions and plans of the authorities, they are not easily convinced and may not support ideas. This happened in California when many people in social media disagreed with strict water conservation rules and their attendant penalties if they are violated. Therefore, the Department of Water Resources had to adopt a different approach to keep the public notified about the significance of water conservation.

Opportunities

1. It helps the formation of unity.
Reconnection makes people get united and act as a team so that they formulate and implement programs more efficiently and effectively. Irrespective of minor issues, they support other departments in several ways. Working as a team improves the ties between people and government.

2. It creates a wide range of ideas.

A wide range of ideas are shared with the aim of improving the implementation of various programs initiated in California. Ideas from the public are significant in removing barriers as a result of a more eco-friendly lifestyle.

Threats

Rumor may be spread easily among reconnected groups. In the case study, it may affect the efforts of stakeholders in a negative way especially when it is not handled well. Stakeholders can be demoralized and may opt to stop implementing even beneficial programs.

6.3.6 SWOT Analysis Result: Decision-making

Decision making entails analyzing and assessing at least two alternatives and eventually selecting the optimum proposal. During this process, information is a decisive and fundamental factor, and social media is a paramount avenue to obtain information. For example, the biggest challenge is the drought. 30 hyperlinks were shared by the official accounts of the California Department of Water Resources both on Twitter and Facebook. About 60 reposts and 100 likes were found under the Facebook post, but no comment was given. About 30 retweets and 90 stars were found under the Twitter post, but no comment was given either. The decision-making function is very useful via social media.
The California State Government shared weekly reports on social media using their official social media accounts, which enabled more people to receive this information and give more feedback in time. However, in this case, some people did have an eye on reports, but virtually no people gave their comment.

Strengths

1. It facilitates problem identification.

Social media provides important information which is helpful to identify problems or deficiencies. It is especially true of two-way communication. In the 2014 drought, the public complaint about the difficulties they were confronted with and problems that were not adequately addressed. From their complaints, officials could select information and use it to identify potential problems.

2. The decision-making process follows all the phases.

After identifying problems, California officials conducted two analyses upon consideration of ethical values. The decision they made was successfully implemented despite the fact that they initially met with strong resistance from the public due to their demanding requirements. The team in charge of decision-making placed much value on information from the California public and other organizations. Hence, they communicated with team members in every step. As a matter of fact, public ideas were very helpful in bringing into being their decisions.

Weakness
The team involved in making decisions was not held accountable for monitoring and evaluating their efficiency and effectiveness. Instead, they transferred this work to another group of professionals who may be unable to relate the aims of the decisions to the results. By the same token, there was very limited communication between decision makers and implementers.

Opportunities

It is inevitable that any decision-making team needs to gather information, conduct analyses and come up with feasible solutions. It creates a marvelous opportunity for people to acquaint themselves with research skills and experiences vital to solving future problems. Social media can provide an ideal platform for conducting interviews and focus group discussions. The findings from the analysis of interview responses and discussions can be employed in making decisions.

Threats

1. Information may be limited.

The public may refrain from sharing information via social media. Therefore, decision makers may not obtain sufficient information. Should it occur, they would be compelled to collect data in person. In some cases, it may take too much time to come up with solutions which instead may not be effective enough to address problems for lack of sufficient firsthand information.

2. Satisficing
Instead of maximizing the decision-making process probably for lack of sufficient information, the team may be tempted to select available options that may not satisfactorily solve the problem or fill the gap. Also, satisficing may rob programs and projects of originality in coming up with solutions to dynamic problems.

6.3.7 SWOT Analysis Result: Donation

The State Government of California collaborated with the Pacific Institution to create an online website, the California Drought (http://www.californiadrought.org/donate/), where well-wishers, donors, NGOs and other institutions can donate their money in helping combat the drought. On this website, one can give donations from any part of the world. However, there is only one donation link on the official website of Save Our Water and no donation link was posted by the official social media account. Moreover, the donation part also has some weakness because the State Government of California may not need any donation. Government agencies, such as Save Our Water, founded by the California Department of Water Resources, do possess this function and run very well.

Strengths

1. It is easy to make donations.

Donations for the California drought can be made on online websites using PayPal, VISA or Master Card. Any individual or organization can donate from their residence without making any transactions or movements. A confirmatory notice is usually sent to the donor upon completion of the transaction. Online donations are very convenient; hence California receives a lot of donations, which proves to be of great significance in running drought combat programs.
2. It provides financial assistance.

Donations provide complementary resources in planning, implementing and monitoring drought programs. With these donations, the government can apportion and utilize them where necessary. For example, they can be used to purchase goods and services or pay wages. They can even give grants to people so that they can readily follow water conservation programs. For instance, homesteads with flower gardens were given $1000 to replace the plants that need more water to survive with plants that are drought resistance such as acacia and cacti.

3. It is a sign of unity.

When people donate money to fund California drought programs, they portray their interest to people who are suffering due to the implications of the drought. They show brotherhood and hope that the victims of the drought could bounce back from the crisis very soon. To make them aware of their interest, donors update their donations on social network, such as Twitter. The information provided and shared via social media is effective enough to monitor how donated funds are spent, hence minimizing the illegitimate embezzlement of donations.

Weaknesses

1. It has many restrictions.

There are many strict restrictions defining what can be donated and how the donations will be used. The numerous restrictions and processes involved may delay money
dispensation. Usually the delayed release of funds is not appropriate for emergency programs in urgent need of cash.

2. It may incur the misappropriation of money.

Donated money can be allocated for different purposes or support different programs. Most of the donations are used to help the needy but sometimes they can be allotted for other uses, thus increasing the risk of misappropriation.

Opportunities

1. It may catalyze regional development.

Donated money helps in running programs that promote the development of a given region. For example, programs whose aim was to increase water conservation may also improve agricultural production, increase commercial activities and alleviate adverse effects in the transport sector.

2. It may help create awareness.

When sourcing donations, a situational analysis report was sent to potential donors, including individuals, institutions, NGOs and the federal government. When they received it, they would read it, which sometimes would help in informing parties with whom they had a partnership.

Threats

1. Fraud
While resources were allocated to run drought combat programs, some individuals provided false information with the aim of creating an opportunity of embezzling funds and using them for their personal benefits. Quotes of logistics prices were exaggerated. Had there been no close and effective auditing, the funds could have ended up being misappropriated. In one word, donated money is vulnerable to embezzlement.

2. Overdependence on donations

There is a risk that people may over-depend on donations and quit their income-earning activities. They may want to create counterfeit problems so that they can trigger more donations and receive more funding. Such acts can create a society that cannot sustain itself economically.

6.3.8 SWOT Analysis Result: Volunteer Management

Managers and officials of NGOs and local agencies operating in California advertised for volunteers in running various drought combat programs in different areas. They put in advertisements via Facebook, Twitter, Google+ and their official websites. After receiving applications, they acknowledged and selected those who were qualified for different positions. Their official websites and social media accounts enabled them to communicate well with volunteers. Subsequently, they kept contact with volunteers mainly via social media. Four activity links and about thirty photos were posted on the official Facebook account of the California Department of Water Resources. Links were also shared by the Twitter account but there was no photo. Only one activity was posted by Save Our Water via Facebook and Twitter. But the activity shared on Facebook and Twitter was different. It was also the case with the reconnection part. A mobile app
released by the local government—PCWA—did this. With this app, subscribers can take pictures or type texts to share information about water conservation with the local government.

Strengths

1. It helps managers gain leadership.

Volunteers should be experts where they choose to do their voluntary work. Therefore, they need intensive training to arm themselves with relevant skills. Leaders need to be patient with them because they may be unskilled or inexperienced. Supervisors learn how to handle until they learn how to fulfill their duties effectively. Therefore, managing volunteers acts as an opportunity for administrators to acquire a plethora of skills in management, particularly in human resource management.

2. It makes managers understand people.

Volunteers can be influenced by external factors of the environment, so managers need to learn how to understand and respect volunteers so that they can work in harmony with each other.

3. It calls for regular assessment.

Volunteer programs need to be regularly assessed to ensure that volunteers are on the right track and master desirable skills and experience. This helps to find out whether they are operating based on the mission statement to achieve the goals. Assessment identifies problems and helps in finding solutions to them.

Weaknesses
1. There may be too much expectation.

There may be too many unrealistic expectations notably in terms of the quality of services offered by volunteers or the benefits volunteers will receive. Occasionally, managers overlook the fact that volunteers may be novice in their voluntary work. In addition, most volunteers may never have worked in tough working conditions, such as the California 2014 exceptional drought. Due to such unconsidered factors, managers have later found that volunteers failed to work efficiently as expected. On the other hand, the benefits volunteers can reap may fail to live to their expectations, so they are increasingly lack of motivation.

2. Volunteer work may not gain recognition.

Regardless of the tremendous efforts volunteers have put in, their work may not be acknowledged. Although they may gain experience in their volunteer work, it is natural that they also hope that their work should be appreciated.

Opportunities

1. It creates volunteer networking.

Organizations that recruit volunteers create a network with prospective workers who are likely to join the work market. Those that have hired volunteers tend to take into consideration the application of the best performers if any job vacancy is available. Furthermore, it is also advantageous to volunteers because they get connected to employers who may give them a better chance of employment.

2. It sets up community centers.
Volunteerism enhances the creation of community centers that acts as a link of human resources to provide assistance in case of emergencies. They help connect job seekers with potential employers.

Threats

1. It may lack a common mission of volunteerism.

Most organizations lack the understanding of volunteerism. In the absence of a common objective, they differ in their opinions on the implementation of significant programs. These differences create more barriers and eventually they may not able to attain their desired goals.

2. Volunteer work is poorly timed.

Most volunteers are college students who choose to do part-time jobs during holidays. Since holidays last shorter than the length of programs, they have no option but to quit volunteering and go back to college to continue with their studies. The sudden departure paralyses the progress of programs being implemented.
7. Discussion

7.1 Practicability of the Study

Social Media

According to Chan (2013), social media enhances collectivity, connectivity, completeness, clarity and collaboration. The case study of the California 2014 drought reveals that social media created a bridge among people of different regions across the globe. Facebook, Twitter and Google+ spark the formation of online communities where subscribers discussed issues about the drought. From their discussions, they came up with possible solutions, some of which were borrowed and implemented by the California State Government and other departments in drought combat. Chan (2013) also contends that social media connects members in a manner that is different from the way they can be connected by other websites in that it allows sharing and directing users to other sites where right information can be found through web links. By and large, the sites whose web links are shared contain relevant information that empowers, educates or informs people of an emergency and its potential solutions. In the Facebook account of the State government of California and the Twitter account of the California Department of Water Resources, web links with important information concerning programs and workshops were posted. More importantly, the website created for online donations is a separate one and when users click on their web links, they are automatically taken to the site where they can follow easy instructions and make a donation. In this case, the practicability of using social media in sharing web links of significant websites helps in sourcing donors and making donations. Besides, people needed to be well-informed of water conservation
regulations and the penalties of violation. Meanwhile, the sites with this information were shared in the social media groups using web links that directed users to the sites where they were posted. Thus, social media helps connect different groups to various website, which proves very effective in managing a crisis like the California 2014 drought.

In managing the crisis of the 2014 California drought, California used social media in all the three stages: preparedness, response and recovery. This is confirmed by Chan (2013) and Bahir & Peled (2013), who state that social media plays a crucial role in crisis preparedness, crisis response and crisis recovery. Facebook, twitter, Google+ and other sites provide information in previous years. Statistics reveal that 2014 could be a worse year regarding its exceptional drought. Upon realizing the extreme effects of the drought, they made every endeavor to mitigate its impacts. The California State Government selected various departments according to their routine activities. Via social media, they provided people with updates and kept them well-informed of their initiatives and policies. They selected a team to take charge of various programs in fighting the drought. All the steps they made were communicated on social media websites so that they could also participate in any way. On top of these, they also posted manual outlines which instructed people on policy implementation, feasible alternatives in water conservation and violation penalties. Social media tools can involve online groups in collecting, analyzing and relaying information at the right time (Chan, 2013 & Virtual Social Media Working Group and DHS First Responders Group, 2013). Therefore, social media is a useful tool in the management of any crisis.

Volunteered Geographic Information
The destruction caused by recent occurrences both in USA in 2012 and in Japan in 2011 prompted the need to create a system that helps increase a community’s immunity to exceptional incidents and catastrophes (Horita & João, 2013). Horita & João also state that in response to extreme effects caused by crises, the public decided to voluntarily give information, which was significant in designing combat approaches and preventative measures.

According to Zook, Graham, Shelton & Gorman (2010), Information technologies are a principal means through which people can contribute a lot by planning and responding to the Haiti crisis to minimize its aftermath without necessarily being present. From their respective, people could use information technology tools to collaborate with non-governmental organizations operating in the area.

In combating the California 2014 drought in California, the same rule applied. People from various regions of California, the United States and even the whole world at large gave vital information and data that helped in designing, implementing and monitoring programs. For instance, when wildfires broke out, people voluntarily provided information on causes, responses and resultant effects. What’s more, the traditional method of communication and response shows its weakness compared with real-time and two way communication method. The California State Government and the Fire Department received relevant information and exploited it to come up with advanced fire-fighting methods.

It is also the same case with the Department of Water Resources. The water conservation team failed to realize that for all the efforts of advocating that less water be consumed, most households didn’t install water meters. Thus, they were unable to monitor water
usage. The information was volunteered from the public and later it was used by the Department of Water Resources in making it compulsory that every household should install a water meter and start to conserve water. Moreover, people also engaged in providing information about those offenders in violation of water conservation measures.

Drought

In this 2014 drought case, people shows less interests than other kind of disasters like hurricane and earthquake. The report of FEMA shows millions of information was posted during Hurricane Sandy. Drought is not similar to those disaster like hurricane and earthquake. These disasters shows more emergent situations which is closely related to human life. While drought is a long last disaster which has more threats towards agriculture or economy. The strength of social media is fast and easier as this paper mentioned in the last chapter. This feature is well related to those emergent disaster. People need more rapid informed which can save life. However, the strength of social media seemed not very closely related to drought disaster, which is a long term disaster. This will make people focus less on drought on social media than emergent disasters.

7.2 Limitations

There is much uncertainty in both information from social network and volunteered geographic information. The public share a lot of information via social media, most of which are not confirmed but appear very interesting. Such information might be useful to other people or organizations and departments responsible for managing disasters, but they have to do a thorough research to determine the authenticity of the data and volunteered information. In some studies, while the program is being
implemented and then information is volunteered on the way, it may bring some
disruption in the way the program operates normally despite the fact that it ends up being
helpful (Horita & João, 2013). For instance, the State Government of California and the
Department of Water resources implemented water conservation programs, only to find
that they failed to get valuable information and thus had to figure out other appropriate
approaches that needed more funding.

Much of the information found in social network is rumor. If it is not tamed
properly, it can fuel tension among the public. What’s more, people usually share
information without confirming whether it is genuine or false. Due to this, sometimes
information in social media fails to capture enough attention that it should deserve.
Therefore, there should be a way of monitoring rumor and preventing it from going viral.
However, in this case, rumor couldn’t be easily detected and virtually no rumor control
work was undertaken. This is a substantial difference between drought and other kinds of
disaster like hurricanes and earthquakes.

Data quality can be a huge issue to bottom up model information like volunteered
geographic information. How to control the data can be trustworthy? One solution is
using user levels to control the data. Higher level have high right to edit the data or the
social media websites can use marks to show which users are more trustworthy. Another
method is the government should work together with social media. In some time period,
the data is only uploaded by certain groups of volunteers. The professional volunteers
will make the data more trustworthy.

This paper separates social media and volunteered geographic information to
analyze the 2014 California drought. The reason is that most governmental websites just
use social media as a platform to do information sharing. The location based technology is still not popular used in this case, though the mobile devices is becoming more and more popular. The limitation of this study can be solved if social media can work together with volunteered geographic information. Government agencies can work together with social media websites like Facebook and Twitter using more of their location based APIs. If that happens, users can have better connection with government agencies using social network.

### 7.3 Suggestions for Future Study

The following areas concerning social network and volunteered geographic information may see a potential for future studies:

i. The role of two-way info-sharing in disaster management.

ii. Comparison between one-way info-sharing and two-way info-sharing in crisis management.

iii. How can social media and volunteered geographic information be appropriately used in management of disasters?

iv. How to monitor factors that might be responsible for the increasing occurrence of disasters via social media and volunteered geographic information?

### Conclusion

Social media is a platform that serves many functions in the current era and its principal purpose is to share information among its users. The function it serves and the way information is relayed can be incorporated in planning, responding to and recovery from
either artificial or natural catastrophes such as drought, earthquakes or floods. Through social media, people provide information that can be used in conducting a situational analysis and eventually defining the course of action. The primary goal of this study is to determine the roles of social media and volunteered geographic information in managing the California 2014 drought so that the extreme effects could be minimized. Two-way and one-way modes of communication are prominent in the management of California 2014 drought. In addressing the issues of the drought adequately, two-way communication is more effective because unlike one-way communication, it allows feedback from the recipient. Regardless of the challenges, social media and volunteered geographic information are very significant in the management of the California 2014 drought especially when they are properly utilized.
Reference


