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Evaluating the Reverse 9-1-1 System in Santa Clara County: Does the Process Work?

Areej M. Sadhan
San Jose State University

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Author: Areej M. Sadhan

Advisor: Dr. Frances Edwards

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INTRODUCTION

In times of crises, emergency first responders need an effective system of communication to notify the public, to organize evacuation, and to direct evacuees to shelters and hospitals around the affected areas. This research focuses on the "Reverse 911" alert system used by Santa Clara County and asks key questions about its efficiency: 'Is it the only alert system used to communicate with the public during crises?' 'Is it a reliable tool?' 'Should Santa Clara County improve its emergency communication?' 'Can we be sure the community is notified on time and well directed to safety?'

The legislative intent of Reverse 911 was to notify County residents whenever they are at risk, from disaster, emergencies and crime, and to advise them of appropriate protective measures. Hence, the research question is: **Does the process used for operating the Santa Clara County Reverse 911 System achieve the goal of providing timely and effective emergency notification to all members of the community? If not, what changes could enhance its operation?**

Background Of Reverse 9 11 And Its Implementation In Santa Clara County:

History of Alerting and Warning in the US

What is alerting and warning?

Emergency warning systems have past roots in civil defense, and the main reason why these systems were developed was to alert the public concerning a forthcoming threat over a given geographical area. In the era of the Cold War, the US developed an emergency broadcasting system known as CONELRAD, which used radio stations to broadcast any emergencies (After Action Report, 2007). Later this system was improved to become the Emergency Broadcasting System (EBS), and then the modern day Emergency Alert System (EAS). This was, for example, frequently used by safety organizations in San Diego to notify the public about adverse weather conditions, such as floods or tornados (After Action Report, 2007).

Given the escalating occurrence of natural disasters in the past two decades, it was important for the government to have a reliable emergency warning system so as to reach a large population within a short period when there is a disaster or an emergency (After Action Report, 2007). The Public Alert and Warning System (IPAWS) then was created in June, 2006 as a merger of existing warning systems after the Hurricane Katrina disaster. President George W. Bush signed an Executive Order to establish the new program to combine Emergency Alert System (EAS), National Warning System (NAWAS), Commercial Mobile Alert System (CMAS), and NOAA Weather Radio All Hazards. IPAWS was designed to integrate the different systems into one modern system and integrate newer forms of

communications such as cellphones, SMS, satellite, radio, television and the Internet (FEMA, 2014).

The continued development of communication devices like mobile phones, PDAs and computers has advanced the manner in which emergency warnings are relayed.

There has been a notable decline in death tolls resulting from natural disasters such as storms, tsunamis, cyclones and even fires. The modern day systems are computerized and they are designed to facilitate rapid message delivery using computer-programmed software. One of these newer systems is "Reverse 911" system (Barry, 2005).

What is Reverse 911 and what is its purpose?

Reverse 911, called AlertSCC in Santa Clara County, is a community-based alerting system provided and owned by a for-profit company called Sigma Communications, Inc. (Reverse 911, 2011). It is a registered trademark of a communication company known as Cassidian, an organization hired to communicate with people in defined geographical regions. This telephone company began the dispatching systems for telephones in 1960 (Strawderman et al., 2012). This system makes calls for the appropriate county agency for public safety, such as police, emergency management, public health, fire and sheriff. It is designed to notify the affected area of any emergency by sending a message through the phone system (Strawderman et al., 2012).

Reverse 911 is also used to contact residents through phone lines in specific geographic areas to deliver alerts and urgent information when they are at risk (Reverse 911, 2011). The company selling this tool provides the computer systems, set up, and training, including Windows 2000, power-supply, printers and phones that are needed for the product to function (Reverse 911,

2011). It requires specific arrangements with the phone service providers in the area and access to the phone number database. (Reverse 911, 2011).

However, unlisted numbers, cell phones and numbers on "no-call" lists are not included in the database unless manually added to the system (Martin, 2002). After installing the computer system, the county must choose how many phone lines it is expecting to use. The phone system functions by interacting with Geographic Information System (GIS), and Computer Aided Drafting (CAD) to deliver emergency notifications to assigned areas (Martin, 2002). Before Reverse 911, emergency responders had to use other methods to contact residents, such as loudspeakers, sirens, weather radios, 'telephone trees' and sending law enforcement personnel to residents' homes to deliver warning and safety instructions.

How Reverse 911 Works and Where It Works

Reverse 911 is a computerized calling system that has the capacity to send thousands of messages, voice and text, in just a few minutes. It functions by first sending alert messages to 'landline' phones, using the 411 (White Pages) and 911 (Emergency) databases. The system then sends these same messages to cell phones, laptops, desktop computers and any other electronic devices that has been registered with the Reverse 911 system, and that has telecommunication access (Mitchell & Anderson, 2009.)

This alerting system in Santa Clara County covers 15 cities: Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San José, Santa Clara, Saratoga, Sunnyvale and the Unincorporated County (Mitchell & Anderson, 2009).

Implementation and expectations

Supervisor Ken Yeager first proposed this system "REVERSE 911" to the Board of Supervisors in 2007. He stated, "The range and flexibility of communication options to be offered will keep our residents safe and well-informed," (Mitchell & Anderson, 2009). Meanwhile, the Santa Clara County FireSafe Council stated this on its website:
"Where will you be when a disaster strikes? Whether Santa Clara County residents are at home, at work, at their children's softball game or sitting in traffic on Highway 101, the new regional emergency notification system 'AlertSCC' will enable residents to receive timely and lifesaving information, no matter their location." (Mitchell & Anderson, 2009).

Those were the expectations at the time of implementing this expensive system (see 'cost' below), but today the question is: 'Has Reverse 911 lived up to those expectations?'

Cost of Alert SCC/ Reverse 911

Santa Clara County is spending a substantial amount of money, given the initial purchase price, plus ongoing service and database management. Furthermore, this is in addition to the monthly and annual contracts with different telecommunications and data providers such as Verizon and AT&T (Wing, 2011). The total cost for a two-year agreement with the system provider company Blackboard Connect, Inc. (BCI) is $1,500,000. (FY 2012 cost of $750,000 plus anticipated FY 2013 of $750,000) (Wing, 2011). The cost of the agreements with AT&T and Verizon for using 411/911 database records is $20,000. (FY 2012 of $10,000 plus anticipated FY 2013 of $10,000) (Wing, 2011).

Previously, from September 2008 to September 2011, Santa Clara County had spent at least $4,380,000 (with BCI), covering that three-year period, equating to annual cost of $1,460,000. However, during the FY 2012 budget process, the Department negotiated with BCI to reduce the annual contract by almost 50% - to $750,000 (Wing, 2011). Over five years, 2008 – 2013, the total cost is more than six million dollars.

This paper will discuss some of the communities that have used Reverse 911 as case studies. This will include Colorado fires in 2010, 2011 and 2012. The second case study will discuss San Diego Fires in 2003 where there was no Reverse 911 and compare it to San Diego fires in 2007 where Revere 911 was implemented and showed a great success. Then, the third case study will discuss an actual disaster using Alert SCC in Santa Clara County: Lehigh Cement Plant shooting in 2011. Was it the only emergency system used? Is Santa Clara keeping up to date with today's social communication trends and change in technologies, such as social media and mobile technologies? Have social media tools been effectively employed, given that they are provided for free, easy to use and widely used by a large number of people?

LITERATURE REVIEW

In recent years, the Reverse 911 alert system became popular among emergency management agencies and was adopted by many counties and cities around the United States. However, different case studies described it as either a failure or a success. Patrick Cassidy in *The Cape Cod Times* complained by saying, "Reverse 911 fails to alert Mass. residents of toxic smoke" (Cassidy, 2009). In contrast, a 2008 case study credits the successful application of Reverse 911 in saving lives from the 2007 wildfires in San Diego County (McKay, 2008). However, that particular study also explained that Reverse 911 was used in conjunction with another web based program, "WebEOC" which is a logistics management system used inside the EOC. This application enhanced the functionality of Reveerse 911 through connecting all emergency management parties together. WebEOC together with Reverse 911 helped to evacuate 500,000 people (McKay, 2008).

Accordingly, this research will examine if Santa Clara County uses, or should use, any other tools or methods in addition to the current "Reverse 911" system. However, given the present budget restrictions, fixing or replacing the current alerting programs could be challenging to emergency management officials. As noted, this mass alert system is expensive and has limited functionality; and yet the integration of multiple tools might help in addressing the failings that these systems have. Furthermore, there are different communication technologies emerging everyday. Many are available at minimum to no cost, and are widely used today by private and public sectors, such as social media tools and mobile apps. Before exploring the use

of these technologies, the limitations of Reverse 911 should be understood.

Reverse 911's trouble with Zip Codes

Reverse 911 alerts people based on their zip codes. For example, if someone's home is in Cupertino but their workplace is in San José, when a crisis happens in San José while they are working, they will not be notified. That will put them in potential danger. This is even worse than if people did not sign up in the first place, because this system is giving people a false sense of security, depending on a system that does not function as intended. A recent example is the 'cement plant shooter' in Cupertino: although many people received reverse 911 calls warning them about an active shooter and advising them to stay indoors, there were others who were not alerted at all, even though they were less than a mile from the random shooting of a woman in the Hewlett-Packard lot on Homestead Road. (Newman, Fernandez, Gomez & Webby, 2011). So based on the registered zip-code of each phone, people were not identified as being in proximity to danger.

Insufficient Registration of the Population

The most pressing problem is that not enough people in the community are even aware of the system, let alone registered as Reverse 911 participants. One has to wonder what has been achieved thus far for six million dollars. In small sub-divisions of the population, such as business workforces and university student bodies, people are advised to register or even automatically registered. Meanwhile in the population at large, only listed landlines not on the "do not call" list are automatically registered, while cell-phones are not, unless these numbers

were manually registered. Furthermore, this lack of inclusion applies also to Voice over Internet Protocol (VoIP), numbers not registered in the phone book, numbers registered on 'no call lists' (which blocks sales-calls) and those with caller ID blocking (Department of Homeland Security, 2011). Multiple case studies also report a common flaw where some residents in an affected area received calls while others in the same area did not (Gorski & Brown, 2012).

Failure to act / Human error

Even in a case where everyone is registered to the system, there exists the possibility that the alerts will not even be activated, perhaps through negligence, inadequate staffing to issue the warning, an organizational disorder, or human error. An example of that is an incident at San José State University, where students and faculty members were not notified on time about a shooter in the 10th Street Garage. This put them at risk and left everyone confused and anxious; the dispatcher had been so busy, that he failed to send the notification (KTVU, 2011).

Language barriers

Language limitation is another major issue with Reverse 911, given that the Bay Area is a diverse community. As stated in the AlertSCC frequently asked questions (FAQ) page, "messages are only sent in English. We hope to enhance AlertSCC in the future" (AlertSCC, 2013). – and yet the website itself is in four different languages.

On the other hand, someone using Social Media can publish a warning message in many other languages. According to Facebook statistics, it supports more than 70 languages globally (Facebook, 2011), and many social media tools include a translation feature, so if someone does

not speak English, he/she can set the tools to automatically translate a message into his primary language.

Over reliance on a 'land based' system

Another flaw with Reverse 911 is that it is land based, which imposes a great risk of losing communication as a result of a large natural disaster, such as flood or earthquake. This lesson was learned from Hurricane Katrina when land communications were completely lost except for text messaging (Committee on Energy and Commerce, 2005).

In a similar case, Reverse 911 would need to have a viable and alternative back up, a part of which could perhaps be the use of social media. It should be noted nonetheless that there are concerns that come with using social media communication. Some case studies address these concerns, such as generational gaps given that not everyone knows how to use these tools, or even knows what social media tools are. Other concerns include accuracy of information, the right to privacy and the protection of personal safety.

After exploring the limitations of Reverse 911, the concern is how to improve this system in the most cost effective way? What are Social Media tools and how would they contribute in improving the current alerting system?

Social Media

Social media tools are internet-based applications that large numbers of people use today. They communicate with each other, share information and exchange resources. There are many examples of social media: *Blogger, MySpace, Wiki, YouTube, Twitter, LinkedIn, and Facebook*,

where Twitter and Facebook are the most popular. These social media tools can be accessed by laptops, desktops, smart phones (phones with internet access) and other hand-held devices such as iPads.

The use of social media is widespread and is becoming more popular since it is easy to use and available for free (Lindsay, 2011). In 2009, a study conducted by the American Red Cross revealed that social media websites were fourth among sources used to access emergency information (Lindsay, 2011). Today it is used even more extensively.

The private sector noticed the benefits of using social media to increase public outreach early on. For example, during the Icelandic volcano eruption crisis, airlines' call centers used social media to communicate with customers as a crisis plan to respond to requests and questions. KLM's CEO published a video message on Facebook and used Twitter to send updates about cancellations, re-booking and links to more detailed information (Tobin, 2010). Lufthansa also used Twitter to reduce calls by redirecting customers to alternative resources (Tobin, 2010).

The public sector and social media

Social media is widely used publicly for many purposes, such as advocating political change, supporting social causes and fundraising. But more importantly, in the context of this research, cities and counties are making social media an integral part of their emergency management strategy. Social media has already many information sharing features, such as text, pictures and videos, whereas other traditional emergency systems are still developing and trying to adopt similar features, such as 'Next Generation 911' (Swallow, 2011).

Other advanced features include mapping and directions tools such as GPS, Map Quest and Google Maps that were all combined to create the "who-what-where-when" in one real-time feature, such as "Check In" used by Facebook and some other social media tools. This feature helps people in one person's network to find his location by providing them with a map and address whenever he "checks in" to a certain spot. This feature can be adopted for organizing rescue teams during and after a crisis as an alternative method in case current methods fail.

Overall, these tools can reach everyone who has a functional cell phone, and has signed in to the emergency social media tool. These applications can be very useful during emergency situations, since most people do not leave their homes without having their cell phones in hand.

Santa Clara County's use of Social Media

Santa Clara Emergency Services created a 'Facebook Group' in April 2010, but it lacks visibility. A year after its creation there had been only 455 people 'signed in' (April 2011). That number increased to only 506 people in Oct 2012, and up to a total of only 660 people in Oct 2014. At the same time they also created a YouTube channel called 'AlertSCC' at *http://www.youtube.com/user/alertscc*. The only activity on this site was on April 15th, 2010 when two informational videos were posted to encourage people to register. Since then these videos have been viewed a mere 2,498 times in a county of 1.6 million people, and the channel has only nine subscribers listed on October 24, 2012. This number increased by only one more subscriber, for a total of ten subscribers as of October 22, 2014. As yet there has been no sign of employing any other social media tools such as Twitter or Blog, or better advertising the

availability of the existing tools. This represents an extremely minimal web and social media presence.

General Observations

Based on initial research, the use of Reverse 911 reveals many imperfections and gaps, some within the tool itself, some in the way it is implemented. It is clearly beneficial to have a more complete and modern set of communication tools working together. Santa Clara Office of Emergency Services needs to reconsider the current system, since different studies and incidents reveal that Reverse 911 has many gaps that make it unreliable during critical times. It needs to revaluate its efficiency in reaching a wider audience. Also, the public needs to be aware of the system. That being said, Santa Clara Office of Emergency Services needs to expand its communication methods by effectively including social media as a current and low cost addition. Social media need to be actively used in combination with older communication methods (telephone, television, radio). As Craig Fugate, the FEMA Administrator, said, “We’re here to support the survivors . . . they shouldn’t have to fit our system, we should fit how they communicate, with the tools they’re using” (Zurer, 2011).

METHODOLOGY

This research used three main approaches: literature review, case studies of the application of Reserve 911 in actual events, and benchmarking against the San Diego system's functionality in 2007.

Case studies addressed in this paper were used to analyze the effectiveness of Reverse 911 in past disasters. These case studies included Colorado fires, San Diego fires and a case study in Santa Clara County. The last one addressed the process and implementation of Reverse 911 during the Lehigh Cement Plant shootings on October 5, 2011.

Case study research was conducted through observation and analysis of reports from past events. This helped with exploring and understanding complex issues, especially where an investigation is needed.

The case study approach enables the researcher to go beyond quantitative and statistical data and to understand the behavioral situations. It is mostly used in government, management and in education research (Yin, 2009). There are three main categories of case studies, as described by Yin (Yin, 2009): exploratory, descriptive and explanatory. This research exploits all three approaches to identify the reasons and circumstances that led to success or failure in each case. For example, in the Lehigh Cement Plant shootings, the questions asked included: Did the process achieve the goal of the program? What is the process used for notifying the community? What kinds of events trigger notifications? Did the implementation succeed? Who was notified? When were they notified? Where did the last murder occur and why did people in the area not receive notification?

This paper also analyzed San Diego before implementing Reverse 911 and after by comparing 2003 fires vs. October 2007 fires.

Finally, the various cases demonstrate the functionality of Reverse 911 in actual events that can be evaluated for similarity to circumstances in Santa Clara County. San Diego County is similar in size and demographics to Santa Clara County, so its experience with Reverse 911 during the 2007 fires provides a useful benchmark against which to measure the performance of the system locally.

FINDINGS

Prior Research done by Santa Clara County before Implementing Reverse 911

According to research conducted by the county prior to implementing Reverse 911, the results showed that the system is effective in alerting people and saving their lives from potential danger (Lohse, 2007).

The system is designed to provide efficiency and speed. While implementing this system, one of the most important things to consider was speed. The system infrastructure had to be designed in such a way that it could send thousands of messages in a single order. In addition, the messages had to be efficient in that no jam or crush would be expected. By using the system, police, fire fighters, and rescuers should be able to send out messages that warn the public of any upcoming hazard or disasters.

The decision to implement the system was brought about by various concerns regarding the safety of the county's residents. Prior to implementing the system, one of the main concerns

was how to get all the people added to the system's database in order to notify them as fast as possible in case of any danger and to prevent future loss of lives. However, to make sure that happened, residents had to register with the system.

The research done for implementing the system had proven at that time that Reverse 911 had the potential to save lives in case of an emergency (Lohse, 2007). During the first tryouts, the system developers had to ensure that it met the needs of the county residents. First and foremost, the county officials considered the ability of the system to make an impact in saving lives. Findings of that research showed that the system is sustainable and effective to include a large number of people (Mitchell & Anderson, 2009). Santa Clara County has almost 1.8 million people (Mitchell & Anderson, 2009). Most of the research done prior to implementing the system was to see whether it had the capacity to reach county residents in a timely fashion. The system proved to be effective then, since it was fast in delivering alert messages in case of any emergency (Lohse, 2007).

In addition, the research showed that the system is flexible in terms of increasing or changing the number of people who would be notified in case of an emergency. This was important since the system would continuously need to be updated and designed in a particular manner to cover different numbers of residents and businesses (Mitchell & Anderson, 2009).

Research results also showed that the system was easy to handle, as the system did not need a lot of maintenance and it was self-maintained (Mitchell & Anderson, 2009). However, deficiencies were discovered. For example, the system had the probability of having a malfunction in times of a disaster (Martin, 2002), because of the large number of messages that had to be delivered within a short time span (Santa Clara County, 2008). The decision was made

to implement the system anyway for the sake of the public safety. The county executive endorsed at as the best option available (Mitchell & Anderson, 2009).

Different methods have been employed to encourage the residents to register with the system. For instance, public seminars were held to motivate people to register, and public officials have been quoted as supporting public participation in publicity pieces (Mitchell & Anderson, 2009). In addition, the County Office of Emergency Services, which is responsible for educating the public about the system, has developed different advertisements to notify the residents (Cassidy, 2009). The registration process has been made simple so that everyone can register online. This has made it possible for more citizens to enroll in the system. However, with all these efforts, many people still never heard of Reverse 911 and they are not aware that they need to take the initiative to register their various communications devices to the system.

Case Studies

Case studies have assessed where Reverse 911 succeeded or failed during a certain disaster in different cities in the United States. This paper will be addressing 2010, 2011 and 2012 Colorado wildfires, 2003 and 2007 San Diego Wildfires and the 2011 Lehigh Cement Plant shootings in Santa Clara County. These case studies will evaluate circumstances surrounding the use of Reverse 911, including time of the disaster, area affected, number of victims, scale of the damage, evacuees, emergency tools or systems used beside Reverse 911, response teams, response time and the database source used for Reverse 911.

A. Colorado Fires Case Study: 2010, 2011 and 2012

2010 fires:

In 2010, Colorado experienced one great wildfire known as the *Fourmile Canyon Fire*, and it continued for eleven days (Spotts, 2010). This fire destroyed approximately 6,181 acres and 169 homes (Spotts, 2010). This fire was declared the worst in Colorado history, until the Waldo Canyon fire surpassed it, in June of 2012 (Muskal, 2012). Summery of 2010 Colorado fires:

Name of Fire	Year	Cause	Acres burned	Homes destroyed	Deaths	Evacuation	County
Fourmile Canyon	2010 Sep 6	May have been caused by a vehicle striking a propane tank according to Investigators	6181	169 homes, 5+ structure	0	3,500 people have been evacuated from about 1,000 homes	Boulder

SOURCE: Spotts, 2010; Muskal, 2012.

When looking at the effectiveness of the Reverse 911, in 2010 the system failed because of human error, flawed data and a blemished effort to get citizens without landlines to register their cell phones. The failure of Reverse 911 in 2010 led to confusion among the rescuers because they did not know who was not notified yet and which areas were still not completely evacuated.

2011 Fires:

In 2011, Colorado experienced separate wildfires between the months of March and June, where in April it witnessed just one wildfire, while in June it witnessed six wildfires (Coffman, 2011). In 2011, there were eleven wild fires, but they were not as serious as those of 2012. These 11 wildfires, which happened between the months of March and June, affected the Boulder, Jefferson, Larimer, Las Animas, Teller and Fremont counties (CNN, 2011).

Summery of 2011 Colorado fires:

Name of Fire	Year	Cause	Acres burned	Homes destroyed	Deaths	Evacuation	County
Lefthand Canyon	2011 Mar	Human	622	0	0	200 + homes	Boulder County
Indian Gulch	2011 Mar	unknown	1,570	0	0	100 homes	Jefferson
Crystal	2011 Apr	Human	3,200	13	0	24 homes	Larimer
Bear	2011 May	Lightning	6,885	2	0	0	Las Animas
Purgatoire	2011 May	Unknown	6,140	0	0	0	Las Animas
Navajo	2011 June	Unknown	57	0	0	104 homes	Teller
Shell	2011 June	Lightning	27,792	7	0	0	Las Animas
Brice	2011 June	Lightning	4,690	0	0	0	Las Animas
Mesa DaMaya	2011 June	Lightning	13,312	0	0	0	Las Animas
Duckett	2011 June	Unknown	156	0	0	The Rainbow Trail Lutheran Camp and Eagle Peak Subdivision have been evacuated	Custer/Fremont
Track	2011 June	Human	329	8	0	40 homes	Las Animas

SOURCE: Coffman, 2011; CNN, 2011.

2012 fires:

In 2012, Colorado experienced separate fires that took place between the months of June and July. These fires each covered vast areas, thus affecting many individuals.

The Little Sand Fire was a 22,400-acre fire and was located in San Juan National Forest (Solution, 2012). The Treasure Fire of 2012 that burned around 420 acres was located in Lake County (Solution, 2012). The Weber Fire burned approximately 10,000 acres in Montezuma County. This fire led to evacuation orders for 140 households, and 390 more received pre-evacuation orders (Solution, 2012).

The Waldo Canyon fire, also of 2012, started ten miles northwest of Colorado Springs and was contained on 15,365 acres of United States Forest Service land (Muskal, 2012). This fire led to the evacuation of about 32,000 residents of Woodland Park, Colorado Springs and Manitou Springs, and it partially evacuated the U.S Air Force Academy (Crawford, 2012). By the time firefighters overcame the fire, it had already destroyed over 350 homes, making it the most destructive in Colorado state history. There was also the High Park fire that happened in June 2012. The inferno torched over 87,000 acres, leaving one person dead and destroying 259 homes (Muskal, 2012).

Finally, the Flagstaff fire happened in July of 2012, in Boulder County and it was contained after it had burned about 300 acres (The Gazette, 2012). In June 2012, these Colorado forest fires were declared federal disasters. Summary of 2012 Colorado fires:

Name of Fire	Year	Cause	Acres burned	Homes destroyed	Deaths	Evacuation	County
Lower North Fork	2012 Mar 26	By embers from a prescribed fire	4,140	23	3	900 homes	Jefferson County
Little Sand	2012, May 13	Lightning	22,400-acre	0	0	0	Archuleta
High Park	2012, June 9	Lightning	Over 87,250 acres	259	1	Thousands of people were evacuated	Larimer County
Springer	2012, June 17	Human	Over 1,100 acres	22 houses and two outbuildings		More than 200 residents	Park County
Treasure	June 21	Human	420 acres	0	0	0	Lake County
Weber	2012, June 22	Human	Over 10,000	0	0	140 households	Montezuma County
Waldo Canyon	2012, June 23	Human	Over 15,364	350 homes		Over 32,000 residents of Colorado Springs, Manitou Springs, Woodland Park, several small mountain communities along Highway 24 & partial evacuation of the United States Air Force Academy	El Paso County
Woodland Heights fire	June 23, 2012	Started by electric line rubbed against a tree	27.3	22 homes and two outbuildings	0	Evacuation ordered from High Drive west to the Rocky Mountain National Park border	Larimer County
Last Chance Fire	June 25, 2012	Thought to be sparks thrown up from a car wheel after a tire blowout	Over 45,000	11 structures & 4 homes	0	25 residents at least	Washington County
Flagstaff (Bison) fire	June 26	Lightning	About 300	0	0	26 households	Boulder County
Pine Ridge fire	June 27, 2012	Lightning	13,920 acres	Burned 3 empty tents and campers	0	Evacuation order issued for the areas of east of I-70, west of 45 1/2 Road, and south of U Road.	Mesa County
Ironing Board fire	June 28, 2012	Lightning	Around a tenth of an acre	0	0	0	Boulder County

SOURCE: Solution, 2012; Muskal, 2012; Crawford, 2012; The Gazette, 2012.

Colorado has had mixed results from the use of a Reserve 911 system for community alerting during wildland fires. Authorities acknowledged that twelve percent of the people affected by the wildland fire of 2012 never got the Reverse 911 call giving them a warning to evacuate. A misconception about this notification system left some fire evacuees from Waldo Canyon waiting for the emergency call that never came (The Gazette, 2012). Some people had already packed and were waiting for the emergency call telling them to evacuate. This misconception is that, if your landline is listed with the telephone company's directory there is no need to register in order to receive an emergency call. Unfortunately, this was not the case because some landlines were automatically listed in the Reverse 911 databases, while others were not. The spokesperson for the agency managing the notification system said that they are evaluating the phone listing failure. Individuals are advised to manually list their contact information to ensure that it is available to the Reverse 911 system (USATODAY, 2012).

The suggestion has been made that the Reverse 911 system is culpable for the deaths in the 2012 fires because it did not notify everyone in the fire endangered areas (Gabbert, 2012). It appears that the public was not adequately educated on the workings of the system and the need to register multiple devices to ensure that warning messages could be received (USATODAY, 2012). The providing company's website, Cassidian, stated: "REVERSE 911® system is ideal for use in small towns and villages, as well as small to mid-sized municipalities, school campuses, Federal agencies and military bases." (Cassidian Communications, 2012). After the Colorado fires of March 2012, Cassidian, the communication dispatching company, pointed out that it was not its fault that Reverse 911 failed to notify everyone in the affected region. It justified its position by explaining that the system was not designed to handle large populations.

It described Reverse911 by saying: "it is only one component of an overall public safety communications strategy. During emergencies like the Colorado wildfire, information should be disseminated through multiple outlets and residents should always seek out information from as many reliable sources as possible." (Cassidian Communications, 2012).

It should be noted that the 2012 Colorado wildfire was far worse than the previous ones in 2010 and 2011. This massive fire, helped by winds and hot weather, destroyed many homes and forced vast numbers of people to flee. The crews battling this deadly fire ranked it as the most destructive wildfire in the history of the state.

It is also important to bear in mind other factors that could have influenced the effectiveness of the emergency response during these events, such as time of the disaster, location and how destructive that fire was. As we have seen, Colorado's wildfires did not take place at exactly the same time of each year. These fires varied in time and location and were hardly predictable.

When analyzing the number of victims and the amount of destruction resulting from these fires, one can see that the 2012 wildfire had the most victims. This fire destroyed 259 homes, and one elderly couple was found dead in their home (Muskal, 2012). This is by far, the highest number of houses destroyed by the Colorado fires in these three years. In 2011, there are no reports of any destroyed structures or homes, and according to this research, there were no reports of any victims. However, in 2010, the 6181-acre inferno burned down 169 homes and displaced vast numbers of residents of Boulder County (Spotts, 2010). The 2012 wildfire forced over 35,000 people to flee their homes and destroyed many of these homes, while that of 2011 led to the evacuation of 9,500 homes on the southeastern side of Denver, and that of 2010 caused

individuals from 169 homes to start from scratch because their homes were completely destroyed (CNN, 2011). Before 2010, there had never been such an expensive wildfire in Colorado, which was estimated at $217 million (Spotts, 2010).

Currently, the State Forest Service of Colorado is the lead agency for suppressing wildfires. They use a system of updating the public about the current and possible future wildfires on their website. The other system that is in use is the fire danger rating system. They use this system to manage elements of wildfire-associated risks and come up with fire danger predictions. It provides a number of indices, which portray potential and current fire danger conditions. Additionally, the emergency notifications are announced in the local radio stations. However, various agencies assist them in doing this job. These include the Division of Emergency Management, the Military and Veterans Affairs Department, and the Department of Public Safety. The duties of the Emergency Management Division are to prepare, prevent, mitigate, and respond. The other responsibility of this department is resource mobilization. On the other hand, the Military and Veterans Affairs Department participates in efforts to suppress the fire only when requested and these requests come only after all the other resources have been overwhelmed. Finally, the Department of Public Safety's mission is to ensure the security and safety of Colorado through uniting powers with local, state, tribal and federal partners in order to protect against, prevent, recover from and respond to all hazards. This agency does not have direct wildfire suppression responsibility or capability. It offers voluntary certification and training of locally organized firefighters. Also, it is responsible for keeping up the emergency resource mobilization plan for the state and resource database that are used to send resources to any large-scale incidents, such as the Colorado wildfires.

The Reverse 911 uses the 911 database of each county as the source for telephone numbers, and it is able to process about 2000 phone numbers in a minute (Chandler, 2010). This system works with all telephones with a Telecommunications Device for the Deaf line, which is an electronic device that provides text communication through a telephone line used by individuals with speech or hearing difficulties. It also has a feature for callback, which ensures that the message is delivered. The published and non-published numbers for "landlines" are dialed, and this system leaves a message if the answering machine picks up. For the Reverse 911 system to call a VOIP phone or cell phone, a person must register his/her number with the authority board of 911 (Chandler, 2010).

Lessons Learned From the Colorado Fires

Everybody should register their telephones with the Reverse 911 notification system in order to ensure that the number is in the system. It is also important to update telephone numbers more regularly and send residents postcards reminding and encouraging them to register their mobile numbers. Regular outreach practices are important to ensure getting more residents to register their contact information so they can receive those emergency messages. Residents who rely on Reverse 911 should be forewarned that this system might not work, and to treat it only as one of many warning tools. It is advisable for an individual to always use multiple information sources when in an emergency to ensure the ability to evacuate before the danger approaches.

B. **San Diego Wildfires Case Study**

San Diego 2003 Fires

The conditions that set a backdrop for the destructive fire of 2003 in San Diego included a dry spell that lasted for a long period of time in Lindbergh Airfield and Los Angeles (Service Assessment, 2004). Los Angeles had not received a measurable amount of rain for a long time and heat slowly began to engulf the area, after which wildfires sprung up (Service Assessment, 2004). The *Grand Prix-Padua Fire,* which was the first major fire in southern California that year, began on October 21, 2003. This fire consumed 60,000 acres in San Bernardino County and over 10,000 acres in Los Angeles County, and destroyed 135 homes (After Action Report, 2007). With the prevailing weather conditions of low humidity and light winds, high pressure mounted in the south. This led to a sustained period of Santa Ana winds. The wind first passed over high mountain canyons on October 24/25 but later it spread to the lower altitudes starting from October 25 until the afternoon of October 27 (Service Assessment, 2004). On October 26, the Santa Ana wind had reached peak intensity and led to the onset of the deadliest fires*, the Cedar Fire* (Service Assessment, 2004).

The source of this fire was an accidental flare from a lost hiker. It spread rapidly due to the prevailing conditions. The Santa Ana wind was traveling at 60 mph and there was less than 10% minimum humidity along with the dreadfully dry fuel, this created good conditions for the fire to spread (Service Assessment, 2004). On Sunday night, October 26, the *Cedar Fire* spread for a distance of over 30 miles to the western and southern parts, places that were densely

populated. During this phase there were 13 fatalities and over 2000 residential structures damaged. On October 30, the last casualty, a firefighter was killed. The worst area affected was the Scripps Ranch community, where over 150 homes were destroyed (Service Assessment, 2004) – and this had led to the ignition of uncontrollable fires on October 25th and 26th (Service Assessment, 2004).

The *Simi Fire* had ravaged over 100,000 acres before firefighters could contain it. During this fire, 990 homes were ruined and six people lost their lives (After Action Report, 2007). The *Paradise Fire* was less destructive as it burned 57,000 acres, destroying over 200 residences and two people lost their lives (Service Assessment, 2004). The *Otay Fire* started October 26 during the Santa Ana wind event. It burned 46,291acers and destroyed one home.

By late Monday, October 27 the weather pattern began to change drastically as the Eastern pressure gradient fell, leading to the relaxation of Santa Ana winds (After Action Report, 2007). On Tuesday, October 28, an onshore flow from southern California and strong western winds caused the fires to spread to the east up the mountain slope (After Action Report, 2007). The November favorable temperatures created a leeway for the fire fighters to contain the wildfire. In this event, 22 people lost their lives, 225 were injured and almost 740,000 acres of forest and urban area were burned within a period of few days (Service Assessment, 2004). The cost appended to fighting this fire was estimated at $121 million, and structural losses amassed up to $2 billion dollars (After Action Report, 2007). Over 3,600 residences, 1,169 outbuildings and 36 commercial buildings were destroyed (After Action Report, 2007). Summary of 2003 San Diego fires:

Name of Fire	Cause	Acres burned	Homes destroyed	Deaths	People evacuated	Response - Evacuation
Cedar	Human	273,246	2,232	14	56,000 people	Midnight. Warnings started early morning
Otay	Un-determined	46,291	1	None	None	Law enforcement personnel knocking on doors and notifying residents from loudspeakers
Paradise	Human	56,700	221	2	Yes	
Simi	Unknown	100,000	990	6	Yes	
Grand Prix-Padua		70,000	135	None	Yes	

SOURCE: After Action Report, 2007; Service Assessment, 2004.

*San Diego **2007** Wild Fires*

These San Diego County Firestorms started on the 21st day of October 2007 near the U.S./Mexico border at 9:30 Pacific Standard Time (PST) (After Action Report, 2007). For a long period of time, the fire burned all the way through San Diego County and finally was contained on November 9, 2007(Chris, 2008). The first fire to hit the ground was the *Harris Fire*, which began at Highway 94 and Harris Ranch Road near Potrero, in the southern part of San Diego County. This fire was fiercely raging and burned northwest towards eastern Chula Vista, causing the safety organizations to order a mandatory evacuation of the people who lived in that area (After Action Report, 2007). By the time the *Harris Fire* was contained it had consumed around 90,000 acres of land (Robin,2008).

The *Witch Creek Fire* was the second fire, commencing just a few hours after the *Harris Fire* in the Witch Creek Canyon (After Action Report, 2007). The fire was rampant and spread

quickly to Poway, Rancho Bernardo, Ramona and Escondido. The prevailing winds were moving at a speed of more than 100 miles per hour. As a result, the fire 'jumped' over some places and continued to ravage the wild forest going towards the West. This fire burned 197,990 acres, which made it the largest wildfire in the year 2007 (After Action Report, 2007).

The third fire to ravage San Diego County was the *Rice Canyon Fire*, which started the next day, October 22nd. It burned a total of 9,472 acres leading to mandatory evacuations of thousands of people living in the northern part of the San Diego County (After Action Report, 2007). On the same day the *Poomacha Fire,* which commenced as a structure fire on the La Jolla Indian reservation, quickly extended to Palomar Mountain where it joined the *Witch Creek Fire* and spread to the Tibia Wilderness (Robin, 2008). As a result, 49,410 acres were burned. The fire was finally contained on November 9th (Robin, 2008).

The 2007 fires led to 10 fatalities, while 23 people suffered fire injuries. Out of the 62,000 firefighters, only 89 sustained minor injuries (After Action Report, 2007). The total land consumed by the fire was 368,340 acres, and it is estimated that over 1,600 homes, 239 vehicles, 253 structures, 800 outbuildings and 2 commercial properties were totally destroyed in the fire (After Action Report, 2007). This fire was contained through the coordinated activities of over 6,000 fire fighters. During this time nearly 90% of the San Diego county public schools were closed and many businesses too (After Action Report, 2007). Freeways were shut down and the inhabitants were recommended to avoid using the roads for some time. Fighting the San Diego wildfires in 2007 was exceedingly successful as compared to the 2003 firestorms where massive damage was incurred, including loss of lives and bodily injuries. It was estimated that the damages caused by the *Poomacha, Rice Canyon, Harris, and Witch Creek* fires could amount to

$41.3 million (After Action Report, 2007). However, one salient feature of this firefighting episode is that 515,000 county residents received voluntary and mandatory evacuation notices, which helped them to run to safety (Robin, 2008). As a result, the U.S witnessed a very successful robust system of containing emergencies as demonstrated in containing the 2007 fires.

Summary of 2007 San Diego fires:

Name of Fire	**Cause**	**Acres burned**	**Homes destroyed**	**Deaths**	**People evacuated**	**Response-Evacuation**
Rice Canyon	Human/ Electrical	9,472	248	0	Mandatory evacuations, 29,000 people evacuated	Law enforcement, fire officials, Reverse 911, Alert San Diego, WebEOC System, 211, television and radio media.
Poomacha	Structure fire	45,000	136	0	Reverse 911 used to contact residents to evacuate	
Harris	Unknown	86,500	206	5	Mandatory evacuations, 5400 people evacuated	
Witch Creek	Power lines	197,990	1,040	2	Mandatory evacuations.	

SOURCE: After Action Report, 2007; Robin, 2008.

Comparing San Diego 2003 Fires before Implementing Reverse 911 and after Implementing In 2007

During the 2003 fires, there were no disaster preparation measures that included a united work of all the parties involved in evacuating the affected areas. Moreover, there was no systematic way of notifying the residents, for example that a fire was starting, hence there was a high level of fatalities, injuries and losses in the 2003 fires compared to the San Diego's 2007 firestorms. In 2007, residents were continually given notifications on what was happening

through different media outlets, like journals, web sites and television. In this way, those who had lost touch with their family members were able to reunite (Bret, 2007). Through the Reverse 911 system, GIS maps were available for use by the JIC and they were therefore important for the media fraternity and the residents of the effected area.

Reverse 911, during the 2007 San Diego wildfires, was used with other various channels of disseminating information, and these included 211, the county web sites, Web EOC and Email. These channels helped the safety organizations to ensure that information was readily available to the right parties at the right time (Dian, 2007). Reverse 911 provided GIS images to the ICS chain of command within the Operational Area EOC (OAEOC) to make sure that the whole team worked in unison with similar objectives. The centralized command allowed the GIS staff to achieve much in a short period (Dian, 2007).

After Reverse 911 was implemented in San Diego, there was a notable cooperation between the OAEOC GIS staff and Federal and State agencies. In the past, these groups worked as separate entities and this led to conflicts in interest leading to wasted time, which translated to more losses. This union helped the OAEOC GIS staff to make use of technologies that were previously preserved for the military and the intelligence of the government (Chris, 2008).

Reserve 911 created a leeway for Google and NASA to chip in their help, in obtaining live images that the OAEOC needed, so as to set the right parameters on how to contain the fires (Dian, 2007). Reverse 911 pre mapped the special needs facilities and this helped in the 2007 fires, whereby 2,100 people were evacuated (Chris, 2008). Moreover, the OAEOC was able to access the GIS maps and imagery through the San Diego State University website. As a result, the public was updated continually (After Action Report, 2007). The evacuation areas were

mapped using the Reverse 911 text information and this created a platform for the city, county and federal agencies to render their help in the most critical time. Through the Reverse 911 system the county, state and GIS staff were able to access WebEOC enabling them to view, post and share geospatial information (Chris, 2008).

The main attribute of this system is that it allows the recipients to reply with a confirmation message stating that they have received the warning. Because of this, safety workers are aware of people who might not have been informed (After Action Report, 2007).

In 2007, the safety organization successfully managed to evacuate over 500,000 residents using telephone aided emergency notifications (Robin, 2008). Having learned bitter lessons from the 2003 San Diego fires, the safety organization set out on a mission to establish the right communications system.

Unfortunately emergency calls through landlines may go unanswered, so San Diego city and county officials have been encouraging the residents of the area to register their mobile phones to make sure that no matter where they might be located, they will still receive any emergency notifications through their cellular phones (Dian, 2007).

In the history of the US, the 2007 San Diego firestorms were the largest and most catastrophic in relation to the mass of land and property that was destroyed. Compared to 2003, the 2007 firestorms were fiercer in duration and intensity (Dian, 2007). However, the safety organizations in San Diego had previously carried out meticulous survey planning and preparation to mitigate any risks accruing from firestorms. Having learned the catastrophes of 2003, the county was exceptionally prepared for the anticipated firestorms. The After Action Report produced after the 2003 fires had illuminated shortcomings and operational lapses in

containing those fires. This helped the county to make significant modifications to fire fighting operations. As a result, fire fighters became much better equipped to manage wild fires in future. The county also made changes to the OAEOC whereby plans were revised, altered and developed to manage emergencies (After Action Report, 2007).

The weather and meteorological department forecasted the Santa Ana winds, creating a perfect scenario for wild fires to spread. Consequently, the San Diego County Office of Emergency Services (SDOES) worked together with the other area partners to prepare for wild fires (Barry, 2005). Indeed a week before the firestorms, all responsible bodies were prepared, awaiting the disaster in order to intervene and minimize life losses and damages to properties. When fires began on October 21, 2007, all the emergency systems were ready. The *Harris Fire* was the first and at the height of the firestorms, there were over seven separate fires. Although ten people died, 23 were injured and 89 fire fighter sustained injuries (Chris, 2008), this was a much better comparative outcome than 2003.

The most astounding factor about the whole inferno is that OAEOC managed to group together a huge cluster of disciplines to play their crucial role in containing the fire. These included Federal, State, and local departments and agencies (Robin, 2008), working together under the ICS, Standardized Emergency Management System (SEMS) and National Incident Management System (NIMS). Making use of technological advancements, the OAEOC improved greatly on its emergency and rescue structures. For instance, it made use of 'WebEOC', a web based emergency management system, and Reverse 911 together with the AlertSanDiego, two computerized telephone delivery systems used throughout the county, for

disaster and evacuation notifications. In order to be more efficient and prepared for the disasters, OAEOC had also reorganized its staff members to create a more robust disaster response team.

New plans were put in place to make sure that they could help the County's Sheriff in combating the ill effects associated with wild fires. The sheriff was responsible for issuing evacuation orders to a population of over 515,000 residents (After Action Report, 2007). This task was made easy at that time through the automated Reverse 911 systems alongside the AlertSanDiego notification system (After Action Report, 2007). The structures were so well prepared that the safety organization was able to coordinate the county residents through the use of the Reverse 911 and AlertSanDiego systems (Chris, 2008).

As the disaster progressed, the Joint Information Center (JIC) coordinated with the OAEOC, and 211 San Diego, together with non-profit organizations, to provide the public with vital emergency information. The JIC played a proactive role in keeping the public well informed concerning the events under way in San Diego. More than 200 press releases were sent out by JIC, which also collaborated with the regional partners to hold press conferences. The public was furnished with the vital information through media outlets and web sites such as www.sdcountyemergency.com. It is estimated this website received over 10 million visitors on a daily basis (Chris, 2008). Moreover, 211 San Diego answered approximately 109,000 calls and assisted with rumor control activities (Chris, 2008). A huge group of volunteers amounting to more than 7,000 people offered their help to the affected population (After Action Report, 2007). The municipal, state and federal agencies operated over 45 shelters in the county (After Action Report, 2007). Additionally, more than 3,000 animals were rescued, moved and temporarily

sheltered before being returned to their owners (After Action Report, 2007). The recovery process for affected individuals was soon begun at four county Local Assistance Centers (LACs). The LACs offered massive help to the affected people by coordinating with FEMA to provide over 24,000 residents with financial assistance and housing facilities (Chris, 2008).

By and large, San Diego County's response to the 2007 fires was competent, effective and successful. Through increased vigilance, regional collaboration, preparedness plans, better communications system integration and the ability to adapt to the changing fire, San Diego County was able to respond to one of its largest fires in history.

C. Santa Clara County 'Lehigh Cement Plant' Shooting Case Study

Describing the crime and the manhunt.

The incident took place at the Lehigh Southwest Cement Plant at 24001 Stevens Creek Blvd in unincorporated Santa Clara County just outside of Cupertino. On Wednesday, October 15, 2011 at around 4:15am, one unhappy worker, a truck driver at the Lehigh Cement Plant, began shooting his fellow employees (Gomez, Webby, Fernandez & Noguchi, 2011). This happened during a meeting where he felt discontent with the operations of the plant and where the management had not met his demands (Gomez, Webby, Fernandez & Noguchi, 2011). He then fled the scene and sometime later, five miles away, he shot a woman in the leg attempting to steal her car near the Hewlett-Packard campus on the east side of Cueprtino (Gomez, Webby, Fernandez & Noguchi, 2011).

This incident left three people dead and seven others critically injured (Gomez, Webby, Fernandez & Noguchi, 2011). Residents remained in danger until the following morning when the suspect was finally found at around 7:30 am and was killed by Santa Clara police while he was threatening them (Gomez, Webby, Fernandez & Noguchi, 2011). Of interest in this case study is exploring the implementation of the AlertSCC communication system during this event.

Protection and safety measures taken:

The endangered area had a population over 50,000, including Sunnyvale and Cupertino. The protection measures taken during this event were the following.

The school district issued a warning asking parents near the areas of the two shootings to keep their children at home, but the warning went out late and many parents has already dropped their children off to schools. The Fremont Union High School District sent out emails warning people of the schools in the district. By 10:30 a.m. all the schools in the Fremont Union High School District were in lockdown. Besides schools in Cupertino, Laurelwood Elementary School in Santa Clara, Peterson Middle School in Sunnyvale and three Mountain View high schools where also closed down by school administrators. De Anza College and Saratoga High School, however, were not closed down, although they were close to the Lehigh cement plant, but according to school administrators they did not believe that the schools where in any immediate danger (Chang, 2011).

Apple, which has its headquarters in Cupertino, asked its employees to stay inside their offices during the incident. HP, on the Cupertino campus, asked its employees not to come to work after the woman in the HP parking got shot and sent to the hospital. HP issued a statement saying, "We are in close contact with local authorities who are currently investigating the incident. The HP contract employee who was injured by gunfire as a result of the incident is safe and in stable condition at a nearby hospital." Santa Clara County sent a recorded warning message to residents living in the area of the manhunt who had registered with the AlertSCC system, and who were defined as near the area of the emergency operation. The Reverse 911 message was sent out at 9:00 AM saying,

“This is an important emergency message from Santa Clara County Communication Santa Clara County Sheriff’s Department. This message is being sent on Oct. 5th, 2011 at 9:00am. Due to an armed subject in your neighborhood, Santa Clara County Sheriff is requesting

that residents in your neighborhood be on the look out for the suspect. The suspect is described as a black male adult, 49 years old, 5'11", 260 pounds, black hair and brown eyes. The suspect also has tattoos. The suspect was last seen wearing a black baseball cap, a large brown jacket, and blue sweatpants. He was last seen on foot Northbound on Camtail. The suspect is associated with 99 brown Mercury Cooper, CA License plate: 6KTN666. If you see this suspect call 911 and don't approach him. Law enforcement officers are actively searching the area for this suspect. For information ongoing updates, please tune to local radio and television stations. This been a message from the Santa Clara County Communication Santa Clara County Sheriff's Department and Alert SJCC. Good Bye." This message was sent to those in communities around the plant. However, many residents near the area of occurrence were still not aware of what was happening." 'She's right in the middle of it,' Chu fretted. 'I'm a little worried. She didn't even know what was going on when I called her." That was a statement from a worried mother who only found out about the shooter when she saw the police blockade around 8 a.m. that day (Newman, Fernandez, Gomez & Webby, 2011).

Communication and notification:

Looking at the communication tools used throughout the day of the incident, people were notified about the series of murders that was in the area in a number of ways. The media, to begin with, was at the forefront in bringing it to the people's attention. The media served to inform the people about the necessary security precautions that they should take in order to keep safe during this dangerous incident. This, however, had little effect since most people were busy at that time getting to work and getting children to school, and remarkably few were keeping up

with the media. The media tools used included television, and radio stations. All these used together in notifying people on the appropriate steps to take in order to protect themselves from the murderer, if they were listening.

The usage of the media however, had a number of limitations. First, it was not specific to the targeted area and group. Many of people who were informed were not among the affected. It unintentionally served to create more tension in the area rather than solve the problem. In addition, most of the targeted people were not reached by the notification of the media outlets, since this incident happened in the early hours when most people were still asleep or on their way to work. One example was the woman shot that day at Hewlett-Packard around 7am (Gomez, Webby, Fernandez & Noguchi, 2011). This woman was never notified of the danger around her, since she was just arriving at work and the alert message was not sent out to the public until 9:00 a.m., two hours after she was shot (Middleton, 2011).

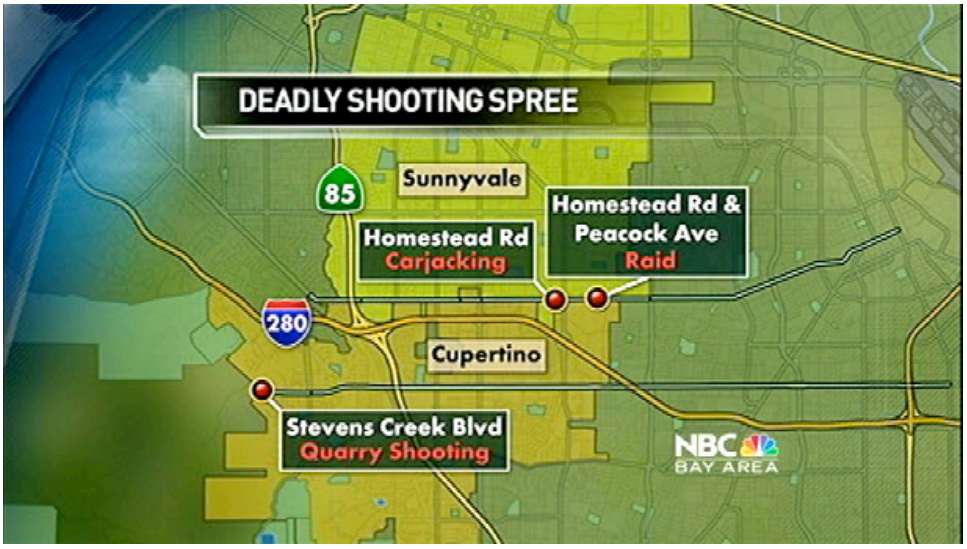
Evaluation:

The update system was slow, and some residents were even released from lock down even though the killer was still not apprehended (Gomez, Webby, Fernandez & Noguchi, 2011). In fact, at around 5:30 pm on the first day, residents were allowed to go home from their work and Peterson School students were instructed to go home (Gomez, Webby, Fernandez & Noguchi, 2011). The main goal of mass notification was to ensure that people could avoid this danger. This, however, was not achieved as expected since the woman at HP was threatened and injured who might have been, instead, protected by the system if the warnings went out on time and had a better basis than being based on telephone zip codes of home phones.

Reverse 911 information system was not effectively employed during this period. Although many people received the alert message on their landlines and registered cell phones, they only got it late. The first shooting happened around 4:15 am (Gomez, Webby, Fernandez & Noguchi, 2011). Then, the first call, reporting the shooting, came into 911 dispatchers at 4:27am (Gomez, Webby, Fernandez & Noguchi, 2011). The Santa Clara County Communication and Sheriff's Department decided to finally send an alert message at 9:00am to warn the people about the shooter (Middleton, 2011) because he was un-apprehended and last seen in a residential neighborhood on the edge of Sunnyvale and Cupertino. In other words, it had taken four and a half hours since the murders were committed for an alert message to be sent. So this notification did not reach the majority of the targeted people on time. Admittedly, the incident was not anticipated, nonetheless, four hours is a lot of time to wait before deciding to inform the endangered residents.

In addition, many people that were not affected were also informed. The main people who were in danger were the workers of the cement plant and people in surrounding areas where the active shooter was wandering. These areas were Sunnyvale and Cupertino where people needed to be notified (Middleton, 2011). The system, however, informed some of the residents about the incident, but only those closest to the cement plant, but not near the Hewlett Packard shooting. Also, since the system was designed to target phones based on their zip codes, many people in the endangered area never received the alert since their cellphones were registered at a different zip code. The system was, therefore, not specific to the targeted area and group.

In addition, some of the targeted people were not reached by the notification of "AlertSCC" Reverse 911 system. One main reason is that dispatchers were challenged with a large geographical area (Gomez, Webby, Fernandez & Noguchi, 2011). As mentioned earlier, the providing company of Reverse 911 has stated in their website that this system is designed to cover small towns, villages and mid-sized organizations such as school campuses and government agencies (Cassidian Communications, 2012), whereas in the given incident, the endangered area had a population over 50,000; this includes Sunnyvale and Cupertino as shown on the following map:



MAP SOURCE: NBC Bay Area News. (2011). Santa Clara shooter [Map], Retrieved October 24, 2012, from: http://media.nbcbayarea.com/images/shootermap.jpg

Another reason is that many people in the area, were on their way to or at work at the time and nowhere near their home (landline) telephones. In that case, they would have needed

prior registration of their cell phones or office phones in order to be notified. For this reason, many endangered people did not receive the alert.

Summary of deaths and injuries as reported by (NBC Bay area, 2011):

Total of three people died (two died onsite while the third person died in the hospital), and seven were critically injured. The last reported incident was a woman shot in her leg around 7:00 a.m. near HP campus while the shooter was trying to steal her car. *Areas affected and incidents that took place included* Quarry Shooting at Stevens Creek Blvd, carjacking at Homestead Road and Wolfe Road, and raid at Homestead Road and Peacock Avenue *(NBC Bay area, 2011).*

ANALYSIS

Effectiveness of Reverse 911 System in Santa Clara County During this Event

Reverse 911, as seen from the case studies in this paper, has a number of flaws that hinder its effectiveness. As has already been noted in the recent case of the Lehigh Cement Shooting, three people died and seven others were critically injured. To begin with, the County employees who were responsible for sending these alert messages were delayed in doing so. This was because they were waiting to receive a confirmation or an order from higher management to issue the alert. In that regard, they were not completely in control of the process. This protocol delayed information dissemination to the individuals concerned. For that reason, the message reached the targeted group late. The woman who was shot might have been more cautious if she

had received a notice, but the eastern end of Cupetino was not included in the 9 am notice, even after she had been shot.

Also, even when the message was sent, it could not reach its entire targeted group anyway - and that could be due to a number of reasons. Some people were not in contact with their registered landline phones. Secondly, some people had changed their cell phone numbers that had previously been registered but forgot to update their new contact numbers to the system. Others were not registered at all. Lastly, the area selected for notification was incorrect and inadequate. For these reasons, reverse 911 could not be fully effective in these incidents.

Many people do not know that mobile phones are not automatically included in the AlertSCC 911 database and therefore they need to register them manually. Some others do not favor SMS as a communication channel. Hence most of the mobile phone users are not registered for the service. This means that still there is a gap in the way to deal with disaster. While some of the people would get the emergency alerts on the mobile phones, others would overlook the significance of having their phones subscribed. Often, SMS cannot be remitted in huge volumes at one go as there are high chances the network may not be able to handle the volume (Barry, 2005). Hence, the forwarded messages may delay and some packets may be discarded on the way.

There are a number of incidences that can invoke generation and sending of Reverse 911 messages to people in a given locality. To begin with, when there is an impending danger in a certain location the residents of that area are expected to receive a notification. This includes an anticipated danger that is likely to claim the lives of many people. Secondly, when there is a sudden situation in a given region, such as fire or disease outbreak, then a designated dispatcher

gives the system an order to send an alert with relevant information to the people in the targeted area (Reverse 911, 2011).

Another main disadvantage with this system is that it is only effective when the people in danger all live in one geographical location. The system associates numbers to geographical locations, so people in different locations cannot be notified at the same time (Niles & Tennant, 2011). Another issue is how Reverse 911 can help people ascertain the whereabouts of their family members during or just after a disaster, and whether this is a reasonable expectation of a notification system.

Often some of the notifications remitted by Reverse 911 are misleading, as they could be intended for the southern part of the city but instead be remitted to the western part of the city or to the whole town. This information becomes irrelevant to the unaffected party and the next notification might not receive a serious consideration.

Also the coverage area of the system as intended by the designers greatly limits its efficiency in a large county. Reverse 911 is designed for limited geographic locations such as small cities and villages (Cassidian, 2012). Most of the cities adopting this system are not aware of, or ignore, this fact until a crisis happens and people start reporting that they never received their alerts while their next-door neighbor did. Santa Clara County Reverse 911 covers 15 cities: Campbell, Cupertino, Gilroy, Los Altos, Los Altos Hills, Los Gatos, Milpitas, Monte Sereno, Morgan Hill, Mountain View, Palo Alto, San José, Santa Clara, Saratoga, Sunnyvale and the Unincorporated County (Mitchell & Anderson, 2009). Going back to the fact that this system is designed for small cities and villages might shed the light on an alarming issue. Would this system be effective in covering any one or two or even more of these cities at one time if a crisis

happens? As we learned from the Cement Plant case study, the answer most probably is no. In that case, it is strongly advised to implement as many communication tools as possible in the county's emergency system and to combine them together into one organized system to increase efficiency and effectiveness during difficult times. The county needs a strong dependable emergency alerting and warning plan that is constantly tested and updated.

Although the system has many flaws, it proved to be effective in different other incidents, such as during the San Diego fires in 2007. This is because it has been planned, run and employed effectively during these incidents. Reverse 911 was used along with other communication tools. It offered a platform for coordinated activities among the various stakeholders who are mandated to offer rescue services. When they worked together through this platform, they delivered notifications within a short time, which saved lives and property. Through the 911 alerting system, all the agencies were able to send unified messages because they operated as a coordinated unit, sending their alerts to the public in general to avoid contradictions and misinformation. During the Lehigh factory incident, however, the system was not effective since there was a substantial delay in sending the message and many targeted people did not receive it at all, and this can be attributed to human error and the poor implementation of this system in the County.

For Reverse 911 to be effective in Santa Clara County there is a need to learn from its effective use in San Diego County in 2007. There is also need to give more control to the employees responsible for sending these notifications in order to ensure speed in the event of an emergency. There is also need to encourage the population to constantly update their contact information, especially when they change their phone, home or work address. Furthermore, the

number of notification channels should be increased to include email, social networks (like Facebook and Twitter), phone push notifications, and many others, to increase the chances of the information reaching the right people and in good time. An informational campaign should be carried out to sensitize the public about the system and to strongly encourage them to register.

All these social media tools are very cost beneficial and they can provide the same level of reliability, if not even better, if used side by side with Reverse 911. Eric Holdeman, the Director of Regional Disaster Resilience Center, emphasized the importance of social media to emergency managers (Holdeman, 2011). He referred, in his Emergency Management blog, to some important points made by Alexa Noruk, a Legislative Policy Analyst for the National Emergency Management Association (NEMA), explaining why emergency managers should use social media.

- Social media may not be popular with "you" but it is with the rest of the world
- It is not just the younger generation using it [in fact Twitter has an older following]
- You can emulate media by providing information directly to your constituents
- It is just another tool in the tool box to use
- The time to build a following is when there are blue skies and there is no emergency [you build trust in yourself and your organization]
- You can't do this if you are not on social media yourself
- Follow others
- Everyone is important and you never know who you might be able to connect with
- Social media is self-correcting and there is more correct information than incorrect

- You need to be the "official word" otherwise it will be an information vacuum filled by others (Holdeman, 2011)

In analyzing the AlertSCC system's performance, the system in the discussion did not live up to the expectations given the massive amount of money that was spent to implement it in Santa Clara County. As Lynn Brown of Mountain View's Office of Emergency Services said, "It just didn't rise to the level of being worth spending the money on" (Lohse, 2007). There is definite need to revise the implementation procedure of Reverse 911 in Santa Clara County in order to make it more effective when most needed. This revision should include all the proposals in this review. Only with this in place will the system be helpful in dealing with emergencies.

What Else Can the County Do to Improve Its System?

- Run toll-free test calls regularly and every time a new contact is added, or an old one updated or changed, make sure the owner of that number can receive it.

- Continue to work proactively with radio, television, social media and other media outlets for rapid information dissemination.

- Invest more in different media tools such as social media to advise and educate the public about the system and encourage them to register their devices to receive emergency alerts.

- Cooperate with residential agencies such astitle companies, rental property managers and the new residents' welcome packet group to send out flyers to current and new residents to advise them about the system.

- Provide better training to employees of the dispatch center on managing the system more effectively. Following lessons learned from San Diego, emergency teams were well trained and

prepared, which lead to effectively using Reverse 911 in conjunction with other communication tools.

- Use Twitter! The importance of social media in today's communication cannot be over-emphasized. Since the county needs to advise the people to register their cell phones to AlertSCC in order to be notified, they may as well advise them to join an AlertSCC Twitter account, which currently does not exist! However, the point is to make use of this free and effective social media tool called "Twitter"! It would take only five minutes to create a Twitter account for AlertSCC. The public needs to be aware that all different communication tools are available, and to encourage them to follow AlertSCC Twitter account and join AlertSCC Facebook page to stay notified of any updates. The same text messages sent from AlertSCC could easily and without effort be sent as tweets by the designated dispatcher.

CONCLUSION

In conclusion, Reverse 911 in Santa Clara County has shown, in this research, some major flaws, such as delay with sending alerts or not delivering those alert notifications to a number of endangered residents in an affected area. However, that does not mean the county has to get rid of Reverse 911 or implement a whole new system, unless a much more effective system were found. Reverse 911 did prove to be effective in other counties and cities, such as San Diego during the fires of 2007. Different case studies discussed in this paper showed that Reverse 911 is useful and effective as a tool, but the problem is mainly in the way it was implemented, run and managed.

The county should learn from the success stories and also make use of all other viable communication tools available - putting them together into one coherent system that connects all different parties involved at times of crisis. This includes all different ways of communication from classic methods such sirens, loudspeakers, radio and TV, as well as new technologies like social media and mobile push notification. As Joe Becker, a senior vice president of disaster services at the American Red Cross, once noted in an event held in Washington, D.C., “It's how we leverage the technology that people use in their daily lives to become part of the response”, and in that he is not saying, ”get rid of the big, proprietary systems” but instead all of these systems must feed into and complement each other (Ackerman, 2010).

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