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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**OPTIMIZING CITIZEN ENGAGEMENT DURING
EMERGENCIES THROUGH USE OF
WEB 2.0 TECHNOLOGIES**

by

Laurie J. Van Leuven

March 2009

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**OPTIMIZING CITIZEN ENGAGEMENT DURING EMERGENCIES
THROUGH USE OF WEB 2.0 TECHNOLOGIES**

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Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(HOMELAND SECURITY AND DEFENSE)**

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ABSTRACT

Emergencies and disasters create hardships for citizens. To speed up recovery, local governments need to engage with citizens in an interactive information sharing system to convey information while the incident is still developing and to help mitigate and recover from damages. Lack of effective communication can decrease public trust and engender stress and anxiety of the survivors. As service delivery becomes more complicated during an emergency, responders can also benefit from additional information from the public to increase situational awareness and better understand the challenges facing citizens.

This thesis examines emergency information needs, emerging information sharing trends, and the potential homeland security application of Web 2.0 technologies such as wikis, blogs, mashups and text messaging. This thesis examines the use of Web 2.0 technologies during the Southern California wildfires as a case study and interviews top emergency managers throughout the country capturing their insights and opinions about the benefits and pitfalls of incorporating Web 2.0 technologies into existing emergency information sharing systems. Local government agencies, the impacted community, and those outside the immediate area seeking opportunities to assist may be interested in the benefits of context-powered knowledge when collaboration from multiple sources converges to facilitate knowledge used for decision-making.

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EXECUTIVE SUMMARY

A NATION PREPARED with coordinated capabilities to prevent, protect against, respond to, and recover from all hazards in a way that balances risk with resources and need.

- Vision Statement, National Preparedness Guidelines
(U.S. Department of Homeland Security, 2007)

The United States faces disasters every year that claim lives, disrupt communities, and impose hardships on citizens, businesses and industry. As a country, we need to be prepared and work together to become more resilient. Efforts to strengthen the nation's preparedness and ability to respond to and recover from disasters calls for collaboration among local, state, and federal government agencies tasked with public safety and security as well as individuals from all spectrums of society. Citizen engagement plays a crucial role in getting people on the same page and working towards a common goal.

The allure of public trust and citizen engagement is gaining ground as more homeland security leaders recognize the importance of collective support from the citizenry. Members of the public need to understand the risks we face as a nation, while local governments need to understand the public's fears, expectations and limitations. One way to foster citizen engagement is by promoting the free flow of information between multiple stakeholders, government agencies, and the public. The prime times to engage with citizens are just before, during and after an emergency.

Information is essential during emergencies. Citizens rely on information to guide their decisions about what to do and how to protect themselves and their families. Emergency responders need information to gain situational awareness and to help guide their resource allocation decisions. Information is vital for connecting people with available aid, and it helps reduce anxiety and stress following an emergency. The public's emergency information expectations are

high and people want immediate access to breaking news and developments following tragic events. They want instant access to information when and how it is convenient for them.

In recent years, many people have been turning to social networking web sites [tools?] to engage in interactive information sharing. New Internet-based technologies and mobile computing capabilities that fall under the heading of Web 2.0 technologies are reshaping the way people send and receive information. Web 2.0 technologies are growing in popularity and offer individuals flexibility in locating information through searchable mechanisms from diverse contributors. These new technologies offer greater contextual understanding and enable real-time dialogue and information exchange in multiple formats instantaneously.

This creates opportunities for emergency managers to jump aboard and take advantage of new methods to engage with citizens, help improve incident response decision-making, and aid recovery activities. The emergency management community may benefit from Web 2.0 technologies if they institute outreach and information sharing efforts that reach online communities where a growing segment of the population spends their time.

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I. INTRODUCTION

A. BACKGROUND/PROBLEM DEFINITION

Effective decision-making about what actions to take during and following life threatening emergencies and disasters requires situational awareness and context-powered knowledge about ongoing exposure to risks and hazards and recovery efforts. Recognizing the right knowledge at the right time is paramount to the public as well as emergency responders. In contrast, lack of knowledge and understanding about an emergency can yield poor decision-making and increased levels of fear and anxiety in those without access to information. Government officials may also begin to lose public trust if information does not flow in a timely and effective manner (Butler, Panzer, & Goldfrank, 2003). In absence of data and information, knowledge and understanding cannot take place (Coakley, 2001), potentially leading citizens to take more risks than they otherwise might. Situational awareness improves when multiple members of a community collaborate and share information about the growing number of threats we face.

Every community throughout the world faces threats from natural disasters and extreme acts of violence such as school or mall shootings. Other incidents that affect local jurisdictions are infrastructure failures such as water main breaks, sewer backups or bridge failures that could significantly disrupt essential functions for the public as well as business and industry. Threats to public health from biological or chemical contamination or even a pandemic outbreak could create a near panic situation for entire communities. These types of emergencies can strike a local community at anytime and without warning, inflicting hazardous life safety conditions and widespread property damage to citizens, businesses, critical infrastructure and key resources.

1. The Critical Need for Information

During and after an emergency, jurisdictions may exceed available resources to conduct response and recovery efforts, resulting in short and long-term hardships for people who may be injured, isolated or confused. Ongoing and still developing conditions may threaten public health and safety; create property damage and economic losses; limit availability of food, water or medical assistance; isolate residents due to vehicle damage and transportation issues; and engender anxiety due to lack of access to timely information and feelings of helplessness.

Information helps people understand the situation they are facing and gain knowledge that enables them to make better decisions and cope with stressful conditions. Communities that can harness and effectively share information among multiple participants about the extent of damage, human service assistance, and donation networks are more apt to match up citizens' needs with available aid to speed up the recovery process.

2. The Current Practice Focuses on One-way Communication

The stakes are high during emergencies when effective communication systems are critical to saving lives and preventing further damage. While many human services agencies exist to provide basic care needs for the community, local jurisdictions frequently lack a robust information sharing system to convey timely information to the public while an incident is still developing and to help the community effectively mitigate and recover from damages. Traditional public information strategies focus on pushing packaged messages out to the public via static one-way communications processes (i.e., outdialing emergency notification systems, news releases, and updates posted on web sites).

A more dynamic approach to collecting and sharing knowledge to and from the public is needed. Collective knowledge from multiple sources may improve contextual understanding. As actors involved in an emergency gain

context-powered knowledge, it may lead to decisions that can reduce the risk of death or injury to first responders and the public; increase capabilities to stabilize and contain the incident; improve resource allocation; ameliorate the hardships experienced by the public; promote recovery; and help the community return to normal conditions.

B. RESEARCH QUESTIONS

The purpose of this thesis is to identify and examine the effectiveness of Web 2.0 technologies within the context of providing an interactive approach to information sharing during emergencies.

1. Primary Research Question

How can local and state governments leverage Web 2.0 technologies to share information and engage with citizens during and following an emergency?

To identify trends and the importance of information sharing indicated in the primary research question, this thesis answers the following set of secondary questions.

2. Secondary Research Questions

- What type of information do citizens need during emergencies?
- What positive attributes exist within Web 2.0 technologies that could improve information sharing?
- How have communities successfully applied Web 2.0 technologies during an emergency and what benefits were achieved?
- What criteria do emergency managers value regarding communications effectiveness?
- What content might citizens be able to provide that would prove valuable to emergency managers?
- What limitations could prevent the use of Web 2.0 technologies by the public or government agencies during emergencies?

3. Methodology for Answering Research Questions

The research component of this thesis is qualitative. It seeks to explain the confines associated with implementing new technologies in the complex and fast-paced environment of response and recovery efforts. The intent of the research is to establish a better understanding of the information needs during emergencies, and the benefits and challenges facing government agencies when considering the use of social networking technologies for the purpose of information sharing with the public.

The first step in addressing the research questions is a comprehensive review of existing literature. Literature provides a baseline understanding of the importance of communication during emergencies. It also provides descriptions and theories that explain the type of information citizens seek and the strategies most commonly employed by organizations. Review of books and business cases provide insight about the power of mass collaboration possible with Web 2.0 technologies in a business environment. Review of online literature produced the basis for a case study demonstrating how communities near San Diego used Web 2.0 technologies during the 2007 wildfires.

The second step of this research project involved a more focused effort to develop the San Diego case study. Interviews with individuals involved in some aspect of the Southern California wildfires help address the questions related to the potential and practicality of using social networking web-tools during emergencies.

The third step of this research addresses the remaining questions and helps fill in the gaps not fully addressed through existing literature or the case study example. This step includes interviews with select emergency managers from local and state agencies responsible for managing a variety of different types of emergencies in different regions throughout the nation. This approach provides the necessary insight to answer questions evaluating how key stakeholders feel about Web 2.0. It also provides insight into the expectations

emergency managers have of communication tools, what operability levels they deem essential and what existing limitations might prevent them from adopting these new technologies.

C. LITERATURE REVIEW

The study of and existing research about Web 2.0 technologies is an area still in its infancy. The disruptive nature (IT Dictionary)¹ of social networking applications and the fast-paced adoption by a wide sector of the public indicate that there will be an ongoing need to research, analyze and synthesize the contributions of these technologies in various disciplines. Currently, there is a research gap in examining the specific use and value of Web 2.0 technologies in the field of homeland security. However, there are case studies and literature about private sector businesses that engage with their customers through wikis and weblogs to create customer-centricity (Wagner & Majchrzak, 2006-7).² Disciplines such as Information Technology, Computer Science, Business Administration, Marketing, and Organizational Studies have all recognized the value of social networking technologies as enablers to solving real world business problems.

This literature review examines the body of knowledge available on the related topics of crisis and risk communications, and use of social networking technology to create collective knowledge.

1. Literature and Theories Considered

The current state of available research related to this subject area is largely grouped into two areas. First, substantial literature is available that

¹ Disruptive technology is a term coined by Harvard Business School professor Clayton M. Christensen to describe a new technology that unexpectedly displaces an established technology.

² Customer-centricity is a business approach that encourages discussion between the business and its customers to engage in cocreation of knowledge in a collaborative knowledge exchange process.

examines the importance of communicating with the public about risks and the type of information needed during a crisis. Consultants and industry associations are among those that produce much of this literature. Second, analyses and theories on the phenomena of wikis, collective wisdom and knowledge management from a business case perspective are available as written in journal articles and books by subject matter experts.

a. *Public Information and Crisis Communication*

Research that touches on the communications aspects of emergency response systems has largely focused on examining traditional forms of public information sharing (i.e., broadcast and print news media). The consensus of the collective body of work seems to converge on the conclusion that effective partnership and collaboration between government agencies, the media and the community in advance of an emergency will positively influence the outcome (Reynolds, 2003). Existing literature also explores the best practices and the importance of constructing effective messages and promoting emergency preparedness (Covello, 2007) (Heath & Palenchar, 2002).

Crisis communication and social science theories point out that a two-way symmetric communication model that engages the public and achieves dialogue is the most effective approach to managing information needs (Grunig & Grunig, 1989). Existing literature on crisis communication theory identifies objectives, strategies and tactics necessary to exchange information successfully with intended audiences (Seeger, Sellnow, & Ulmer, 2003). However, development of this literature is prior to the emerging trend of the public turning to Web 2.0 technologies and social networking web sites for their news and information and does not take into consideration the potential of tactics that include new interactive technology.

Additional literature that focuses on how organizations have fared following a crisis provides insight to the important role communication timeliness plays during an incident. Many case studies are available that examine both the

positive and negative outcomes related to the quality of public information strategies deployed during periods of intense organizational crises. The manner in which Tylenol, a Johnson & Johnson product, overcame the public's fear when seven people died related to the first-ever product tampering case back in 1982, is a prime example of the positive power of time-critical information sharing with citizens. The concerted efforts of Johnson & Johnson to warn citizens not to use their product and to pull Extra Strength Tylenol capsules off store shelves nationwide demonstrated their commitment to protecting lives above protecting the product's image. Authorities discovered two more cyanide-laced capsules from the recalled products. This approach to timely information sharing, frequent and ongoing situation updates, and a transparent approach to share details about the situation were all part of the organization's public information crisis communication strategy, which is credited with restoring public trust and brand loyalty (Fearn-Banks, 1996).

This thesis does not seek to dispute these theories, as they are still valid and rooted in sound rationale, but rather delves deeper into potential new strategies to create richer context. This research project explores emerging technology and the type of social web-based tools that the public is using every day and that people will inevitably turn to in times of a disaster.

b. Collective Wisdom and Social Networking

Most of the available literature on collective wisdom and Web 2.0 technologies is based in the disciplines of business management or information technology. This literature addresses the question of what positive attributes are present in Web 2.0 technologies. There have been studies about the disruptive influence of Web 2.0 technology as an emerging trend with youth as well as for adults in the workplace and during off hours for entertainment. The ability of Web 2.0 technologies to allow users from around the world to access and co-create context-powered knowledge has led to increased opportunities, "for learning, for earning, and for fun" (Reding, 2007).

The research and literature most commonly comes in the form of case studies, from a business management perspective, for gaining market share and engagement of their existing customer base. Books about innovative business models such as *Wikinomics* have documented the success of companies such as Linux, Proctor & Gamble and Wikipedia. Literature has identified these and many other companies as establishing best practices for their creative use of the science of mass collaboration via technology to effectively grow their businesses, innovate quickly, and advance their research and development efforts (Tapscott & Williams, 2006). Other business books that focus on the beneficial use of Web 2.0 technologies include *Groundswell* (Li & Bernoff, 2008), *Blue Ocean Strategy* (Kim & Mauborgne, 2005), and *The Starfish and the Spider* (Brafman & Beckstrom, 2006).

More independent scholarly research on the knowledge management aspects of collective wisdom has studied the rapid flow of information across people, organizations, locations and time, concluding that knowledge flow patterns should be incorporated into information technology design theory (Nissen, Winter 2005-6).

Overwhelmingly, the available literature is consistent in offering a positive outlook for the beneficial use and expanding future of social networking technologies. While there is a convergence of opinion that wikis, blogs and mashups are valuable for use in entertainment and business, literature that addresses the use of this technology in emergency management or homeland security applications is lacking.

A great deal of commentary and topical articles exist from Internet web sites that specialize in technology reviews and emergent trends. The researcher reviewed this literature to gain knowledge about new technology trends. These articles generally share the perspective that wikis, blogs, and other social networking technologies are making a large impact on the nature of the Internet and the public's interest in co-creation of knowledge that will influence the future of knowledge management (O'Reilly, 2005).

2. Southern California's Use of Web 2.0 for Wildfire Emergencies

Several online articles and content on blogs emerged in the fall of 2007 touting the successful deployment of several Web 2.0 technologies during the extensive wildfire incidents near San Diego. Online information sources about the use of Web 2.0 technologies during the wildfires provided the current and specific example that this thesis uses to help answer the primary research question of how local and state government agencies can leverage Web 2.0 technologies during and following an emergency. This case study presents the activities of non-government agencies and explores online web sources of information that are not academic or research-based. The case study provides the opportunity to explore a real-world application of Web 2.0 technologies for the purpose of interactive information sharing during an emergency.

In perhaps the largest natural disaster the San Diego region has ever seen, fires raged in and around communities for a week and more than half a million people were evacuated from their homes (San Diego Immigrant Rights Consortium, Justice Overcoming Boundaries of San Diego County, & ACLU of San Diego & Imperial Counties, 2007).

Local government agencies and private organizations successfully capitalized on new technologies and approaches to bring the public into the loop during the fires. The creative use of web technologies such as wikis, mashups and Twitter, along with the leadership and vision of KPBS, a small local public radio station in San Diego, led to the genesis of an interactive portal that provided real time information about the community's response to the disastrous fires (Patterson, 2008).



Figure 1. Use of Web 2.0 Technologies for Public Information during the San Diego Wildfires (From: Patterson, 2008)

Insiders at KPBS, who recognized the need to offer citizens more options to locate information specific to their neighborhood, scrambled to adopt new technologies that would become a pivotal part of the emergency response. While the radio station did have an emergency plan for sharing information with the public, the new technologies they began considering were not among those identified in the plan, much less in place at the time of the fires. However, some KPBS staff members were aware of social networking web tools and felt there might be a way to put them into place to aid with citizen's emergency information needs. Later, employees revealed that they set up the technology systems quickly with the help of private sector companies such as Google (Patterson, 2008). These collaborative partnerships helped KPBS overcome the technical hurdles of setting up graphical interfaces and facilitating two-way interactive features on or linked to from KPBS's home page.

KPBS achieved a synergy with its radio news outlet that drove citizens to its web site to find the most current updates, especially detailed information for specific neighborhoods. This emergency information management system allowed visitors to click on an interactive map powered by Google (as a mashup) to find out evacuation information, the nearest shelters, status of the fire, etc. People were also able to subscribe to Twitter text message groups in order to keep more information at their fingertips and share their own observations. Citizens used Flickr to upload and share images and photographs of the fire and damages.

The phenomena of private industry collaboration, individuals with creativity and initiative, and public participation resulted in a groundbreaking emergency information management system. This case study of the California wildfires is evidence that we have barely scratched the surface of the potential of these new technologies (Chapter V contains more details about the Southern California wildfires).

3. Body of Literature

Currently a gap of available research or literature exists that specifically analyzes the effectiveness of Web 2.0 technology applications within the disciplines of emergency management or homeland security. The rapid expansion and growth of Web 2.0 technologies in the private business sector to cater to customers has many potential applications in government sectors. The research in this thesis bridges existing academic writings about knowledge management with business industry models of customer service enhancements via Web 2.0 technologies with that of potential government uses. The convergence of these two existing areas of study to explore the use of context-powered knowledge via wikis, mashups and other social networking technology provides a baseline for future research.

D. ANALYZING A NEW APPROACH

This research project contributes to the dialogue about the importance of citizen engagement, the benefits of effective information sharing, and the value of context powered knowledge for use in decision-making. In addition, this research delves into the less prevalent topic of how unique attributes of some Web 2.0 technologies might be applied specifically to the demanding information needs during and following an emergency.

Social networking technologies that lead to richer content and improved understanding of a subject are changing the way people gather and share information (O'Reilly, 2005). Social networking tools have been gaining popularity on the Internet in recent years and show great promise in the application of managing emergencies and public information sharing. Government agencies are starting to recognize the merits of Web 2.0 technologies but they have been slow to integrate the technology into interactive emergency information sharing networks that engage citizens.

This thesis will describe the potential benefits and challenges of implementing Web 2.0 technologies for emergency information sharing with the public within the field of homeland security and emergency management.

E. CHAPTER OVERVIEW

Chapter I identified emergency information needs during the stressful times of a disaster that requires quick actions to save lives and ameliorate hardships. It posited that citizens have valuable information to share with emergency managers and responders. It outlined the limitations of traditional information sharing systems, and described how one-way communication channels prevent citizen engagement and can exacerbate problems. It also examined literature and noted that existing research and theory on the use of

Web 2.0 technologies for use in emergency management is limited, but provided an overview of one case study in San Diego and several business case examples of Web 2.0 applications.

Chapter II categorizes the types of emergency information that citizens need during emergencies to prevent and mitigate further complications during cascading events, and move the community into effective recovery mode. It uses existing literature and real world examples of how citizens have responded to emergencies and how they have adopted Web 2.0 technologies and social networking web sites to access and contribute information to a broad community. It also provides examples of the psychological benefits of effective information sharing following an emergency.

Chapter III provides an overview of Web 2.0 technologies and describes the characteristics of four different types of social networking tools that hold particular promise in real world applications for homeland security.

Chapter IV describes the methodology used to answer the primary and secondary research questions. It provides an overview of how this thesis evaluates opportunities for multiple private and public participants and local government agencies to collect and co-create context-powered knowledge during the evolution of an emergency incident.

Chapter V presents a case study from literature and the findings from interviews with those who were involved in the Southern California wildfires in which non-government organizations used many social networking tools. It delves deeper than the literature review to reveal more about the challenges associated with managing the information needs of the public during the incident. The case study also describes how organizations were successful in overcoming obstacles to deploy Web 2.0 technologies effectively and provides advice to local jurisdictions. This section helps address the primary and secondary research questions.

Chapter VI introduces the research observations and findings from interviews with key emergency managers throughout the country. These findings provide insights about the perceptions and attitudes of key stakeholders/influencers necessary to incorporate Web 2.0 technologies in an emergency management atmosphere. It identifies the perceived benefits and challenges of interactive information sharing with citizens and explores the willingness of emergency managers to augment their current public information tactics with strategies that include Web 2.0 technologies.

Chapter VII summarizes the research findings from literature, the case study and the stakeholder interviews. It outlines the benefits and the challenges of Web 2.0 technologies and concludes the thesis. For those with an interest in how a jurisdiction might go about implementing an interactive information sharing strategy, Appendices A and B offer some suggestions. The strategy proposal outlined in the appendices provides an area for future research to test the model.

Chapter VIII also suggests additional paths for this research and expanded research opportunities for the future.

Appendix A introduces a strategy proposition of how jurisdictions might go about augmenting Web 2.0 technologies into existing information sharing strategies.

Appendix B proposes recommendations and specific steps for how a local or state agency might build an interactive information sharing system. It makes suggestions for overcoming barriers and engaging with stakeholders to form a megacommunity of support.

II. THE POWER OF EMERGENCY INFORMATION

People often say that all emergencies begin at the local level and end at the local level, inferring that the performance of local government to manage the emergency effectively is the most important factor in how well a community survives the incident. While the level of preparedness of local government and its ability to respond to the needs of the public is crucial, citizen engagement and their collective response to emergencies can save lives and contribute significantly to recovery efforts. It is simply not possible or realistic for local government agencies to respond to every citizen's needs following a disaster. Citizen responses that result in helping themselves or others to limit the effects of a disaster are a common phenomenon (Helsloot & Ruitenbergh, 2004). Therefore, when emergency resources are limited and the public needs to fend for themselves, access to emergency information is critical.

A. THE BENEFITS OF INFORMATION SHARING

The benefits of improved information sharing can aid multiple stakeholders. In most disasters or catastrophes, members of the public at large are the first on the scene. They will be the first to witness an incident and will have the most accurate and timely situational awareness of what happened. They may be more readily available to render aid and support to victims, especially following a large-scale disaster. According to Helsloot and Ruitenbergh (2004) during their review of citizen response to disasters, post-incident evaluations revealed that average citizens were responsible for saving most lives. Real time situation reports from community members in the field can provide emergency responders with improved situational awareness, additional context, and greater understanding of an incident. For example, greater situational knowledge and context may lead to an increase in the number of

people waiting until water recedes rather than attempting to drive on flooded roads, hence possibly reducing the number of rescue operations required of emergency responders.

The impacted public also needs timely information about what type of support is available and how to access local government services and recovery assistance. Citizens need to know about dangerous conditions, evacuation plans, and instructions on how to protect their family and property. They will also seek opportunities to engage with people from a broader network who can offer financial assistance, donations and psychological support.

1. The Premium Value of Dynamic Information

Emergencies can frequently develop into complex cascading events as the incident evolves, creating multilayered problems and changing circumstances. During this evolution, collaborative information sharing is critical. Traditional approaches to information sharing during and immediately following an emergency are primarily one-way, one-dimensional communication vehicles such as television, radio and newspapers. One of the many challenges with a traditional approach is that the information is static. In other words, the people receiving the information cannot contribute their own unique information and cannot ask questions or receive clarification about instructions, thus the approach is not dynamic and does not facilitate high-powered contextual knowledge that would guide decisions and actions.

a. The Difference between Information and Knowledge

There are many variations on the definitions of information and knowledge, most of which involve communication, meaning, representation and understanding. Information involves collections of facts that people use to process, organize or manipulate to help facilitate understanding and draw conclusions. Knowledge on the other hand, is the result of studying, interpreting,

and analyzing information to generate wisdom on a given subject (Wikipedia).³ Acquiring knowledge and applying it to make informed decisions about potentially life-saving actions during an emergency, first requires a mechanism to send and receive information.

b. The Importance of Knowledge and Informed Decisions

Effective information sharing can occur synchronously or asynchronously. For example, information sharing via a news broadcast is synchronous (i.e., people are receiving the same information at the same time), but an interactive dialogue between two or more people is asynchronous since each individual's contribution builds upon prior contributions. Both methods of information sharing are applicable during emergencies depending on the desired result.

To understand the applicability and benefit of timely collaborative information sharing in multiple directions, consider the challenges of an extreme wind and rainstorm that causes urban flooding on city streets. While traditional strategies such as broadcast news reports push synchronous information out in one direction to the public about weather reports and flooding problems, they do not provide opportunities or encourage the public to contribute their own information and observations. If an observant passerby notices a hillside that appears unstable and is beginning to slide, a dynamic asynchronous information system, such as text messaging, could enable him/her to send warnings out immediately. The Fire Department might be the first responder to a 911 call after a landslide has already occurred, but other participants who might have received that text message could use that emerging information to influence their decisions and actions to mitigate potential damages. The Transportation Department could close the road, drivers could select a different route,

³ Various sources create the definitions of information and knowledge including Wikipedia.

homeowners at the top of the hill could evacuate, and utilities could mobilize crews to protect their infrastructure such as gas pipelines, and water or sewer mains.

Providing citizens, businesses, non-profit organizations and government agencies with the opportunity to contribute their unique information about the situation and ongoing risks has the potential to save lives and property and help foster improved decision-making by all participants. For example, according to Federal Emergency Management Agency (FEMA), 60 percent of flood-related deaths occur when moving water sweeps people away while attempting to drive across flooded roads (*FEMA and KDEM Urge Flood Awareness*, 2008). Drivers who understand the danger related to driving through flooded areas may opt to stay put or move to higher ground. However, they must first have situational awareness about which roads are hazardous and the potential risk involved so they can make informed decisions. This is an important public information message that needs to be widely shared since people often underestimate the force and power of flood water.

2. The Changing Landscape of Information Sources

When the goal is to tap into a broad network of people and the most current information on a given topic, people are turning to the Internet and less traditional forms of communications and information sharing. Gone are the days when people returned home from work and sat down in front of the television to learn about the day's events from the six o'clock news broadcast. The public is increasingly reliant on new methods to access news when and how it is convenient for them. Falling under the heading of Web 2.0 technologies, tools such as wikis, blogs and mashups serve those with a desire to share information and network with others (Stenstein, 2005). The capabilities of these social networking tools to connect a wide and diverse group of people around social topics, common interests, and ideas have changed the way knowledge is shared

among a diverse group of people throughout the country and the world (see Chapter III for more details). However, government agencies have been slow to adapt to the emerging trend of social networking technologies.

The benefits of establishing dynamic and interactive networks for emergency information include improved situational awareness for emergency responders and citizens; improved decision-making and potential reduction in assistance or rescue operations immediately following an emergency; improved ability for the public to cope with stress; and a stronger network of people and organizations that can align available resources with recovery needs.

Current communication practices within the realm of emergency management most frequently focuses on one-way communication vehicles. A more interactive emergency information system that encourages participation from a wide array of stakeholders improves the flow and access to information (see Figure 2).

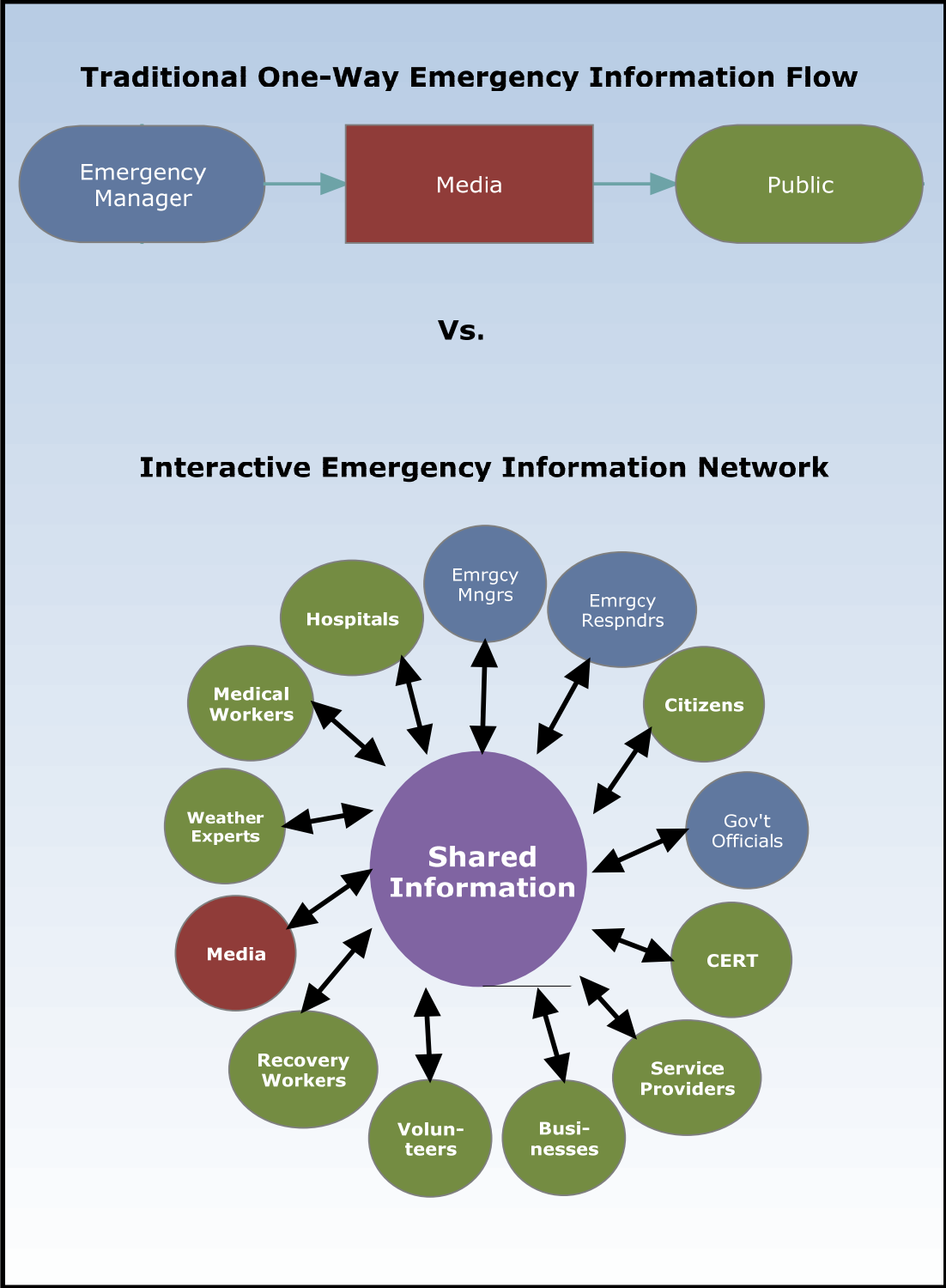


Figure 2. Interactive Information Flow

B. CITIZEN ENGAGEMENT AND THEIR EMERGENCY INFORMATION NEEDS

Emergency response activities that incorporate the information needs of citizens can reduce risk, mitigate the impact, and help communities recover. According to research on the impact of emergency response messages, emergency managers need to recognize local citizens' fears and concerns and create dialogue with communities to share information and alleviate anxiety (Heath & Palenchar, 2002). Addressing the information needs of the public requires a feedback mechanism to ascertain their concerns including what types of information they need and how they want to receive it. The most probable types of emergency information needed by the public are listed below.

1. Four Types of Emergency Information

The type of information the public needs following an emergency falls into four categories: 1) Situational Awareness; 2) Expert Knowledge and Advice; 3) News and Emerging Information; and 4) Recovery Assistance (see Figure 3). Engaging citizens and incorporating information they provide can improve the quality and depth of knowledge derived by participants in each of these areas.

a. Situational Awareness

Emergency managers and responders possess information about emergency incidents and the extent of damages. They are also tasked with sharing that information with the public. However, information that contributes to situational awareness should flow in multiple directions.

Community members with first-hand knowledge about their neighborhood and the impacts of the incident could feasibly improve situational awareness for first responders. For example, residents may be the first to witness that flood waters have washed out a road; that houses on a residential

street have caught on fire; or that a broken water main threatens a hillside community. Developing information from community members in the field can provide responders with context and a greater understanding of an incident.

Impacted citizens also need timely information about what type of support is available and how to access local government services and recovery assistance. They need information about dangerous conditions, evacuation plans, and instructions on how to protect their family and property. Improved information sharing in this category may lead to better decision-making by residents and emergency responders.



Figure 3. Categories of Emergency Information

b. Expert Knowledge and Advice

While the public may have some understanding of an incident due to their proximity or first-hand knowledge about an event, knowledge and advice from experts regarding risks and appropriate actions are critical during emergencies. There are many locations across the world that experience recurring emergencies and subsequently develop disaster subcultures. Citizens among these subcultures benefit from the exchange of knowledge about previous incidents (Helsloot & Ruitenber, 2004).

Members of the public who may be isolated by the emergency may also possess expertise that can contribute to the greater good of a community's needs. For example, a utility worker may be able to share advice about where to find shut off valves, a nurse may be able to describe a technique for rendering first aid, and a volunteer worker might be able to suggest services offered by a community center. People need to know how to reduce their risk exposure safely and effectively when resources are limited and rescue operations are not currently available.⁴

Other examples of expert advice that needs to come from government agencies include: health warnings about contaminated drinking water supplies, dangers related to natural gas outages, warnings about carbon monoxide poisoning (due to indoor barbeque usage during power outages), and public health hazards related to sewage backups or uncollected garbage.

c. News and Emerging Information

The public can also help by reporting news and emerging events through photographs and eyewitness accounts. Some impacts from emergencies develop and expand over time. Warming temperatures and rainfall following a snowstorm may evolve into unstable conditions and risks related to landslides,

⁴ In an interactive environment where the public contributes information freely, liability issues may be a concern. This concept may need to be explored in greater detail by a jurisdiction prior to implementation.

sink holes, avalanches or damage to levees. The eyes and ears of the public can alert emergency responders and other residents about developing hazardous conditions not present at the onset of an incident.

d. Recovery Assistance

Survivors from an emergency who are suffering from a variety of hardships will seek opportunities to engage with people from a broader network who can offer financial assistance, donations and psychological support. Community volunteer groups and individuals frequently provide support, donations and other recovery assistance through formal and informal networks. During the aftermath of significant disasters, people throughout the country and the world may be inclined to offer assistance, both financial and in kind. Following Hurricane Katrina, people turned to Craigslist, an interactive online posting bulletin board, to offer assistance to those suffering hardships. Beyond monetary assistance, Craigslist became an invaluable hub for putting greatly needed goods and services directly into the hands of those who needed help (Axline, 2005). People offered spare bedrooms in their homes, donations of furniture, food and clothing, and posted the whereabouts of evacuated family members in other parts of the country.

C. INFORMATION EXCHANGE AS A COPING MECHANISM

When the emergency reaches a disasterous or catastrophic level, there is even a greater need for interactive information. Whether it is a large-scale disaster, such as a terrorist attack, a natural disaster such as a tsunami, an earthquake wipes out an entire city or coastline, or an extreme act of violence such as shooting spree that kills innocent people or children, shock and denial are the common first symptoms survivors experience (American Psychological Association, 2004). Regardless of the cause of the tragedy, survivors often end up with poignant feelings of hopelessness, anxiety and stress, which can slow down community-wide recovery and turn into long-lasting impacts for survivors

and those who have either witnessed the event, or been affected by its consequences (i.e., death of loved ones, job loss, property destruction, financial losses).

To explore the viability of information exchange as a coping mechanism, this section describes the psychological impacts most commonly experienced following a traumatic event; outlines existing coping mechanisms for dealing with stress; analyzes the role of information before, during and after a disaster; and examines the benefits of interactive information sharing to relieve stress.

1. Psychological Impacts

There are many different degrees of exposure to a traumatic event and equally as many consequences to living in the aftermath of a disaster. The types of mental health conditions that individuals face as a result from trauma include Posttraumatic Stress Disorder (PTSD) and Acute Stress Disorder (ASD). Both PTSD and ASD can result in symptoms such as nightmares, depression, dissociative behavior (distancing self from anything related to the trauma), and severe impairment in social situations (AllPsych Online, 2004). An extended duration of these symptoms is a strong indicator of a diagnosable condition in which professional psychological treatment may include therapy and/or medications.

The less intense condition of traumatic stress following a disaster is more common. People within a community tied together through a shared traumatic experience tend to lean on a network of people who are intent on helping survivors recover, which can help ease anxiety levels. For example, following Hurricane Katrina, offers of assistance and support rolled in from all over the country and the world at a time when the survivors were feeling scared, confused, and isolated. Effective systems that can link needs with available resources may be a viable option to lessen the intensity of feelings of despair and hopelessness of the survivors.

2. Coping Mechanisms

Individuals resort to different coping mechanisms to deal with stress and traumatic events. Some people will look inwards towards their faith and religion for answers; some will lean on close friends and relatives for support; and others will roll up their sleeves and emerge themselves in activities to help others. The manner in which people cope with stress may have a significant effect on how quickly they recover. Two types of coping mechanisms include emotion-focused strategies and problem-solving strategies. Emotion-focused coping involves efforts to regulate the emotional consequences of the event, while problem-solving strategies or active coping strategies intend to change the nature of the stressor itself. For example, people impacted by a natural disaster within a community can actually help ameliorate the situation by taking active measures themselves to reduce the impacts by participating in rebuilding efforts.

The amount of social support a person has, influences their ability to recover with an emotion-focused strategy, since that support increases their likelihood to share their experiences with others (Litz, 2002). In most cases though, people rely on a combination of both strategies to get them through stressful conditions and the consequences of a disaster. However, research indicates that active coping strategies are a more beneficial way to deal with stressful events and facilitate quicker recovery (MacArthur & MacArthur, 1999). A critical factor to getting people involved in a problem-solving strategy is ensuring they have information about what type of recovery assistance and efforts are taking place. Access to information in the wake of a disaster is a critical component of recovery.

3. Access to Information

Effective decisions about what actions to take during and following life threatening emergencies and disasters requires situational awareness and context-powered knowledge about ongoing exposure to risks, hazards and recovery efforts. Recognizing the right knowledge at the right time is paramount

to the public as well as emergency responders. In contrast, lack of knowledge and understanding about an emergency can yield poor decision-making and increased levels of fear and anxiety in those without access to information. Government officials may also begin to lose public trust if information is not shared in a timely and effective manner (Butler, Panzer, & Goldfrank, 2003b), potentially leading to resistance and non-compliant behavior that could increase citizens' exposure to risk.

Information sharing with the public prior to an event has the ability to alert people about the hazards, anticipated consequences and best strategies to be better prepared (Butler, Panzer, & Goldfrank, 2003a). For example, in a region prone to earthquakes, public information campaigns may motivate and influence residents to secure heavy items in their homes (i.e., water heaters, bookshelves, china cabinets) which can lessen the damage and the likelihood of injuries. This advanced knowledge can empower citizens to take responsibility for their own well-being, build confidence that they have some control over their own circumstances, and lead to higher survival rates. Information sharing in advance also has the benefit of taking some of the unknown risk out of the equation. The more people recognize and prepare for risks, the more likely they will be able to recover from the psychological impacts.

Clear, credible and timely information is one of the best defenses to combating fear and anxiety. When things are falling down around us, we seek reassurance, instructions on how to protect ourselves, estimates of service restoration, and an indication of when things may return to normal. Forthcoming information following a disaster or tragedy can build public trust in local government and response and recovery efforts. Failure to provide this exchange of information can create misunderstandings, suspicion and resistance (Glass & Schoch-Spana, 2002).

Information helps people understand the situation they are facing and gain knowledge that enables them to make better decisions and cope with stressful conditions. Communities that can harness and effectively share information

among multiple participants about the extent of damage, human service assistance, and donation networks are more apt to match up citizen needs with available aid to help people actively cope and speed up the recovery process.

4. A New Coping Approach: Interactive Dialogue

Taking it a step further than information dissemination, the concept of engaging in interactive dialogue can be a valuable coping mechanism. Emergency response and recovery strategies that incorporate the information needs of the public can have a measureable affect on a community's ability to actively cope with stress, bounce back from traumatic experiences, and provide ongoing support to other community members. According to research conducted by Butler, Panzer and Goldfrank (2003) about the psychological consequences of traumatic events, those who share their experiences with others who have survived and overcome a disaster may promote greater community cohesion. That, in turn, can lead to a greater feeling of altruism and more willingness to volunteer and "help thy neighbor." Engaging in dialogue, turning to others for support, attempting to gain more information about the incident, and fulfilling the urge to "do something" are all forms of active coping that can help survivors through the recovery process.

Advanced and interactive emergency warning systems that can quickly share information about an emergency can help connect citizens to others who have experienced the same incident. For example, when Los Angeles experienced a 5.4 magnitude earthquake on July 29, 2008, residents who received instantaneous information about the quake were those who turned to Twitter, a Web 2.0 technology that provides low-band text messaging among a subscriber group. Most people are not sitting idle in front of a television waiting for a disaster to occur, so they may not receive instant reports about an emerging situation. While some traditional media sources were able to report quickly, others were scrambling to gather information and organize news reports. Meanwhile, Twitter subscribers, who most frequently carry their cell phones with

them wherever they go, were alerting each other within seconds and rapidly sharing their experiences. Twitter was also instrumental in alerting the public about the earthquake that hit China earlier in 2008 (Sutherland, 2008).

Tim O'Reilly, the person who coined the term Web 2.0 Technologies, frequently describes the continued exponential growth of these emerging web-based tools at technology conferences around the world (O'Reilly, 2005). Given the growing popularity of these web-tools, incorporating them into emergency information sharing strategies provides survivors with improved active coping mechanisms to help reduce stress. In this sense, providing and encouraging two-way information sharing is just as important as providing medicine (Glass & Schoch-Spana, 2002). The following chapter will describe features of Web 2.0 technologies in more detail.

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III. WHAT IS WEB 2.0 AND HOW CAN IT HELP?

A. CURRENT PRACTICE AND OPPORTUNITIES FOR IMPROVEMENT

There is a lot riding on effective communication systems during emergencies in order to save lives and prevent further damage. People affected by incidents need information and frequently have information that could add value to others. Traditional strategies that focus on one-way information sharing need to leverage new technology and emerging trends to establish interactive information mechanisms. Collective information from multiple sources may improve contextual understanding. As actors involved in an emergency gain context-powered knowledge, it may lead them to make better decisions, subsequently speeding up a community's return to normal conditions.

This chapter explores the value of Web 2.0 technologies in the context of emergency information sharing and provides descriptions of four specific Web 2.0 technologies. Web 2.0 is a second generation of web-based sites, communities and services designed to optimize social networking, collaboration and sharing among users to create a richer user experience (O'Reilly, 2005).

B. WEB 2.0 TECHNOLOGIES AS SOLUTIONS

New technologies that leverage the collective intelligence of the public to create richer content and improve understanding of a subject are changing the way people gather and share information (O'Reilly, 2005). Social networking tools have been gaining popularity on the Internet in recent years and show great promise in the application of managing emergencies and public information sharing. Web 2.0 technologies such as wikis, blogs and mashups got their beginnings in the entertainment side of the Internet catering to wired teens with a desire to share information and network with others (Stenstein, 2005a). Government agencies are just starting to recognize the merits of Web 2.0 technologies.

One particular emergency management office in a local setting that has recognized the benefits of social networking to reach the public before, during and after disasters is Philadelphia. The City of Philadelphia's Office of Emergency Management launched an initiative in January 2009 to establish a presence on Blogger, Facebook, MySpace, Twitter, YouTube and LinkedIn. According to MaryAnn Tierney, Philadelphia is exploring how these tools can help obtain important information about damaged areas following severe storms. They are also looking at using these web sites to supplement their traditional communication methods and better understand the community's needs and concerns (Tierney, 2009). Tracking the progress of Philadelphia's social networking for emergency management initiative is a potential area for future research.

The following section describes four different Web 2.0 technologies and provides some examples of why they hold particular promise in the application of an interactive emergency information sharing system.

1. Wikis for Quick Collaboration

One way to gauge the impact of new technology is to observe the trends of those who are using it and for what purposes. The word wiki (or wiki wiki) literally means fast in Hawaiian (Stenstein, 2005b). A wiki is a web site that allows visitors to easily add, remove and edit content. The world of wikis came alive when people sought opportunities to collaborate and share information quickly. People also turn to wikis when they want information from a variety of sources that can result in a richer dialogue on a given topic. One of the most recognizable wikis is Wikipedia (www.wikipedia.org), a self-correcting, evolving encyclopedia updated by the collective contributions of its community of users. Wikis, such as Wikipedia that primarily focus on text contributions, only represent the tip of the iceberg, exposing the potential for wikis to serve as a springboard for a number of other interactive tools.

The use of wikis during large-scale humanitarian efforts demonstrates a conceivable application for use during other emergencies. Wikis were an integral part of public information sharing during the South Asia earthquake and Hurricane Katrina relief efforts (Zieche, 2006). Not only were wikis used to provide situation reports during the initial phases of the disasters, but they remained active to connect volunteers and donation sources with those in need. Wikis provide much quicker and more direct one-stop shopping for any size community (local to global) interested in mitigating damage and mobilizing needed resources.

Another good example of the useful nature of wikis, within a homeland security application, is the information sharing that is taking place through the creation of Intellipedia. In 2006, members of the Central Intelligence Agency (CIA) developed Intellipedia to serve many members of the U.S. Intelligence Community (IC) with a dynamic, interactive online information sharing system with access limited to those with the appropriate security clearances. These relatively recent, multi-level efforts undertaken by the IC to share intelligence information is once again recognition of the value of shared information and content contributions from multiple participants to influence decision-making. The wikis that make up Intellipedia (i.e., Joint Worldwide Intelligence Community System (JWICS), Secret Internet Protocol Router Network (SIPRNet), and Intelink) have improved the IC's ability to share information across different agencies and encourage dissenting [differing?] points of view on intelligence analysis within a common location (Burke & Dennehy, 2008).

2. Blogs for Interactive Dialogue

The interactive, real time power of weblogs (blogs) can provide a valuable feedback mechanism between government and the public. Blogging has gained popularity in recent years helping replace the static nature of web sites with more dynamic exchange of ideas and ever-changing content. A blog is a platform-based tool that aggregates and organizes information from multiple contributors

related to a specific topic. In its simplest form, a blog is an online, chronological diary where visitors can post their responses to a topical discussion thread. Blogs help build online communities that are rich in dialogue and information exchanges. Blogs have been described as conversational watering holes that have evolved from peer-to-peer bulletin-boards (O'Reilly, 2005). Blogging is another tool that can improve public information sharing by releasing the control of information and inviting dialogue and contributions from the public.

During emergencies, blogs can provide the public and those managing the incidents with real time information about hazardous conditions, road closures, human-interest stories and endless other contextual references. Blogs can also provide a much-needed outlet and psychological support for those who are struggling to make sense of a disastrous event. Following the Minneapolis bridge collapse in 2007, blogs sprang up in many forms on the Internet and provided situational knowledge about the number of lives lost, photographs of the incident, and commentary about potential causes (On Deadline Blog: USA Today, 2007). Providing a community with opportunities to reach out to others and share stories, ideas and fears can serve as a positive recovery function.

3. Mashups to Improve Contextual Understanding

Mashups display an overlay (or mashing together) of one data set on top of another data set. Anyone who has used a real estate map of homes for sale in a geographic area has used mashup technology. As you click on an icon (house) you get a description of the property pulled from a database (price or square footage). Maps represented in a graphical format are the most common applications.

Government agencies use mashups for many purposes, such as locating buried infrastructure (i.e., water mains or sewer pipes) that are not visible from a photograph. During emergencies, mashups provide opportunities to improve users' understanding of the situation by tagging maps with photographs, annotations, situational status of roads, or evacuation information. Mashups

were used in San Diego to help residents determine the impacts of the wild fires that raged though the area in October 2007 (more about San Diego's use of technology is discussed in Chapter V).

4. Text Messaging to Conserve Resources and Bandwidth

The wide-scale adoption of cell phone technology into everyday life provides another tool that incident managers should tap into for optimal information sharing with the public. Nowadays, cell phones act as mobile devices with their own personal servers that can send and receive text messages without overloading voice telecommunication lines. Two similar systems that use this technology are Twitter and TwiddleNet.

Twitter's text messaging system allows cell phones to connect to the Web for real-time updates and emergency alerts. Twitter allows a person or system to send out text character bulletins that recipients subscribe to and receive on either their computer or cell phone. One distinguishing feature of Twitter is its ability to promote concise communication by limiting the number of characters to 140 per message. Twitter is an interactive system that enables group members to share their own text messages or photos (*Twitter Frequently Asked Questions*).

The most evident benefit of this technology is its application in the first 48-72 hours of an emergency, when phone lines may be overtaxed. Instead of being isolated, users can Twitter into a group that a home on their street is going up in flames, or a shelter service could inform a community that it is about to be evacuated, or that water and supplies are on their way. The streamlined efficiencies offered through text messaging is hard to discount given its potential as a quick alternative to the voluminous traffic that can crash phone lines (land lines and cell phone networks) when users flood a network's capacity to transmit audio signals immediately following an emergency.

C. CRITICAL FACTORS FOR SUCCESS

Regardless of the potential benefits of using Web 2.0 technologies to enhance collaborative information sharing and increase contextual knowledge, many local jurisdictions do not have clearly defined processes in place to employ a dynamic and interactive information sharing system that adequately engages the public. Why have jurisdictions that seem ahead of the curve in some emergency response efforts, been slow to implement collaborative information sharing systems with the communities they serve? Three possibilities are that 1) local jurisdictions have not recognized the potential benefits of an interactive information sharing systems; 2) local emergency management officials do not trust the public to contribute accurate information; and 3) jurisdictions do not have policies in place that outline expectations for how emergency information will be shared with the public. The first two issues of the unrecognized benefits of Web 2.0 technologies and the fear of inaccurate contributions from the public is addressed in more detail in Chapter VI through analysis of interviews with local and state emergency managers.

1. Benefits of a Well-Defined Policy and Implementation Strategy

The recovery functions of food, shelter, restoration of services, health care, outreach, clean up, and damage claims need to be clearly addressed through policies of individual jurisdictions. Interactive information sharing can help facilitate the first step in determining needs of an impacted community. Response and recovery agencies first need to understand the hardships citizens are facing before making determinations of what level of services need to be made available. Likewise, customers such as residents, businesses, visitors or anyone else who relies on local government services, need to know what services will be available or restored and when.

Regardless of different service level policies among local jurisdictions, the community needs to know what level of services to expect. Even though local jurisdictions cannot make service level determinations until they are aware of the

damages and resource limitations, the information needs to reach the public as quickly as possible. The expectation for local government agencies to effectively communicate with the public and provide interactive information sharing opportunities during emergencies could become a common approach employed by various agencies within a regional area, hence eliminating some of the public's confusion about how to access information.

A key policy objective of agencies seeking to improve their information flow and citizen engagement efforts, is to identify and implement a solution that does not detract from or impair response activities, but rather provides a framework for ongoing information sharing to aid in recovery and assistance for those impacted. The on-scene Incident Command System and the Emergency Operations Center must mirror the commitment to interactive information sharing with the public to ensure a coordinated and comprehensive approach. Various response agencies will need to work together, to improve outreach and information sharing efforts. Chapter VIII provides more details on a proposed strategy for implementing Web 2.0 technologies as part of an interactive information sharing system.

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IV. RESEARCH METHODOLOGY

The rapid growth and emerging social trend of citizens engaging with each other to share information via Web 2.0 technologies indicates that this form of interactive communication is becoming a mainstream practice of the public. Existing scholarly research related to social networking websites largely revolves around identification of which segments of the population are using the technology and for what purpose. These scholarly research categories include friendship and impression management; network structures; cross-cultural studies; the safety and security of children and teens that frequently use social networking websites; privacy issues; and the dynamic of capitalizing on weak ties to co-create solid and structured data sets (Boyd & Ellison, 2007).

Primary research on the applicability and feasibility of local government jurisdictions to incorporate strategies that include Web 2.0 technologies for sharing emergency information with the public is a new frontier. The adoption rate and use of new technology is inherently inconsistent across generations, cultures and disciplines. Hence, the project called for a qualitative research approach to describe amenable conditions for use of the technology and to interpret the insights, attitudes and perceptions of the stakeholders who would use them. The researcher used inductive reasoning to gain a broad understanding towards a set of generalized questions, while maintaining a flexible strategy to narrow in on specific components as the research project evolved.

Answers to the research questions of this study are not indicative of the views or opinions of any particular individual. The research includes findings from various sources and takes on an emergent nature. As such, the research is not prescriptive but rather flows and evolves organically in an iterative process. Questions during interviews were open-ended and responses by the

interviewees helped shape the qualitative data used for analysis (Leedy & Ormrod, 2005). The following section describes the specific methods selected by the researcher to design a flexible strategy based on the research goal.

A. RESEARCH GOAL

The research contained in this thesis explores and interprets the concepts, conditions, ideas and perceptions necessary to evaluate the potential use of Web 2.0 technologies within the homeland security community. The research focuses on the complex and fast-paced environment of local and state response and recovery efforts. The research explores the need for citizen engagement; the challenges with traditional information sharing strategies; and how government agencies might be able to leverage Web 2.0 technologies successfully. The ideal goal of this research is to provide local jurisdictions with a proposed model of how to increase citizen engagement and improve interactive information sharing with the public.

B. QUALITATIVE METHODS

The researcher identified a general problem and set of related questions, and then followed the path to a potential solution. The qualitative methods selected by the researcher include a case study, content analysis and triangulation of data to reveal where the findings converge. These qualitative research methods provide the flexibility to enlist more than one approach to gathering data applicable to the research goal (i.e., literature, a case study, and interviews). The researcher remained open to the emergence of themes, unanticipated responses, and was prepared to change directions to pursue new evidence.

1. Case Study

The case study phase analyzes the impacts many local jurisdictions faced during separate, but linked wildfire events. The goal of the case study is to

provide an example of an effective application of Web 2.0 technologies during the management of an emergency incident. The Southern California wildfires that took place in 2007 provide that example. The case study is an in depth analysis that provides an opportunity to better understand the type of conditions that led to the trial and successful deployment of Web 2.0 technologies during a real emergency. This case study describes what type of information needs existed and how they were satisfied. While the case study portion only focuses on a single case, the Southern California wildfire case embodies many jurisdictions. The wildfire case is particularly suitable for this research due to its unique ability to portray a successful application of several forms of Web 2.0 technologies during a disaster that lasted an extended period and evolved dramatically from inception to conclusion.

The case study includes primary research in the form of interviews with insiders from a local news outlet actually involved in setting up interactive information sharing systems. Insights related to the case study include details about how the disaster unfolded, what types of information citizens sought, how citizens interacted with new technology, descriptions of the partnerships required to implement the technology, and the challenges encountered by the media outlet through the process. The case study also utilized secondary research in the form of published articles that evaluated the approach and the results.

2. Content Analysis of Interviews

The content analysis portion of the research builds upon the findings from the case study by exploring reactions and perceptions of the homeland security community and their willingness to consider adopting a similar strategy to that employed in the case study. Leading research educator Paul Leed describes the premise of content analysis as “a detailed and systematic examination of the contents of a particular body of material for the purpose of identifying themes, patterns, or biases” (Leedy & Ormrod, 2005). That is precisely what this portion of the research effort accomplishes.

This phase of the research uses a deliberate approach to identify a relevant body of stakeholders. It then identifies a representative sample that provides diversity and a broad range of perspectives. The researcher then conducts interviews with the sample and incorporates a systematic analysis of transcripts. The content analysis results in categorized characteristics and criteria that help interpret the multifaceted layers of the general problem and potential solutions.

a. *Interview Sample Selection*

The researcher uses a purposeful sample of participants to gather a diverse representation of the stakeholders involved in implementing an interactive information sharing system. Group selection criteria included participants from different occupational backgrounds vested in successful information sharing outcomes. Included in the sample are: EOC managers and response leaders tasked with managing incidents in a local government setting; Information Technology managers responsible for implementing and managing technology; and Public Information Officers. It was also important to identify participants who had varying degrees of familiarity with Web 2.0 technologies. Another criterion for diversity was locating people from different geographic locations of the country who deal with different types of regional weather emergencies or disasters (i.e., hurricanes, tornadoes, earthquakes, flooding, and snowstorms).

The researcher first created a listing of geographic locations from the United States that frequently manage regional weather emergencies, or that have been involved in a significant disaster such as an infrastructure failure, a terrorist attack, or a chemical spill. Next, the researcher engaged with a variety of potential interviewees and conducted a brief screening to ascertain the candidate's familiarity with Web 2.0 technologies, selecting candidates with a

variety of experience and understanding of these tools. The resulting sample selection included nine individuals from six different states including the East Coast, West Coast and the Mid-West.

b. Interview Process

The interviews were semi-structured and revolved around a few central themes related to the research questions, but with ample room for interpretation and the ability to proceed in a free-flowing nature. The interviews took on an emergent in design, in which insights gained from the first participants influenced additional questions and dialogue during subsequent interviews. As the interviewees provided keen insights that were unexpected, the researcher followed them through to take advantage of unforeseen data sources (Leedy & Ormrod, 2005). Each interview was audio recorded and turned into a written transcript. This yielded information that included facts, perspectives, feelings, motivations, frustrations, lessons learned, and concerns.

3. Triangulation

The researcher uses triangulation to identify areas of data from various sources (literature, case study and interviews) that converge to help interpret the findings. The descriptive nature of the case study research component provides details and context about the use of Web 2.0 technologies that allow readers to draw their own conclusions. The researcher analyzes evidence collected from the sources using content coding and provides graphs and analytics to help interpret the findings.

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V. 2007 SOUTHERN CALIFORNIA WILDFIRES CASE STUDY

The case study approach provides unique contributions of knowledge gained and lessons learned from the perspectives of those directly involved with a specific event (Yin, 1989). Examining the experiences of local communities during a real world emergency as a case study provided the researcher with the context to answer the following research question: *How have communities successfully applied Web 2.0 technologies during an emergency and what benefits were achieved?*

A. CASE STUDY SELECTION

Locating real world applications of Web 2.0 technologies used in the context of an emergency is not difficult. Examples of Twitter messaging, wikis, and Craigslist are abundant. However, locating a case in which multiple types of online resources, social networking sites, and interactive collaboration played an integral part during an emergency over an extended period is more difficult. The case of the 2007 Southern California wildfires illustrates the multitude of information needs and challenges during a fast-paced emergency that evolved over time. It also highlights the different type of information needs citizens have and how sharing their stories and needs with others aided in the recovery process.

The 2007 Southern California wildfires demonstrates how far the net can be cast to collect information from a multitude of sources to improve knowledge and understanding about a dangerous, life safety situation. The use of Web 2.0 technologies by individual citizens that blended with existing media sources resulted in a layered network of information in different formats that included everything from text messages, videos on YouTube, photos on Flickr, dialogue and Q&A on blogs, and online message boards (Glaser, 2007). While these are

not traditional sources for news, the public valued the content and the ease of use and sought these sources out. As such, this particular case study is ideal for demonstrating the potential of Web 2.0 technologies during emergencies.

B. THE PERFECT STORM

By all accounts, the 2007 California wildfires were a natural disaster that wreaked havoc across the southern part of the state. The onset of the first fires began on October 20 and blazed uncontrollably throughout seven counties for the next 7-10 days. The Southern Region Emergency Operations Center in Los Alamitos and the State Operations Center in Sacramento remained activated until the final fire in Malibu was contained on November 24, 2007 (Sellers, 2008). Other city and county Emergency Operations Centers (EOCs) in impacted areas were also activated. Local jurisdictions needed to warn citizens about life safety and eventually evacuated more than 300,000 people. The displaced residents anxiously sought out situational updates and information. Frustration set in after the fires subsided while information about re-entry into impacted areas came slowly.

1. Contributing Conditions

The wildfires occurred in October, following the end of a long, dry summer. A variety of factors contributed to the onset of the fires and the veracity with which they destroyed hundreds of thousands of acres. New development and urban encroachment into wilderness areas provided underbrush and other fuel close to homes. Ongoing drought conditions, climate change, and sustained hot weather created an easily ignitable environment. Lightning strikes and arson are among the suspected sources of the various fires. The fierce and notoriously hot Santa Anna Winds whipped the fires at sustained speeds of up to 85 mph creating the most significant challenge that impeded containment and led to uncontrollable circumstances (Nielsen, 2007).

2. Life Safety Concerns

The immediate concern for all jurisdictions was that of protecting life safety, which meant getting people out of the path of the fires. Various fire chiefs recounted the extreme conditions and described an expectation from the public that they should have been able to halt the wildfires sooner. Unfortunately, the unrelenting wind left little opportunity to challenge the fires. They also had difficulty allocating necessary resources due to high demand for firefighters, engines, bulldozers and hand crews since there were so many fires burning simultaneously (Jones, 2008). Emergency managers relied on public address systems, reverse 911, and door-to-door tactics to convey mandatory and voluntary evacuations hoping they were getting the word out to the impacted public (anonymous local government official, interview with official from North County Fire Protection District, 2008).

As the wildfires continued, consequences to infrastructure created even more challenges such as widespread power outages, drinking water system failures, road closures and congestion, and stress on the healthcare system when patients from evacuated hospitals filled up beds at the remaining local hospitals (Dickfoss, 2008). During the first days of the fires, thick smoke and burned down street signs hampered rescue operations making it difficult to find stranded residents. When the fires appeared to have moved through an area, citizens were so anxious to return to their homes, and keeping them out of dangerous zones became increasingly difficult.

According to one Public Information Officer involved in the response, residents understood the danger when the plume of ash and smoke was evident. However, once the plume dissipated, residents wanted to return prior to a safe designation by emergency authorities. He described the need to convey the ongoing risks to the public.

There were widow-makers⁵ all over the place and we had real concerns about the sustained Santa Anna winds that could blow down the burned trees and telephone poles. Slight shifts in the wind direction could've easily resulted in backburning danger. We didn't want to evacuate them once and then have to evacuate them a second time. (Anonymous Local Government Official, Interview with Official from North County Fire Protection District, 2008)

The quantities and size of the fires varied from county to county. San Diego County experienced the two largest fires and the most significant destruction and acres burned. See Figure 4 for more details.

C. STATE OF EMERGENCY

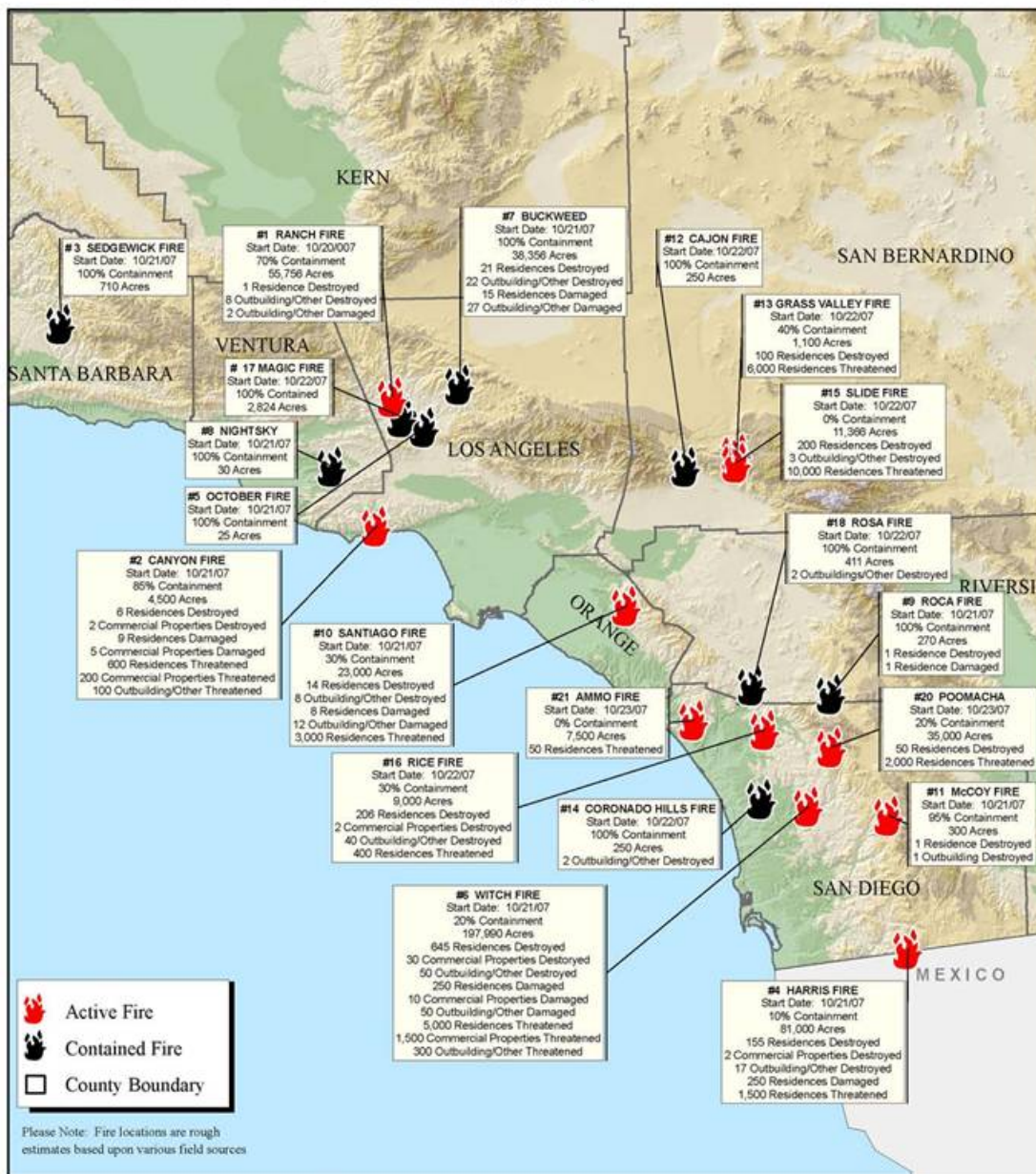
The wildfires quickly exceeded existing emergency management capabilities and resources, and required mutual aid and federal assistance. Governor Schwarzenegger proclaimed a State of Emergency for seven counties on October 21, 2007. On October 22, President Bush issued an Emergency Declaration and two days later, the President issued a Major Disaster Declaration that triggered the Stafford Act responses. By the end of the disaster, widespread damage calculations included the following tallies (Sellers, 2008):

- 24 fires affecting seven counties
- 522,168 acres burned
- 10 fatalities
- 147 injuries
- 2,180 homes and 927 other buildings destroyed
- 321,500 people evacuated
- 26 hospitals evacuated
- 22,195 persons sheltered in 54 sites
- 20,000 mutual aid responders from 31 states, Mexico and Canada

⁵ Widow-maker is an expression used in the Fire Service when referring to trees or poles that might fall and kill a firefighter.

SOUTHERN CALIFORNIA WILDFIRES

as of 10/25/07 - 0600 Hours PDT
with Start Dates - Chronologically



Created by OES - GISK/Higgs
October 25, 2007 Source: FEMA/2007
active_incidentfires/2007/Statewide/October/
projects/Statewide_Fires_102507_001.mxd

Figure 4. Southern California Wildfires (From: Higgs, 2007)

D. MEETING THE DEMAND FOR INFORMATION

From the emergency management side, public information was critical for public safety warnings and evacuations during the wildfires. From the public side, information was valued at a high premium due to simultaneous fires burning in so many locations and the desire for situational updates. The extreme conditions were changing rapidly and new dangers were emerging every hour. The population across the seven impacted counties (Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara and Ventura) exceeded 21 million (U.S. Census Bureau, 2006). The magnitude, intensity and newsworthiness of the disaster overwhelmed limited emergency PIO staff.

The disaster consumed all traditional media outlets in California and placed a strain on existing information systems (such as phone lines and web sites). Citizens trying to find specific information about their neighborhood had to wade through reports about other areas. As described in Chapter II, citizens needed four types of emergency information.

- **Situational Awareness** – location and extent of the fires/evacuation information
- **Expert Knowledge and Advice** – air quality warnings/how to protect homes
- **News and Emerging Information** – road closures/utility outages
- **Recovery Assistance** – shelter locations/community support

If people are not able to ascertain the information they need quickly, they end up in limbo, waiting to make decisions about what actions to take. Fortunately, in California, many residents were persistent, looked for information from a variety of sources, and found opportunities to share their experiences.

1. Local Jurisdiction Information Sharing Methods

Local jurisdictions recognized early on that the public need for information would be extremely high. According to a report from the Wildland Fire Lessons Learned Center, the primary information sharing strategy was to set up Joint

Information Centers (JICs) and staff with as many Public Information Officers (PIOs) as possible. The JICs focused on two audiences: media and political representatives. The report describes news releases as the primary information sharing output. Other methods included talking points, ongoing media updates, and an information phone line. The formal PIO function also fed information to local newspapers, some with a blog presence on the Internet. The emergency management community credited the JICs and PIO function as a successful strategy in connecting the public to all the information they were looking for (Holt, 2008).

The Lessons Learned report and the official After Action Report from the City of San Diego do not mention a communication objective of engaging in an interactive dialogue with citizens. In fact, the strategies outlined in these formal reports rely almost exclusively on the media via a one-way communication system. The reports seem to imply that once the official communication function reached the media, the responsibility to disseminate the message transferred to the media outlet (City of San Diego, 2008). This leaves the public out of the loop to contribute any information they may have for emergency managers. Evaluation of how the public actually perceived the information sharing efforts of local jurisdictions during the wildfires is an opportunity for future research.

2. Citizen Frustrations

Mounting stress and anxiety related to the raging wildfires drove many local residents to seek information from television news reports that were airing constantly. The challenge, was trying to find specific information tailored for residents needs. The flood of information to sort through was overwhelming. According to a local PIO, citizens complained that they kept flipping channels looking desperately for information about their neighborhood. The PIO advised citizens to “stay put on one channel and wait for the information to roll through

the cycle.” Contrary to this advice, some residents began frantically seeking up-to-the-minute news and information about local services through other sources (Poulsen, 2007).

E. WEB 2.0 TECHNOLOGIES FILLED IN THE GAPS

Many residents turned to Web 2.0 technologies to capitalize on existing social networking tools and to tap into the collective knowledge of others. It also provided a much-needed outlet for those who wanted to express their concerns and share their experiences. Participants involved in Web 2.0 technologies for real time wildfire updates and information fell into two groups: Independent Citizen Reporters and Progressive Media Outlets.

1. Independent Citizen Reporters

Twitter was one of the most popular sources of information sharing during the wildfires. Using short bursts of information called Tweets, users were able to send out and receive rapid-fire updates among a designated subscriber group. The type of information shared through Twitter included: evacuation information, meeting points, places for sheltering animals, locations of open stores with supplies, and various other shreds of information residents wanted to know (Poulsen, 2007).

One resident who elected not to evacuate his home, used Twitter and Flickr, an online digital photo-sharing site, to keep his evacuated neighbors up to speed on the status of their homes (Poulsen, 2007). Flickr provided excellent situational awareness by visually sharing information through photographs taken by local citizens. Flickr also provided an interactive posting blog feature that helped survivors share their concerns and engage in coping strategies. Here is an example of one of the thousands of exchanges captured in Flickr’s public forum.



Figure 5. Flickr Information Exchange as a Coping Mechanism (From: Flickr.com)

Flickr User #1: *About 3:30 a.m. looking southeast from Old San Pasqual. This is a very short distance from our house. Escondido, CA.*

Flickr User #2: *I hope your house was spared. This looks too close from all I've been seeing in the news. Be safe and my prayers are with you and yours...*

Flickr User # 3: *I saw this coming to my house too. I live in Rancho Bernardo. It's really horrifying to wake up in the middle of the night and see a massive wall of orange ready to swallow you whole. Hope you are doing well and I wish you luck with recovery.*

Local independent residents were not the only participants during the wildfires engaged in Web 2.0 technologies. KPBS, San Diego's local National Public Radio affiliate, took a strong leadership position among media news outlets to get information into the hands of the public.

2. Progressive Media Outlet

Amidst the stressful conditions everyone in the San Diego area was experiencing during the wildfires, KPBS staff was hard at work trying to facilitate interactive situational information for citizens. The next section of this case study draws upon information gathered from an interview with three members of the KPBS team responsible for setting up the new technologies recognized as being wildly successful during the fires. The remaining portion of this chapter includes detailed information gained from Leng Caloh, Senior Online Managing Editor (at the time); Joe Spurr, Web Developer; and Nathan Gibbs, Web Producer.

a. Strained by Demand

When she first heard about the fires, Leng Caloh and other staff began prepping the KPBS web site for content when she determined that she needed more than just text. Since Caloh did not have a graphic designer on staff, she decided to use a Google Map embedded on the site to add a visual element. The next day when the wildfires really began to take off, KPBS, and other local media, experienced a huge surge of traffic hitting their web site as citizens hunted for information. Citizens were not relying just on TV or radio; they were seeking information from the Internet. According to Nathan Gibbs, the heavy demand clogged the KPBS web site and overloaded the server making updates impossible and rendering the web site useless.

Everything went down on the site including RSS feed capabilities (the ability to aggregate content automatically from known sources). The KPBS team scrambled to fix the problem by switching over to a temporary domain with higher bandwidth capabilities. The strategy worked to revive the web site, but high volumes persisted, estimated at 36 times the normal traffic. KPBS had been “playing around with Twitter” for a few weeks prior to the wildfires, mostly between staff members, and they had done a previous project using Google Maps. This small taste of the unique capabilities of these tools provided the incentive KPBS needed to consider using them as a key part of its strategy

during the fires. It became clear to Caloh that Twitter messages and Flickr photos generated by the public, and interactive maps showing the location of the fires, would be the most valuable information.

Google's My Maps capability functioned as a mashup with icons that provided greater context and the ability to get a quick overview of what was happening in a particular neighborhood. Spurr admitted that KPBS pushed the limits with the interactive map during the wildfires. "I don't think anybody else went as crazy with as many icons as we did. We helped develop it a little bit." A Google staff member came to the KPBS station and Google was able to add some new features that were under development, but not yet released, such as the time stamp feature.

Another critical move to handle the volume was directing people straight to Google for the interactive map. This tactic worked well since Google's web site was functioning and able to handle the traffic, rather than tying up the limited server resources on KPBS. The capacity to keep the web site up and running amidst the high demand stabilized and the KPBS team focused on facilitating the public's information needs using new media sources. In a continued effort to conserve bandwidth, Caloh, Gibbs and Spurr set up a Twitter account for KPBS and added RSS Twitter and Flickr feeds to the web site.

b. Unique Characteristics of Interactive Vehicles

People live busy lives and want information at their fingertips. They do not have the patience to sit idle and wait to hear something that applies to them. KPBS Web Developer Joe Spurr described another dimension of why information via the Internet was so critical. The Internet and social networking sites provide more flexibility than traditional sources for emergency information. The Internet provides a searchable, customizable mechanism for the user. "There are so many little fragments of information and TV or radio cannot convey it all at once. It was unique that we could fill the bucket with these fragments and could work with a variety of formats," explained Spurr. Twitter proved to be an

appropriate medium since it generated small contextual updates to existing stories. From a workflow perspective, the RSS Twitter feed made perfect sense since it did a lot of the footwork keeping the public informed.

As a media outlet tasked with informing citizens, KPBS recognized the shift in how people wanted to get information. People wanted real time updates and the ability to generate the topic from their end. Web Developer Nathan Gibbs described a realistic scenario during the wildfires that demonstrated this concept. Since so much of the area was on fire, people could have easily driven into a dangerous location. If they stopped and turned on the radio to find out if the area was safe, the chances were slim that the station would be talking about that particular area at that exact moment. Using Twitter, on the other hand, someone could send an inquiry and receive a quick response back that could improve their ability to make good decisions and lessen the risks to life safety issues.

The KPBS team described the public's information needs as primarily related to evacuation information, shelters, road closures, status of neighborhoods, and re-entry instructions. Gibbs recounted that the public would call in with information about closed roads, new evacuation zones, and churches that had opened their doors as shelters. When asked about whether or not that information was coming from local government, the KPBS team shared some insights about what worked well and what did not. The following section captures recommendations from KPBS.

F. LESSONS TO BE LEARNED

Traditional media will continue to play a large role in public information strategies that require effective partnerships with media outlets. A new dimension of information sharing with Web 2.0 technologies has crested the horizon. The Southern California wildfires case demonstrates the growing trend of citizens looking for ways to obtain and share information during an emergency through interactive forums. Local jurisdictions need to incorporate these methods into

their information sharing strategies in order to meet citizens' expectations. That will require an understanding of the shifting information needs, formats and time lines.

1. Coordination with Emergency Management Agencies

Since KPBS was covering the disaster as both a radio station and the leading online web site, their interaction with emergency management agencies provides a valuable perspective that blurs the line between traditional media and new media that includes Web 2.0 technologies. Given that so many people in Southern California, and across the country, crashed local media web sites searching for information, the Internet and interactive formats of information proved to be an integral part of managing the information needs of the public. This section captures the perspectives of KPBS staff that needed to receive information from official sources and effectively integrate it into Web 2.0 technologies. The need for local government agencies and media to collaborate during emergencies is not a new concept; however, the rules for how they collaborate need to change.

Leng Caloh described some level of frustration regarding the emergency management mindset that was too hesitant about sharing information, specifically some mapping data that San Diego State University's Homeland Security Program had available that displayed the heat intensity of the fires as a graphic Google Earth overlay. "I felt it would be really valuable information for the public, but they for some reason thought it would inspire panic or be too sensitive to release," said Caloh. "I didn't understand that at all because I thought it would actually be the opposite." Caloh described her desire to see official sources create and host the interactive real-time maps themselves, so media sources could just point people to them. She also advocated for collaboration with emergency service agencies in the newsroom by locating a PIO right there to vet the information and get it out more quickly.

The KPBS team provided the following advice in Figure 6 to emergency managers who want to work smoothly with media outlets using Web 2.0 technologies.

Lessons Learned and Advice from KPBS
Develop a crisis plan that describes the technology and recognizes the challenges such as server capacity and web site infrastructure. Have a flexible system in place and identify backup plans to address heavy demand.
Broaden the list of stakeholders to include resources who can help maintain and troubleshoot the technology.
Understand the technology. Hire young staff members and incorporate the technology into internal processes to become more familiar with it.
Build alliances with media ahead of time. Find out which outlets have staff to support Web 2.0 technologies – the chances are at least one media outlet will be receptive.
Keep information flowing and avoid periods of stagnation. Prioritize road closure maps in an evacuation scenario.
Share information quickly and engage with Web 2.0 technology experts and providers to develop and customize available tools.
Provide updates in easily editable text formats. KPBS found that PDF files of news releases clogged up email inboxes and created a tedious process to extract and post the information.
Set up RSS feeds from local emergency web sites so media outlets can pull content directly from official sources more efficiently.
Recognize the organic nature of social networking sites that will automatically taper off when the public's interest is shifting.
Do what serves your audience and your community best. Do what makes sense.

Figure 6. Lessons Learned and Advice from KPBS

2. Hybrid Approach

Online discussions boards or blogs, where citizens create their own dialogue during an emergency, have potential as well as risks. Blogs can be a viable mechanism to share information, collect feedback, and ascertain the needs and hardships a community is facing. KPBS has a blog dedicated to the topic of the week. During the wildfires, they posted questions such as what are your concerns about the fire and how is the fire affecting you? These simple questions sparked hundreds of responses from citizens asking for information about where they lived and what local services were available. The KPBS team sees a role for community discussion boards that can help populate a larger vetted discussion. Joe Spurr described his vision for a filtered hybrid approach where users talk to each other and generate raw data on one level, and the site owner places the best content in a more prominent location. This would provide information that is somewhat filtered for those looking for the information, while giving the user the option to drill down and contribute their own information.

The question of where to locate a web site that promotes emergency information using Web 2.0 technologies is a challenge. According to Leng Caloh, local government agencies should start by creating a blog and posting press releases in the blog. Then by providing a RSS feed to media outlets, the information would upload instantly to existing media web sites that citizens tend to rely on for the most current breaking news. Currently, Caloh finds that press releases or maps posted on local government web sites in PDF formats slow down the process and takes valuable time and resources to reconfigure for their purposes. During the wildfires, Gibbs described how satellite images from the forestry service were delayed for hours waiting for the data to be transferred into a PDF format by county agency staff.

G. CASE STUDY FINDINGS AND SUMMARY

The 2007 Southern California wildfires was a disaster that levied fear and destruction on citizens, businesses and government agencies in many communities. This case provides a real world example of how Web 2.0 technologies can engage citizens and help them attain the information they need.

1. Findings Relative to the Research Questions

The case study findings provide insights to the following subset of research questions.

- What positive attributes exist within Web 2.0 technologies that could improve information sharing?
- How have communities successfully applied Web 2.0 technologies during an emergency and what benefits were achieved?
- What limitations could prevent the use of Web 2.0 technologies by the public or government agencies during emergencies?

a. What Positive Attributes Exist within Web 2.0 Technologies?

Local government agencies in California focused their information sharing strategies on traditional media, which created gaps in getting timely information about specific neighborhoods. People frantically sought out additional information specific to their needs and engaged in interactive information sharing networks that included Web 2.0 technologies. Local radio station KPBS, broke the mold and implemented progressive social networking technologies to meet the following needs citizens were seeking.

(1) Community Based Information. Citizens sought after information that was specific to their own circumstances. They did not want to wade through volumes of information about other jurisdictions. They wanted to drill down to find out what was happening in their neighborhood.

(2) Interactive. Citizens wanted the flexibility to contribute their own information and to interact with others who were in the same boat. Social networking systems through Twitter and Flickr provided citizens, businesses, and media with the ability to interact and share information about service outages, which stores were open, and limitations of supplies. It also gave people the opportunity to share their stories and offer psychological support.

(3) Greater Context. Citizens flocked to visual information sources such as the interactive Google map and digital photos that helped provide a more comprehensive understanding of the scale and severity of the disaster.

b. How Have Communities Successfully Applied Web 2.0 Technologies during an Emergency?

Local radio station KPBS broke the mold and implemented progressive social networking technologies into their information sharing strategy. The experiences shared by KPBS highlights how valuable Web 2.0 technologies can be during an emergency. Recognizing the limitations of traditional media is a starting point. Other key findings for successful implementation of Web 2.0 technologies include:

- Developing a crisis plan that includes quick, flexible and interactive information sharing strategies.
- Building relationships with media outlets that can serve as conduits for Web 2.0 technologies.
- Cultivating people within the organization who possess knowledge and expertise with online social networking.

c. What Limitations could Prevent the Use of Web 2.0 Technologies by the Public during an Emergency?

The key finding from the case study applicable to this research question is that organizations need to build the Web 2.0 systems and infrastructure ahead of time to handle high volume traffic. KPBS found that once the disaster hit, there was no easing into the incident. The information needs

were immediate and the volume of people searching for neighborhood specific information via the Google map crashed their web site. Therefore, any organization that plans to use Web 2.0 technologies during emergencies would benefit from having technology infrastructure in place that can handle a high volume of traffic prior to an incident.

2. Summary

When the Southern California wildfires sparked out of control, San Diego residents clamored for interactive information and found it anywhere they could. The findings from this case study provide local government agencies with options and advice on how they might be able to use Web 2.0 technologies successfully in their own jurisdictions.

Those who have seen and experienced the power of interactive emergency information are eager to see others adopt the same philosophy. “Hopefully government agencies will hire people into emergency management positions who are in to this sort of thing [social networking],” said Joe Spurr. “I see this technology as big as the printing press in terms of human development. It’s going to catch on.”

The next chapter of this thesis addresses research questions related to the value emergency managers place on information sharing, the type of information the public may be able to provide, and the criteria of an effective information sharing strategy from the emergency management community’s perspective.

VI. STAKEHOLDER INTERVIEW ANALYSIS AND FINDINGS

The Southern California case study illustrates the potential benefits to the public when they have opportunities to participate and interact with others during the stressful events of an emergency. Other potential benefits of citizen engagement and interactive information sharing are quicker access to information and increased situational awareness from a responder's or emergency manager's perspective. This chapter addresses the following specific research questions through analysis of interviews with stakeholders:

- *What type of information do citizens need during emergencies?*
- *What criteria do emergency managers value regarding communications effectiveness?*
- *What content might citizens be able to provide that would prove valuable to emergency managers?*
- *What positive attributes exist within Web 2.0 technologies that could improve information sharing?*
- *What limitations could prevent the use of Web 2.0 technologies by the public or government agencies during emergencies?*

A. STAKEHOLDER SELECTION

The following sections describe the characteristics of the interviewees and their thoughts related to the research questions. The interview sample focused on individuals with an interest in effective emergency information sharing strategies. The researcher conducted interviews with nine individuals from six local and state jurisdictions. Some of the interviewees were familiar with Web 2.0 technologies and others were not. The stakeholder sample represents the type of individuals who need to support emergency information strategies due to their decision-making roles and influence in strategy development.

The selected interview participants have many years of experience managing emergencies and the information needs that accompany extreme events. The jurisdictions represented in the sample have dealt with a wide variety

of disasters including severe flooding and windstorms, a terrorist bombing, tornadoes, hurricanes, a major bridge collapse, extreme chemical fires, massive wild fires and snowstorms. Each participant's experiences provided the context to anticipate the practical application of a new approach to information sharing and hence, colored their responses.

1. Participant Occupations

The stakeholders interviewed represent those with a high level of interest and influence in the proposed strategy of using interactive information sharing systems. The participant occupations include:

- **Emergency Managers** – Incident Commanders or Emergency Operations Center (EOC) managers who make the final determination before they approve and release messages to citizens during emergencies and who might benefit from receiving status reports from citizens for improved situational awareness.
- **Public Information Officers** – Public Information Officers (PIOs) or Public Affairs staff are stakeholders due to their role and expertise in constructing and disseminating emergency messages to the public.
- **Information Technology Managers** – Information Technology (IT) Managers are stakeholders due to their subject matter expertise and the importance of obtaining their support for successful implementation of new technologies.

These three stakeholder occupations represent the targeted participants the researcher focused on for this phase of the research. More details about the stakeholder analysis are included in Chapter VIII.

2. Limitations

The participants cover all three occupation categories listed above, but not equally. Five of the participants were EOC managers; three were communication managers/PIOs; and one participant was an IT manager. The participant's occupation and relative decision-making experience during emergencies influenced their perspectives and contributions to the overall discussion and

answers to the research questions. The researcher purposely focused the interviews primarily on the decision-making authority of the EOC managers, but recognized the valuable perspectives of other stakeholders. To provide clarity and accommodate for the weighted participant selection, the graphs in this chapter layer the data according to interviewee contributions by occupation.

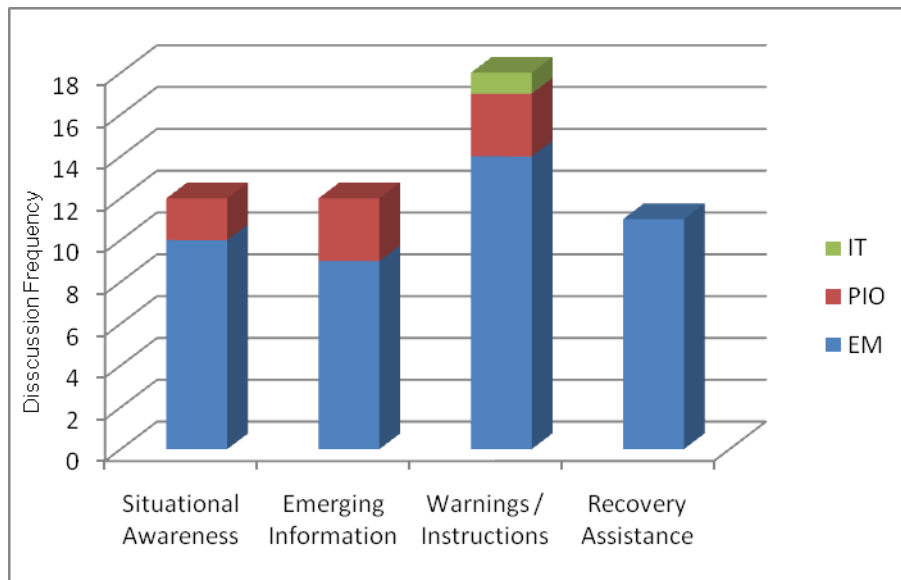
3. Content Analysis Graphs

The participants answered open-ended questions and customized follow up questions. The emerging dialogue followed the path set by the interviewees. The graphs on the following pages provide a visual display of the topics most frequently discussed by the interviewees. This semi-structured approach and analysis provides insight to challenges of managing information flow during emergencies and the interests, concerns, and in some cases, misperceptions about Web 2.0 technologies.

B. WHAT TYPE OF INFORMATION DO CITIZENS NEED?

Participants discussed the public information needs they focus on during an emergency. The categories of information described by participants were consistent with those outlined in Chapter II: situational awareness, emergency information, warnings and instructions, and recover assistance.

Table 1. Categories of Emergency Information



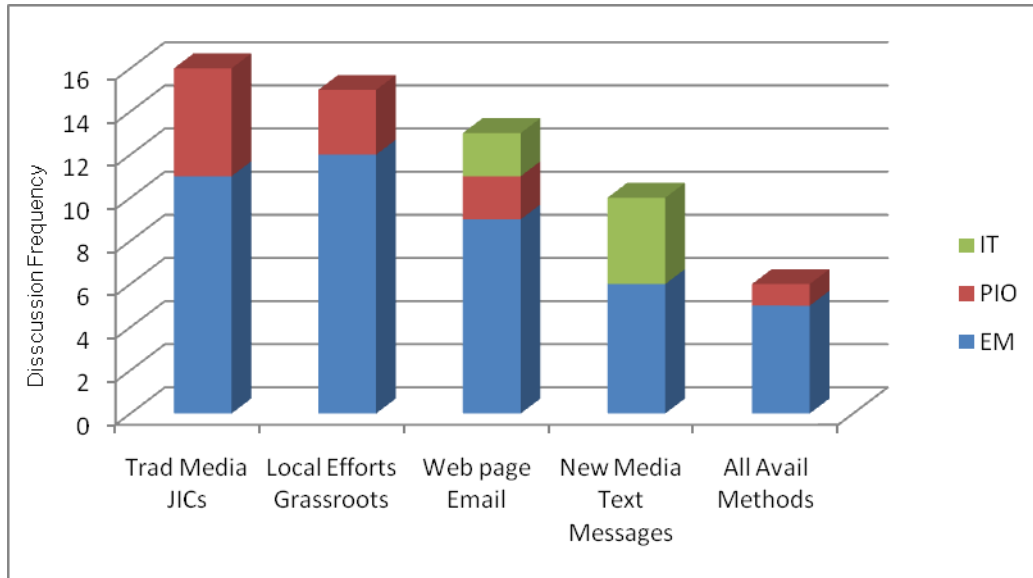
While all participants acknowledged the importance of quickly disseminating life safety warnings and instructions, the participants from local jurisdictions shared specific examples of why this type of information is so critical. According to Bill Anderson, Emergency Management Coordinator for the City of Minneapolis, scenarios such as a chemical spill might require critical life safety strategies for impacted citizens. Anderson described the potential confusion resulting from a chemical spill if citizens are not clear about whether they should evacuate or shelter in place (Interview, City of Minneapolis, Division of Emergency Management, 2008). Sharing this type of warning and instruction information is a primary goal of the emergency management community.

C. EMERGENCY INFORMATION SHARING METHODS

The specific methods used by participants converged in the frequent use of traditional media outlets such as TV, radio, newspapers, and Joint Information Centers (JICs). Some jurisdictions structure their information sharing strategies heavily on providing hourly media briefings, press releases and regular daily situation updates. After they provide media updates, some jurisdictions refocus

their efforts to response, leaving the information sharing up to the media outlets. The following chart depicts the frequency that participants discussed various types of methods they use or would consider using to share information with the public.

Table 2. Emergency Information Sharing Methods



1. Allure of Traditional Media

When a disaster is approaching, participants mentioned the importance of advanced information and how they use local television and radio stations. Traditional media has the resources necessary to provide a centralized distribution network that takes some off the burden off emergency managers. Once the disaster has hit or already passed, participants regularly establish a JIC to be the liaison between the media and the EOC. JICs also focus on coordinating messages with neighboring jurisdictions and agencies, and keeping political appointees apprised.

2. Grassroots Efforts

Participants mentioned the value of localized grassroots efforts, such as community meetings, local organizations (i.e., faith based), community outreach offices, and door-to-door warnings for evacuations. These methods provide interactive information exchange and help emergency managers gain feedback from the community. The downside to these methods is that the reach is limited since it is so labor intensive at a time when information needs are high and resources are low. According to John Buchanan, a PIO involved in the Southern California wild fires, the grassroots strategies of door-to-door evacuation warnings and face-to-face daily briefings at various shelters were an effective method of interactive communication, but they created a strain on limited resources and were not sustainable until reinforcements arrived through mutual aid (Interview, North County Fire District, San Diego County, CA, 2008).

3. Emerging Media Recognition

In Florida, the State is blending traditional media strategies with web coverage and is experimenting with Web 2.0 technologies. “During a disaster, our web site is the primary means for information sharing and we back that up with a lot of live press conferences,” said Florida State Emergency Management Director Craig Fugate. “We also shoot a lot of videos and can pop up a digital briefing pretty quickly.” Florida just started producing a daily video situation report posted on Youtube that provides a quick snapshot of daily operations, statewide weather reports and hazardous conditions (C. Fugate, Interview, Florida State Department of Emergency Management, 2008).

Participants who are less familiar with social networking technology recognized the value of citizen feedback to help guide their decisions. Oklahoma Department of Emergency Management Director Albert Ashwood described how his agency tries to match up resources with the greatest need. “Any method we can use to get that information is important. That tells us where the true need is

and where we can place our resources,” said Ashwood. “That is going to help us respond to the situation” (A. Ashwood, Interview with Oklahoma Department of Emergency Management, 2008).

D. WHAT TYPE OF CRITERIA DO EMERGENCY MANAGERS VALUE?

The participants agreed that getting information out quickly is a high priority. Some participants felt that information always changes as the situation develops and that each message needs to include a disclaimer that “this is what we know at this time.” Others felt that the accuracy of official information was just as important if not more. Most participants acknowledged that inviting interactive info sharing would create some mixed messages.

When it came to discussing the topic of control over situational awareness information, the participants voiced different opinions. For example, some participants commented that situational awareness develops over time and that even the emergency information released from official sources may change dramatically from the first hour through the course of the incident. Other participants felt that the information accuracy was the utmost concern. One participant felt strongly that those responsible for managing emergencies needed to be in control of the messages that fall into the hands of the public and expressed a high level of concern about the potential consequences of misinformation.

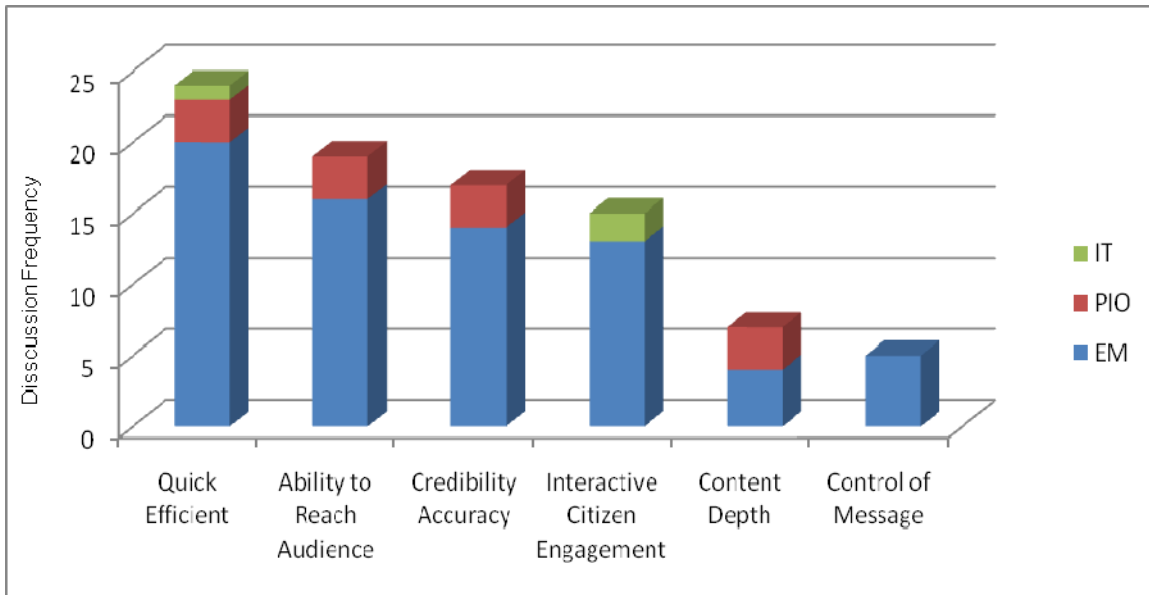
A frequent criterion mentioned by participants was the ability to reach the affected audience. This criterion was two-fold, in which the mechanism first must actually be viable and functioning following the incident. The second factor is how well the mechanism can reach people when and where they are. For example, if the power is out in a widespread area, many people will not be able to access TV, radio or Internet news reports, however, they may be able to receive text messages. When all available mechanisms are functioning, a different perspective of this same criterion is whether citizens are sitting in front of a TV when a disaster strikes and able to catch a breaking news report or an

emergency broadcast alert. One participant mentioned the importance of reaching citizens who are out shopping or on the golf course when a disaster strikes. According to Bill Anderson, the ability to reach those citizens might match up better with messages sent via Twitter through cell phones they carry with them all the time (Interview, City of Minneapolis, Division of Emergency Management, 2008).

Several participants mentioned the importance of layering communication messages through multiple mechanisms to reach a wide audience. Doug Hoell, Director of North Carolina Division of Emergency Management offered his perspective on combining approaches to get the word out. "There is a lot of networking among people out there," said Hoell. "We have to do the best job we can to get information into their hands and trust that people are willing to fan the message out to others, whether it is by text messaging, telephone or simply walking next door to the neighbor's house" (D. Hoell, P. Farmer, C. Benton, & M. Montague, Interview, North Carolina Division of Emergency Management, 2008). The trust factor between civilians and the emergency management community is an area that participants voiced divergent opinions.

One participant mentioned his concern about diverting precious resources to monitoring messages from civilians. "I don't want to spend all my time doing rumor control just because we have established some sort of a system where we are constantly fighting people who are sharing bad information." In contrast, another participant felt that the public is actually faster, more responsive and has more accurate information than government. "I like to hear from the people standing in their front yard saying the F18 just hit. They are the ones with real situational awareness."

Table 3. Criteria for Effective Information Sharing



PIOs weighed in on the importance of content that provides depth to ensure the audience is able to retrieve the specific information they are seeking. EOC managers and the IT manager espoused the importance of interacting with citizens and the ability to get direct feedback and situational knowledge from their perspective using available sources of information. Craig Fugate recounted his experience related to limited availability of communication infrastructure. “Following Hurricane Katrina so many of the communication links were badly damaged or overloaded in New Orleans that you couldn’t get a cell phone call through, but you could still text message.” Fugate advocated for pulling in status reports from responders, citizens, media footage, and all available resources (C. Fugate, Interview, Florida State Department of Emergency Management, 2008).

Those interviewed mentioned the strong likelihood that the public will be involved in initial response activities following a disaster. Speaking from direct experience in Minneapolis where the I35 Bridge collapsed in 2007, Bill Anderson recounts how citizens acted as emergency responders to pull people out of the Mississippi River. “There were some real accounts of heroism to get people out

of very steep gorges and deep water,” said Anderson. “It was done by first responders and civilians” (Interview, City of Minneapolis, Division of Emergency Management, 2008). Recognizing that civilians can and do save lives during emergencies tied into some participants beliefs that they can also provide valuable situational information. Craig Fugate shared his perspective on the topic of citizens’ abilities to aid the emergency management community.

Unfortunately, the tendency of emergency managers is to look at the public as not being a reliable source and treating them as suspect. We shut off all that information from the public, even though they were there and they can tell us what is going on. Yeah, there may be some bad information, but how often do we have our own people in the business who come back with wrong information about something because they did not quite understand what they were looking at? If we get many similar reports coming in from the public, we get a sense of what is going on and we can start using that information and make some decisions faster. (C. Fugate, Interview, Florida State Department of Emergency Management, 2008)

E. PROS AND CONS OF WEB 2.0 TECHNOLOGIES FOR EMERGENCIES

People often assess new strategies that challenge conventional wisdom with a high level of scrutiny. Exploring the potential use of social networking and other Web 2.0 technologies brought up positive and negative connotations from the interview participants. While some participants did not understand the term Web 2.0 technologies at first, all of them recognized the increasing role new media would play in the future. Some participants expressed a desire to move forward and begin implementing some Web 2.0 tactics, while others felt it was too soon. The researcher questioned the participants further to understand their divergent opinions about the positive attributes that might inspire them to consider adding Web 2.0 technologies to their toolkit and the challenges that might prevent them from implementing the new tools.

1. What Positive Attributes Exist within Web 2.0 Technologies?

The participants shared their opinions about the perceived benefits of Web 2.0 technologies. The participants with less familiarity with wikis, blogs, mashups and text messaging did not contribute as much to this part of the discussion, however, they did identify the area of interactive, real time dialogue as being a positive attribute for application within an emergency management setting.

a. Interactive Dialogue

Participants frequently discussed the pros of interactive dialogue made possible from use of social networking technology. Participants specifically mentioned the benefits of gaining situational updates from citizens via Twitter, digital photos and videos. EOC managers discussed the advantages of being able to see the incident through the eyes of citizens who are first on the scene or who might be in a remote or isolated location. They acknowledged the widespread use of cell phones and the power of capturing and sharing visual data quickly for improved situational awareness.

Response Section Manager of the Washington State Emergency Management Division, Paul McNeil, explained how he perceives the value of real time information exchange from photos or videos captured at the scene from a passerby. "It has great value and great utility because you are getting it right from where the rubber meets the road," said McNeil. "We need to know about what is going on as soon as we can to guide decisions about how we are going to respond and what support the locals are going to need from us" (P. McNeil, Interview, Washington State Emergency Management Division, 2008).

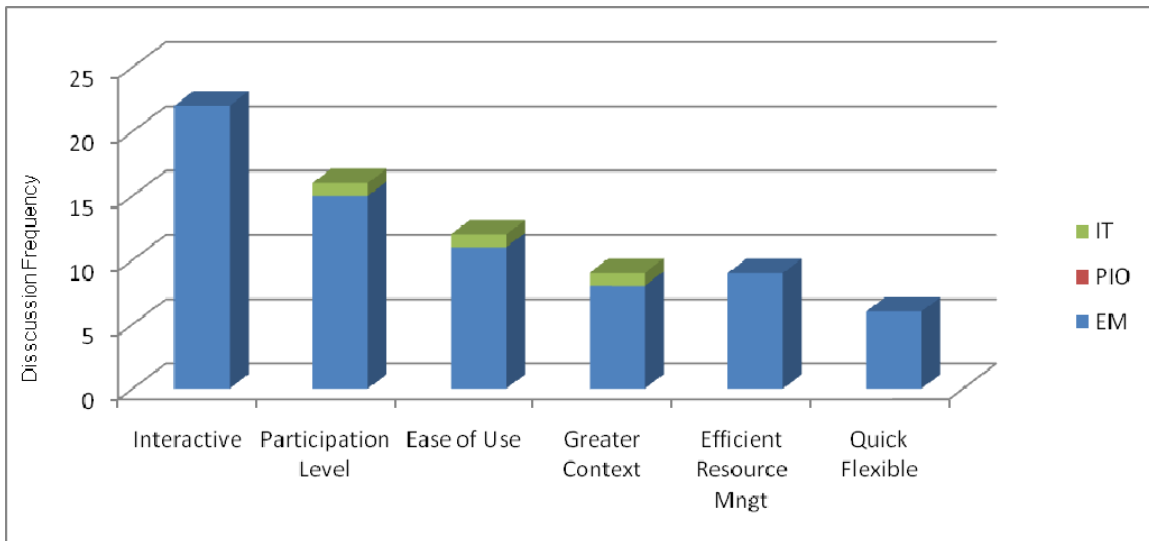
The concept of inviting the public to contribute their situational knowledge directly to those managing response activities is a relatively new territory for emergency managers. Most participants recognized that text messaging systems such as Twitter hold a lot of promise since it could facilitate instant warnings and instructions to members of the public who have cell phones

with them regardless of where they are. Participants mentioned the value of layering communication strategies and using a combination of tools to send out life safety messages.

b. Citizen Participation Levels

A topic that several participants felt was an important benefit of Web 2.0 technologies is the ability to reach younger audiences. Bill Anderson frequently works with Minneapolis public schools providing information about school security, safety and emergency preparedness. He discussed his perception that much of the reason the emergency management community needs to adopt Web 2.0 technologies is to reach across the generational divide. “Social networking is a very big deal with young people,” said Anderson. “People under 25 practically live on Facebook and YouTube. But, if you ask a 50-year old about Facebook, they think it’s something on the New York Times bestseller list.” Anderson believes that citizens’ use of social networking technologies will increase and the public will expect government agencies to follow suit. Currently, the City of Minneapolis is seriously considering how to incorporate Web 2.0 technologies into its communication strategies. “We in the public sector need to be aware of the technologies, of how to utilize them, and how to get accurate information out through them, because ignoring them is no longer an option” (Bill Anderson, Interview, City of Minneapolis, Division of Emergency Management, 2008).

Table 4. Positive Attributes of Web 2.0 Technologies



c. Ease of Use

Many participants mentioned that a criterion that would inspire them to consider using new technologies is ease of use and adaptability. “It would have to be something that is easily adaptable and that people could pick up and learn fairly quickly,” said Pete Farmer, Information Technology Manager for North Carolina Division of Emergency Management (D. Hoell, P. Farmer, C. Benton, & M. Montague, Interview, North Carolina Division of Emergency Management, 2008). Those participants familiar with text messaging and RSS feeds, pointed out that the technologies provided a streamlined process to get information out to citizens. Some participants specifically mentioned the value of text messaging in the context of a school shooting such as the Virginia Tech incident in 2007, because texting is fast, quiet and discrete.

d. Other Benefits

Other positive qualities that might inspire participants to consider using Web 2.0 technologies included greater context afforded through visual data and multiple perspectives; the ability to decipher where the greatest needs are and hence allocate resources more efficiently; and mechanisms that are quick and flexible.

2. What Limitations Could Prevent the Use of Web 2.0 Technologies?

When it came to discussing what if any obstacles exist within their own organizations or within the community at large, participants identified a common set of challenges that were consistent across the board. Some participants spoke about the challenges as if they were deal breakers, while other participants were more optimistic that jurisdictions could overcome the implementation barriers.

a. Lack of Resources

Overwhelmingly, participants most frequently discussed their concerns about lack of resources to integrate Web 2.0 technologies effectively into existing information sharing strategies. Participants mentioned two types of resource challenges:

- Staff limitations and difficulty monitoring and responding adequately to interactive information requests
- Cost barriers and funding limitations to build the networks, systems and infrastructure

Albert Ashwood described his perceptions about resource limitations. “When you are working a 24/7 disaster operation, it’s all about manpower,” said Ashwood. “We have to set up a Joint Information Center; take information in from local entities and the general public; develop twice a day briefings; organize press conferences; conduct radio and TV interviews and everything else that goes with that. Where do I find the people to sit online and

do the blogs and Twitter?” (A. Ashwood, Interview with Oklahoma Department of Emergency Management, 2008). Paul offered his opinion on implementing Web 2.0 technologies. “It is a very interesting concept,” said McNeil. “I know it is coming and I’m not going to be resistant. There’s just no time or money to figure out how” (P. McNeil, Interview, Washington State Emergency Management Division, 2008).

b. Lack of Trust with the Tools and Content

Several participants mentioned implementation barriers and concerns related to a lack of trust about the tools and a hesitancy to jump on board too quickly. Some participants mentioned the need to think through the process before implementing new technologies. Albert Ashwood recognized that the emergency management community is probably lagging behind the technology, but shared his thoughts about implementation. “We can’t be too quick to run out and say this is the greatest thing, let’s turn it on and go for it, unless we know what the expectations are and we can manage those expectations,” said Ashwood. “If you tell people all these avenues are open they will expect a response from you. And you better be able to provide it” (A. Ashwood, Interview with Oklahoma Department of Emergency Management, 2008).

As referenced earlier in this chapter, the importance participants placed on accuracy is a concern that could prevent some jurisdictions from implementing social networking technologies. Many participants echoed the concern about the potential for inaccurate content and identified the need to monitor and mitigate the impacts of misinformation.

c. Unfamiliar with Technology and Lack of Support from Leadership

Several of the participants have not used Web 2.0 technologies at home or at work and admitted they were not familiar with the terminology or

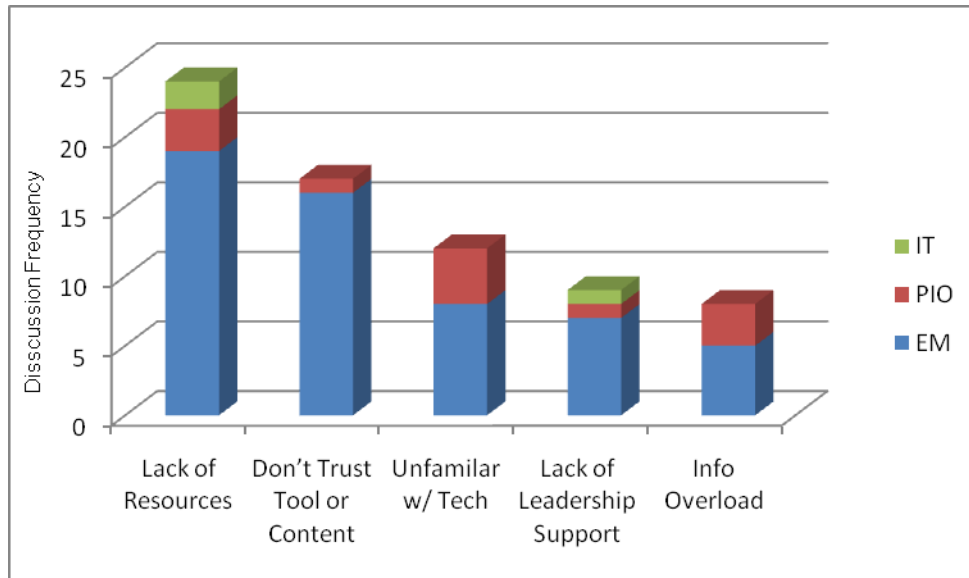
processes. Other participants were aware of the technologies from a social perspective and have used them on their own personal time. One participant has been advocating and using Twitter for internal communications, but has met with resistance from staff who are unfamiliar with the technology. Another challenge identified by participants is getting support from IT professionals who have concerns about the security aspect and potential instability problems of new applications. Participants also mentioned the obstacle of gaining support from leadership who are not familiar with the technology and who do not understand the value it could bring to their jurisdiction during an emergency.

d. Information Overload

Emergency Operation Center staff handle a large volume of information streaming in from multiple disciplines such as fire, police, service providers, hospitals, roads, weather services, GIS, and media. The idea of adding the public to the mix and generating more information sparked concern from several participants. Some participants felt the size and breadth of the incident would magnify the volume of information and in some cases could be overwhelming and therefore would not add value. Craig Fugate offered a potential strategy to overcome this challenge.

The scale of a major earthquake or hurricane could lead to hundreds of thousands of people trying to send us information. We need to get smart about using search and monitoring capabilities to see what is already posted and then sample it like statistical analysis. I don't have to see everybody's information coming out of an area. If I can see three to five percent of it, I have a pretty good idea of what's going on. I don't have to look at every single picture that is posted to see a trend developing. (C. Fugate, Interview, Florida State Department of Emergency Management, 2008)

Table 5. Web 2.0 Technology Implementation Limitations



F. SUMMARY OF RESEARCH FINDINGS FROM INTERVIEWS

The interview process revealed answers to several of the secondary research questions; however, it also provided some unexpected insights related to Web 2.0 technologies. The researcher found that while only one jurisdiction is actively using Web 2.0 technologies, the topic was of interest to all the participants. Participants were eager to engage in dialogue about the technology and its untapped potential. Several jurisdictions indicated that they are looking for new ideas and a better understanding of **how** to implement social networking tools. The interview participants provided specific insights to their feelings and perceptions towards the following research questions.

1. What Type of Information do Citizens Need?

The participants confirmed that there are four categories of emergency information: Situational Awareness, Emerging Information, Expert Knowledge and Advice [Warnings and Instructions], and Recovery Assistance. The interviewees placed an emphasis on the importance of warnings and instructions (i.e., expert knowledge and advice.)

2. What Criteria do Emergency Managers Value Regarding Communication Effectiveness?

The participants identified the following criteria as being important aspects when selecting an information sharing strategy: citizens' ability to receive quick access to information; the ability for emergency managers to reach the intended audience; the accuracy and credibility of the message delivered; citizen engagement via interactive methods that yield feedback; and depth of content to provide details about specific neighborhoods.

3. What Valuable Content Might Citizens be Able to Provide?

The participants felt that the citizens might have specific situational information about their own neighborhoods much more quickly than emergency responders might. Participants also recognized that citizens could provide feedback about the hardships they are facing and needs they have, which in turn, might improve resource allocation decisions.

4. What Positive Attributes Exist within Web 2.0 Technologies that could Improve Information Sharing?

The participants identified the following positive attributes that would inspire them to consider incorporating Web 2.0 technologies into their information sharing strategies: interactive; high participation levels, ease of use, greater context and use of visual data, ability to guide resource allocation decisions, quick, and flexible.

5. What Limitations could Prevent the Use of Web 2.0 Technologies by Government Agencies?

The participants overwhelmingly identified lack of resources as being the number one limitation of implementing Web 2.0 technologies. Adding Web 2.0 technologies was only considered a benefit if it was added to existing methods not as a replacement; therefore, new resources would need to be identified to support the new strategy rather than diverting existing resources from other

tasks. Other limitations the participants identified included: lack of trust in the technology and the content; lack of familiarity with the technology; lack of support from leadership; and concern over information overload.

A key finding of the interviews and an area of common agreement was the concern about lack of resources. This provides the ability to narrow in on a potential solution to answer the primary research question.

G. SUMMARY

Some of the interview participants shared details about how they are already experimenting with Web 2.0 technologies and the strategies they have been using to overcome implementation barriers. The participants also provided insights as to why the emergency management community is lagging behind in using Web 2.0 technologies and their concerns about managing volumes of information that may not be accurate. The findings from the stakeholder interviews help fill in the blanks to the primary research question: *How can local and state governments leverage Web 2.0 technologies to share information and engage with citizens during and following an emergency?*

For example, interview participant feedback revealed perceived operational challenges related to information overload. Their insights helped identify a strategic implementation gap. Jurisdictions will likely be more successful in leveraging Web 2.0 technologies when they fully understand how important it is for their agency to secure new staff resources to handle the increased need for effective information management.

The next chapter ties together the research findings from literature, the Southern California Wild Fire case study, and the interviews and it identifies the challenges that local jurisdictions should anticipate when considering implementing Web 2.0 technologies.

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VII. FINDINGS AND CONCLUSION

This thesis has reviewed literature, examined an in-depth case study, and analyzed the thoughts and observations of a number of different stakeholders regarding the effectiveness of citizen engagement via Web 2.0 technologies during an emergency.

A. SUMMARY OF FINDINGS

1. Findings from the Literature Review

The literature review identified the importance of information during emergencies and broke down the types of emergency information into four categories. It also revealed that the current practice of emergency information sharing focuses on one-way communication vehicles and identified the benefits of dynamic and interactive information sharing strategies. It also presented the expanding trend of the public turning to social networking sites for their instant information needs.

Another finding that emerged from the literature review is the beneficial role interactive information exchange can play in coping mechanisms. People who engage in dialogue, turn to others for support, and fulfill the urge to get involved in the solution are all forms of active coping that can help survivors through the psychological impacts of the recovery process.

Literature also identified several examples of how private citizens are using Web 2.0 technologies via peer-to-peer communication to gain information following an emergency.

2. Findings from the Case Study

The Southern California wildfires case study revealed that the public wants specific information tailored for their neighborhood. It identified the

information challenges that existed during a disaster that evolving over an extended period. It confirmed the literature findings about the public's needs for emergency information and which types.

The case study identified the positive attributes of Web 2.0 technologies and presented successful examples of how KPBS used them to aid in sharing information with the community. Other findings included the limitations of Web 2.0 technologies and lessons learned from KPBS's experience.

3. Findings from Interviews

The interviews from stakeholders brought light to the opinions and perceptions of emergency managers, PIOs and an IT manager. Their responses and dialogue about the potential of Web 2.0 technologies indicates that there is a lot of interest from the homeland security and emergency management community. The interviews confirmed previous findings about the information needs of the public and provided consistent findings about the categories of emergency information.

The interview findings identified the criteria used by emergency managers regarding communication effectiveness and provided insights on the value of content citizens might be able to provide during an emergency. It also revealed the participants opinions about the positive attributes of Web 2.0 technologies such as being interactive, having a high participation level, and its ability to guide resource allocation decisions with quicker access to situational information. Findings from interviews also pinpointed the limitations that could prevent jurisdictions from implementing Web 2.0 technologies, most notably, due to a lack of resources.

B. SPECIFIC FINDINGS

This research provided examples of how Web 2.0 technologies are suited for emergencies, an analysis of the potential benefits, and identification of the challenges agencies may encounter. It highlights the value of citizen engagement and interactive dialogue derived from Web 2.0 technologies for information sharing during emergencies.

1. Web 2.0 Technologies can Enhance Traditional Media Strategies

Web 2.0 technologies can provide a venue for citizens who need to access information specific to their own neighborhood. When emergencies or disasters impact residents spread across multiple communities, traditional media outlets do not provide information in a searchable format. This creates challenges in matching up information needs with information sources. Web 2.0 technologies such as mashup maps allow citizens the ability to find localized information to meet their specific requirements. Citizens used the Google map created by KPBS to gain neighborhood specific information and stakeholder interview participants confirmed that one of the positive attributes of Web 2.0 technologies is greater context and use of visual data, especially detailed information by neighborhoods.

Web 2.0 technologies provide an additional information source that can improve the timeliness and access to emergency information thereby increasing citizens' and emergency managers' situational awareness and improve the ability of emergency managers to quickly share warnings and provide life safety instructions to the impacted public.

2. Web 2.0 Technologies Engage Citizens Interactively

The literature reviewed in this thesis and the case study confirms that emergencies create stressful environments in which survivors can benefit from information exchange as a coping mechanism. Use of Web 2.0 technologies,

specifically, in the form of Twitter, blogs, wikis, and other social networking sites, provide quick and interactive mechanisms that enable citizens to share their own experiences and information with a broad audience.

The case study research and the stakeholder interviews establish a consistent revelation that the public participation level of Web 2.0 technologies is growing at a fast pace, especially with younger generations. The public will increasingly expect government agencies to adopt the new media tools that they are using regularly. Local governments may find it beneficial to adapt to the trends and focus on building public trust and engaging with citizens on their terms.

Local jurisdictions that are interested in citizen engagement and real time feedback to improve their understanding of the community's emergency needs may find Web 2.0 technologies beneficial. Stakeholder interview participants confirmed that obtaining on-scene reports from residents could help guide resource allocation decisions and provide improved situational awareness by obtaining direct feedback from a broad community of people who regularly use Web 2.0 technologies.

3. Organizations Need Resources to Promote, Develop, Implement and Manage Web 2.0 Technologies

The case study and the stakeholder interviews revealed that key resources are integral in successful deployment of Web 2.0 technologies. Interview participants discussed their perception that their colleagues or they themselves do not understand what Web 2.0 technologies are, let alone how they can incorporate them within their own organizations. Participants described the importance of getting decision-makers to recognize the value of the technologies before requesting support for initiatives with staff and funding to develop them. Findings from the case study specific to KPBS's experience,

confirmed that the learning curve for an organization to implement an interactive information sharing strategy can be steep and that it likely will take time to develop.

Emergency managers frequently mentioned resource limitations as an obstacle that might prevent local or state jurisdictions from implementing Web 2.0 technologies. Challenges cited by interview participants included: lack of expertise; lack of technology infrastructure; lack of funding due to economic pressures; and lack of staff needed to monitor and manage the technology during an emergency.

C. CHALLENGES TO OVERCOME

1. Unfamiliar with Technology

Even though online social networking sites are gaining popularity at a rapid pace in social settings, the use of this new technology among homeland security disciplines is still in its infancy. As citizens gain experience using Web 2.0 technologies following emergencies, through the use of web-based applications that are compatible with cell phones, such as Twitter and Flickr, the expectation for government entities to adopt these technologies might increase. Local jurisdictions that recognize the value of Web 2.0 technologies need a champion within the organization who provides the necessary leadership and guidance to overcome the hesitation of decision-makers.

2. Fear of Mixed Messages and Loss of Control

Some stakeholder participants voiced their concerns about misinformation that could result from the public having the ability to contribute content to emergency information sharing systems. If local jurisdictions are seriously considering use of Web 2.0 technologies, they will need to let go of the desire to control the message one hundred percent of the time.

Local jurisdictions can still put out the official word on an emergency via traditional media and Web 2.0 technologies alike. The only difference is when using blogs, Twitter or other mechanisms that allow the public to contribute their own content, there inevitably will be information that emergency managers will not be able to verify or that may be inaccurate. Not all participants voiced concern about the fear of losing control of emergency messages disseminated to the public; however, all interviewees acknowledged that provisions should be in place to remove erroneous content.

3. Resource Limitations

The development of this thesis and the associated stakeholder interviews occurred during a period when our nation was facing one of the most significant financial crises in history. The anxiety levels of local and state leaders who are facing operational budget cuts and a general tightening of the belt are extremely high. Resource limitations in funding levels and staff availability place a strain on jurisdictions' willingness and abilities to launch new initiatives such as planning, developing, implementing and managing Web 2.0 technologies.

D. CONCLUSION: THE SHEER POSSIBILITIES

Many local governments today rely solely on traditional one-way approach to information sharing with the public. In an emergency, the stakes are high and every second counts because lives and property are on the line. Lack of information about the situation or understanding about where to go to for help and what actions or precautions citizens should take magnifies the fear and anxiety levels felt by survivors of large-scale events. People are increasingly turning to the Internet for information. Recovery efforts and requests for aid stretch beyond the reach of jurisdictional boundaries.

Accurate and expedient information sharing with the public is critical to citizens and local jurisdictions during emergency response and recovery. As such, strategies that leverage all resources and information interactively results in stronger communities that are more resilient and can bounce back quicker from a disaster.

A critical factor that has vast potential to save lives and limit property losses is situational knowledge. People need information about weather forecasts, health warnings and potential responder limitations in advance of an emergency to help prevent impacts and prepare for predictable consequences. They also need immediate access to information about damages and ongoing hazards following an emergency to understand how to protect themselves amidst emerging conditions, and to guide themselves on where to find the recovery assistance they need.

Web 2.0 technologies can facilitate situational awareness on multiple levels. Citizens can drill down to find the specific information they need, cell phone users can receive warnings and instructions instantly, and emergency managers can pull situational reports in from those on the front lines. The visual context and increased understanding afforded through tools such as mashups, wikis, digital photos and videos open up new channels of information exchange for the emergency management community.

Equally important, when providing outreach to the public, is the need to deliver messages via mechanisms people use on a daily basis. Social networking technologies are changing the way people gather and share information. Web 2.0 technologies offer more flexibility in the type and format of available content and can result in greater understanding of a subject. Social networking tools have been gaining popularity on the Internet in recent years and show great promise in the application of managing emergencies and citizen engagement. Failure to share information effectively may also contribute to loss of public trust and lack of confidence in government capabilities. Local government agencies tasked with emergency response need to adapt to the changing expectations of

the people they serve and the current environment of collaborative information sharing. As one government employee stated, John Anderton as quoted by Aliya Sternstein, when commenting on new technology tools for public information, “You do outreach to people where they are, not where you are” (Stenstein, 2005).

Taking the leap into an unfamiliar territory can be daunting. Local government agencies without experience using Web 2.0 technologies may opt to partner with local private sector entities or younger employees with more hands on experience to help guide them. In the end, the potential for Web 2.0 technologies to help local communities become more resilient during and immediately following emergencies is too great to ignore and too costly not to try.

E. FUTURE RESEARCH

The researcher has developed a strategy proposal that may provide a solution to how a local jurisdiction might be able to implement Web 2.0 technologies to engage with citizens for emergency information sharing. This strategy proposal can be found in Appendix A and it represents an area in which future research might focus on the applicability of the model in a real life case study of a jurisdiction seeking to implement Web 2.0 technologies.

Appendix B of this thesis provides more details in a systematic approach as a framework for an implementation plan. This step-by-step framework provides a possible roadmap for how a jurisdiction might be able to implement an interactive information sharing strategy that includes Web 2.0 technologies.

APPENDIX A.

A. STRATEGY PROPOSAL

The findings presented from this study confirm that Web 2.0 technologies can provide value to the public and the emergency management community as part of an interactive system for information sharing. The next section provides a strategy proposal that offers a potential strategy that addresses the primary research question:

How can local and state governments leverage Web 2.0 technologies to share information and engage with citizens during and following an emergency?

1. **Redefine Strategy for Effective Emergency Information Sharing**

It is important to recognize that effective information sharing during an emergency includes interactive citizen engagement. Once a jurisdiction recognizes the benefits of information exchange from multiple sources, it can turn the corner to create and embrace innovative strategies in place of conventional strategies. Breaking out of the conventional wisdom using media relations as the primary mechanism for information sharing opens up new opportunities to create value in areas that previously fell through the cracks. W. Chan Kim and Renee Mauborgne describe this type of shift in strategic logic as the creation of “value innovation” in their book, *Blue Ocean Strategy* (Kim & Mauborgne, 2005).

The value innovations in using Web 2.0 technologies for emergency information sharing include pulling information in to responders to improve situational awareness and providing an interactive information exchange among multiple stakeholders including citizens (see Figure 7).

Interactive Emergency Information

<p>Eliminate</p> <p>Reliance on Press Conferences One-way only communications</p>	<p>Reduce</p> <p>Reliance on traditional media Control of message Potential (unintended) short-term reduction in credibility of message</p>
<p>Roles</p> <p>Safety Warnings and Instructions Detailed Recovery Information Access Info When/How Convenient Greater Context and Understanding More Timely Information</p>	<p>Create</p> <p>Improved Situational Awareness for Responders Interactive Citizen Engagement</p>

Notes:

Red Ocean Strategy = Media Relations Approach to Public Information
 Blue Ocean Strategy = Web 2.0 for Interactive Public Information Sharing

Application of Blue Ocean Strategy Principles:

1. Reconstruct Market Boundaries - Redefine User Involvement
2. Focus on the Big Picture - Public needs info and has info to share
3. Reach Beyond Existing Demand - Integrate new trends for info access
4. Get Strategic Sequence Right - Effective Change Mgmt Strategy
5. Overcome Organizational Hurdles - Leadership gives up control of message
6. Build Execution into Strategy - Leverage public desire to contribute

Strategy Canvas: Web 2.0 Technologies for Interactive Emergency Communications

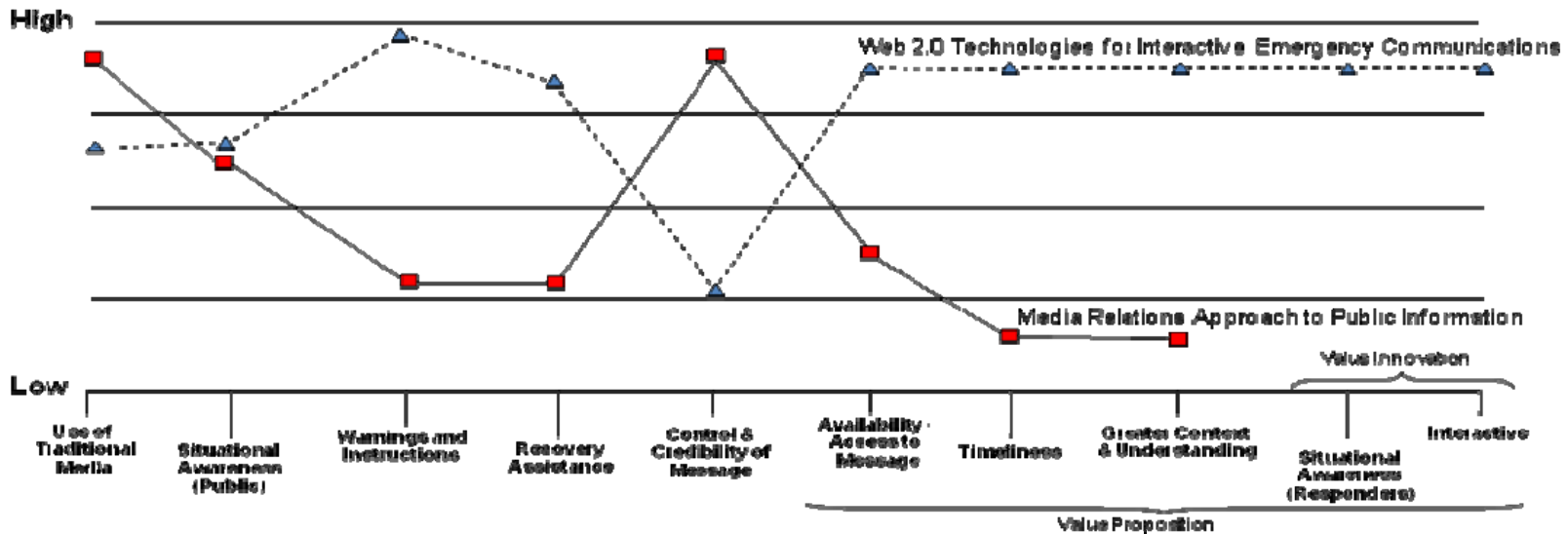


Figure 7. Value Innovation of Web 2.0 Technologies

APPENDIX B.

A. BUILD IT AND THEY WILL COME

Communities all face an increasing list of complex and challenging threats. Providing citizens, businesses, non-profit organizations and government agencies with the ability to contribute timely information about a pending disaster or current emergency may facilitate greater contextual understanding and knowledge on which various participants will base decisions. In order to facilitate improved contextual knowledge, information needs to flow in multiple directions (i.e., from government to citizens, from citizens to government, from non-profits to government and citizens, and from citizens to other citizens). Given the broad range of available information sources, there is no one entity that can produce all relevant types of information without collaborating with multiple organizations, key members of the public, and individual citizens.

Building such a multifaceted network or a megacommunity, requires effort to establish relationships and build the necessary framework of participants with shared interests to keep the network alive and thriving (Gerencser, Kelly, Napolitano, & Van Lee, 2008). If there were only one contributor providing content to the network, it would be indicative of the more traditional one-way communication system. When more people participate in the network, the information reflects more diverse insights and perspectives.

Jurisdictions that recognize the value innovation of using Web 2.0 technologies might be able to move in that direction by experimenting with one or two social networking technologies first and then make a determination of how to integrate it on a wider scale. A more strategic approach, however, would be to develop a strategic plan that moves through several steps to build a broad base of support. The next section proposes recommended steps to building an effective network for interactive emergency information sharing. This thesis will

only briefly discusses the process involved in each step and recognizes that this is an area for ongoing and future research, potentially through a case study approach of a jurisdiction ready to implement Web 2.0 technologies.



Figure 8. Building an Interactive Information Sharing System

B. STEP 1: UNDERSTAND THE TRENDS

The public has increasing expectations about access to and their desire to participate in the creation of information. More and more frequently, people seek opportunities to tap into a broad network of people and access the most current information on a given topic. To accomplish this, they are turning to the Internet and less traditional forms of communication and information sharing. People do not rely solely on television or the newspaper anymore. The public is increasingly reliant on new methods to access news when and how it is convenient for them.

The capabilities of social networking tools to connect a wide and diverse group of people around social topics, common interests, and ideas is changing the way knowledge is shared among a diverse group of people throughout the country and the world.

The value and expectation to establish collaborative and interoperable communications capabilities among first responders is widely recognized by homeland security leaders and incident managers. The GAO report on Hurricanes Katrina and Rita confirm this by acknowledging the importance of everyday emergency communication systems and interoperability needs, however, government agencies have been slow to incorporate the public into the equation. The lessons learned through Katrina have focused on improving internal emergency communication systems, but have stopped short of addressing the need to develop a more comprehensive emergency information sharing system that includes the public (Walker, 2006). The emergency response community should take steps to apply the same information sharing and collaboration principles to communicating with the public during emergencies. Local jurisdictions need to adapt their policies and practices regarding emergency information sharing to encompass the emerging trends and information access desires of increasingly sophisticated members of the public.

C. STEP 2: STAKEHOLDER ANALYSIS

One of the first steps in considering how to inspire a different mindset about adopting an interactive information sharing system that involves Web 2.0 technologies is to identify those who have the ability to affect change within an organization or community. These people need to provide their support and influence, and their opinions and attitudes will directly affect the success of the endeavor. In John Bryson's book, *Strategic Planning for Public and Nonprofit Organizations*, he describes the importance of identifying the various

stakeholders who have influence and power. “A major purpose of a stakeholder analysis is to get a more precise picture of the players in the arena” (Bryson, 2004).

It is important to identify and array the various stakeholders involved in information sharing strategies during emergencies. During the stakeholder interviews, it became clear there are several stakeholders who have a substantial role in the adoption of Web 2.0 technologies. The Power versus Interest Grid (see Figure 9) identifies those who are creators, producers, distributors, influencers, decision-makers, or consumers of information during emergencies and places them into a quadrant based upon their level of power and interest (Bryson, 2004).

1. The Players

The players represent those with a high level of interest and influence in the proposed strategy of using interactive information sharing systems. Emergency Operation Center (EOC) managers or Incident Commanders make the final determination before they release messages to citizens during an emergency. They also have a vested interest in effectively communicating with citizens to protect life safety and to reduce risk to the public during developing situations. There may also be benefits to EOC managers in the form of receiving status reports from citizens and improved situational awareness. Information Technology managers are players due to their subject matter expertise and the importance of obtaining their support for successful implementation. Public Information Officers are also critical players due to their role and expertise in constructing and disseminating emergency messages to the public.

MySpace. Companies that provide services based upon Web 2.0 technologies are also key subjects. Google has a wide range of Web 2.0 applications such as maps and interactive mashups that can help provide context to the public during an emergency. Twitter is another example of a company that may be part of an effective, interactive emergency information sharing system.

3. The Context Setters

The context setters are the policy makers and those with a lot of power and influence. Traditional media fall into this group due to the influence they have over the public, especially during emergencies. Elected officials may not have much interest in how the public received the messages, as long as the officials are well informed. Traditional media will continue to play a key role in emergency communication. If traditional media becomes more interested in interactive information sharing (as we are seeing with i-reports on CNN and in the case study with KPBS in San Diego), they may move into the player arena.

4. The Crowd

The crowd consists of the members of the public who do not have an interest in new technology. They may be an older generation that is not comfortable with new media, or they may not even own a computer. There are also members of the public that own computers, but do not use Web 2.0 features. Community-Based Organizations fall into this category since the strength of these organizations is that they gather face-to-face at local venues within a community (i.e., churches, community centers, libraries). However, there is a possibility that community-based organizations might adopt some Web 2.0 technologies by offering hands-on classes or tutoring sessions for their members.

Once a jurisdiction has conducted a stakeholder analysis, it needs to make a determination of when and how the different groups will be engaged in the planning process. The following Participation Planning Matrix (see Figure 10) provides an example of which stakeholders might be involved in particular

phases of the strategy. This helps define the level of effort required by the planning team in order to develop a winning strategy for successful implementation. The matrix demonstrates how the players may end up more frequently engaged in the planning process than other stakeholder groups. By developing a plan to engage participants at varying levels that weighs the importance of building support from stakeholders with a high level of power and interest, the strategy is more likely to have positive results.

Participation Planning Matrix					
	Inform	Consult	Involve	Collaborate	Empower
Organizing Participation	NM TM	TS	IT W2 CBO	EOC	PIO
Create Ideas for Strategic Action	TM	NM	PIO CBO	IT TS W2	EOC
Building a Coalition	NM TM	TS	IT W2	PIO EOC CBO	TS
Implementing Monitoring and Evaluating	OF	IT	EOC TS	PIO	

Participants	
Community-Based Organizations	CBO
Elected Officials	OF
EOC Managers	EOC
IT Managers	IT
New Media	NM
Public Info Officer	PIO
Tech-Savvy Public	TS
Traditional Media	TM
Web 2.0 Companies	W2

Figure 10. Participation Planning Matrix

D. STEP 3: ESTABLISH A MEGACOMMUNITY

The concept of a megacommunity is bringing together participants from various sectors and organizations to facilitate cooperation to achieve common goals and promote shared interests (Gerencser et al., 2008). The interdependencies among members of a community during the response and recovery phases of an emergency creates a natural merging of shared interests. A megacommunity that recognizes the value proposition of an interactive emergency information sharing system to enhance knowledge transfer to all participants will improve the probability of success.

The suggested megacommunity for interactive emergency information sharing system is comprised of citizens and multiple agencies from the public, private, and nonprofit sectors to optimize and leverage emergency information interactively. Building a megacommunity dedicated to creating an collaborative platform for emergency information is a preferred method since there are so many stakeholders that support a common goal and since there is no one entity that can successfully achieve the goal without collaborating with others.

E STEP 4: LEVERAGE ALL AVAILABLE RESOURCES

As mentioned in Chapter VII, many agencies cite lack of available resources for implementing Web 2.0 technologies. One of the options for managing the resource limitation challenge is to develop a phased approach that brings on one type of Web 2.0 technology and builds expertise and familiarity during normal operating conditions. Something as simple as establishing a Twitter account for an Emergency Management Division might be a good place to start.

Another benefit to building a megacommunity as mentioned above is that multiple agencies can leverage scarce resources as long as they have a common goal, in this case, the goals of citizen engagement and community

resiliency. A strategy that brings many jurisdictions together to develop a common approach to interactive information sharing is consistent with national guidelines for citizens and government preparedness.

1. Expectations Related to the National Preparedness Goal

Developing and implementing an information sharing system that encourages collaboration and incorporates contributions from the community, is consistent with the expectations established in Homeland Security Presidential Directive 8 (HSPD-8) to strengthen national preparedness. HSPD-8 states that all levels of government, the private sector, and non-governmental agencies must be prepared to prevent, protect against, respond to, and recover from a wide spectrum of major events that exceed the capabilities of any single entity (Department of Homeland Security, 2005). Complex hazards require a unified and coordinated national approach to planning and to domestic incident management.

2. Incorporate Citizens and Media as Resources

Once a jurisdiction recognizes the value of building a broad base of participants into its information sharing strategies, it will become easier to engage with them and identify partnerships that can help build the network and contribute content. Content provided from non-traditional sources for emergency information can actually relieve some of the pressure to keep information flowing from just one official source. Often times, members of the public who participate in online forums can obtain instant credibility when others confirm their statements (Brafman & Beckstrom, 2006). The trust factor works in favor of a third party participant who has nothing to gain from their contributions, unlike government officials that some citizens perceive as less than trustworthy or forthcoming during stressful incidents.

F. STEP 5: DEVELOP A SYSTEMATIC APPROACH

When a disaster strikes, emergency responders may require coordination and support from multiple departments, private sector companies, non-profit organizations, and other local agencies resulting in Unified Command operations to manage collective response efforts. There needs to be equal efforts, policies and standards in place focused on citizen engagement and collective information sharing.

Sharing specific information about available support, and coordinating the flow of information to and from the public and multiple agencies, is inherently difficult during the chaotic nature of emergencies. Policies and well-established protocols about information sharing with the public developed in advance of an emergency will help ensure the appropriate systems are in place prior to an incident.

1. Consequence of Failure to Communicate Effectively

The widely recognized failure of collective response capabilities following Hurricane Katrina in September 2005, underscores the need to improve many key components of disaster response capabilities to protect the lives and property of citizens. As stated in a report of preliminary observations by the Government Accounting Office (GAO) regarding Hurricanes Katrina and Rita, “Key capabilities such as emergency communications, continuity of essential government services and logistics and distribution systems underpin citizen safety and security.” The GAO report also identified that it took several days before local authorities had a full picture of the situation and were able to make determinations of what types and how much assistance was needed (Walker, 2006).

2. Recognize the Importance of Dynamic Information Sharing

The United States has developed several national initiatives to address the needs identified in HSPD-8, to ensure that the nation has a common approach to preparedness and response (Department of Homeland Security, 2005). Federal requirements that mandate that all local jurisdictions train emergency responders in the National Incident Management System (NIMS) is a prime example of a systematic approach that encourages a dynamic, coordinated exchange as opposed to an uncoordinated approach when responders from different agencies might otherwise use a variety of protocols and language resulting in confusion and inefficiency.

Contrast the consistent, structured and dynamic command and control initiatives for emergency response activities, with the inconsistent, static, one-way communications processes most frequently used by cities and other local jurisdictions to disseminate information to an impacted community (i.e., outdialing emergency notification systems, news releases, and updates posted on web sites). In addition to inconsistent approaches taken by different sectors of local government, the lack of a common information sharing system makes it nearly impossible for the public to know where to turn for information and how to contribute their own information.

Residents who move from one jurisdiction to another have no idea what type of communications system they should use in the event of an emergency. They will have little advanced understanding about how they will receive information or where they should turn for help, let alone how they can contribute valuable information to the benefit of others. Regions throughout the U.S. would benefit from a standard approach that incorporates interactive initiatives aimed at communicating information to and from the public.

3. Prototype for a National information Sharing System

Imagine the benefits to citizens in an entire region that provides a common location where residents, local government, and non-profit agencies can share information. One government sponsored web site (or wiki) could serve as a portal for emergency information such as: 1) maps populated with links to images showcasing damage on specific streets; 2) locations of shelters willing to accept pets; 3) listings of volunteers able to provide care for stranded or elderly neighbors; and 4) text messages from civilians reporting developing threats. To make it simple for residents and visitors, every major metropolitan city in the nation could designate a common URL for disaster information sharing such as www.newyork/emergency.gov, www.seattle/emergency.gov or www.miami/emergency.gov and so on. This could be a national initiative endorsed by FEMA to promote emergency preparedness information during non-emergencies and switch content to emerging situational awareness and service availability to promote community resiliency during and following an emergency.

These are just some of the possibilities that Web 2.0 technologies can provide to local cities willing to adopt a strategy that embraces collective knowledge from multiple sources. Taking steps to implement a coordinated approach that leverages limited resources and includes information provided by the public for the recovery component will strengthen national preparedness capabilities (Department of Homeland Security, 2005).

G. STEP 6: INCORPORATE WEB 2.0 TECHNOLOGIES

Building such a multifaceted network requires effort to establish relationships and build the necessary network of people with shared interests to keep the network alive and thriving. It also requires infrastructure to enable the system to function properly. Depending on the complexity of the system, it may require a series of technical steps to build the technology into existing systems

through a well-conceptualized process that involves information technology (IT) professionals. Emergency managers need to recognize that rolling out a new system will not occur overnight.

Adopting new technology can be intimidating for an agency. Dabbling with one technology as a pilot project would enable an agency to become familiar with the features and benefits while building skills and expertise to evaluate and implement additional technology in the future. While there are numerous Web 2.0 technologies that may fit a particular agency's needs, each have limitations unique to different applications and usage. Before a local jurisdiction employs a new technology tactic, it must recognize and take steps to measure the benefits and challenges associated with all phases of implementation and ongoing maintenance.

When ready, begin building the interactive information sharing network around new technology and dynamic approaches such as wikis, blogs, mashup maps and other Web 2.0 technologies to draw in participation from the public and other civil, business and nongovernment sectors. Three different possible approaches are outlined below.

1. The Targeted Audience Approach

One strategy to consider for entering the Web 2.0 technology realm is selecting a narrow target audience (i.e., twenty-somethings) and interacting with them on their own turf. Many social networking sites such as Facebook, MySpace, LinkedIn, Bebo, Delicious, and Skype offer free accounts. Implementing this strategy might take time to build an identity and establish a network of followers. However, the knowledge and understanding that a group of emergency managers, IT professionals and PIOs can gain about the trends and possibilities available from using Web 2.0 technologies might be a worthwhile effort.

2. The Neighborhood Approach

Local governments might find that there are various types of services and information citizens seek out on a daily basis. Jurisdictions might consider packaging commonly sought after information in Web 2.0 formats, which could then provide a launch pad for use during an emergency. For example, residents might find value in a neighborhood mashup on a city's web page that lists upcoming events and invites the public to add their own icon representing an event to the map. There could also be weekly blog topics that provide an opportunity to leave feedback for elected officials. This would provide citizens with the opportunity to engage with other citizens and with local government officials on the government's turf. This approach might result in a sizable community of users who will be well-primed to look for emergency information in this location first.

3. The "Just Try It" Approach

The rapid evolution of Web 2.0 technologies can be a conundrum. While it takes time to develop a comprehensive strategic approach, new emerging tools are constantly on the horizon. An organization that requires multiple stages of beta testing new software applications may obliterate the intended flexibility and timeliness of Web 2.0 technologies. Some emergency management professionals who are already using or considering the use of Web 2.0 technologies advocate for a quick adoption of a few tools and then evaluate them along the way to see how it goes.

According to Craig Fugate, many low cost applications exist that require very little additional money or effort to incorporate into existing systems. "We set up a Twitter account and started using at no extra cost at all," said Fugate. Florida Department of Emergency Management is posting daily video situation reports to YouTube via simple applications. "All we're using is the capability of

Microsoft Movie Maker, a laptop microphone, and a web cam. I want us to do this because I know there is going to be more emphasis on real time dialogue in the future” (C. Fugate, Interview, Florida State Department of Emergency Management, 2008).

H. STEP 7: IMPLEMENT THE INTERACTIVE INFORMATION SHARING NETWORK

In addition to conducting a stakeholder analysis, and determining a governance structure, jurisdictions need to develop a comprehensive IT system. An IT development life cycle (Kay, 2002) includes project planning for a system that meets the information and access needs of the community, system analysis and design, ensuring it has scalability, integration with other systems, and identifying the expertise necessary to construct and maintain the new system. Once the local jurisdiction identifies the recommended solution, they need to secure the appropriate level of leadership support and budget to cover equipment, development costs, testing and user acceptance processes, rollout strategies, and ongoing training for employees and the community.

Bring new people into the organization that are experienced and have an interest in new media and Web 2.0 technologies. Reach out to subject matter experts in the private sector who can troubleshoot and navigate the technological hurdles. Build enough server capacity to host a large volume of traffic. Co-create solutions to problems and involve the active members to carry out specific roles and responsibilities. Populate initial offerings with emergency preparedness content from participants and encourage new visitors to become members and participate by contributing their own content. Encourage traditional media outlets to support efforts by offering reciprocal links.

I. STEP 8: EVALUATE THROUGH MONITORING AND MEASUREMENTS

Agencies should use consistent criteria when evaluating the different tools available. The Internet has numerous measurement capabilities that allow site

owners to gather data on the effectiveness of its tools. Available data includes web site hits, number of site visits, amount of time spent on sites, path taken through links, etc. This information will help the megacommunity of providers and users tailor the system to provide access to information and to enhance the overall user experience.

The direct feedback mechanisms built into blogs and wikis provide a real time conduit for obtaining information from the users about their needs and expectations. Jurisdictions should utilize the natural benefits of instant feedback that is available from thorough examination of content posted to associated wikis and blogs as well as content generated from other social networking sites, and links established through the Internet.

Another important aspect of monitoring is ensuring that the content is appropriate. The users themselves can help police this activities similar to what happens with the phenomena of Wikipedia where the users can update and remove erroneous or inflammatory information. However, there should be some oversight by local government to correct inaccurate information as soon as possible. Continued monitoring is essential to ensure the public is using the tools responsibly. Clear roles and responsibilities should outline who will remove and/or block any offensive or divisive content. Jurisdictions should anticipate and plan for adaptations in strategy as needed to achieve the megacommunity's goals.

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