ACHIEVING ELECTRIC RESTORATION LOGISTICAL EFFICIENCIES
DURING CRITICAL INFRASTRUCTURE CRISIS RESPONSE:
A KNOWLEDGE MANAGEMENT SYSTEMS PERSPECTIVE

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Achieving Electric Restoration Logistical Efficiencies during Critical
Infrastructure Crisis Response: A Knowledge Management Systems Perspective

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DEDICATION

This thesis is dedicated to the fine men and women of San Diego Gas & Electric Company. Their dedication to their work, and continued and reliable delivery of gas and electric services to the community, is inspiring especially during response to an emergency. Their professionalism and skill serve their region well and I am proud to be among their ranks. And to my husband, Dale Durbin, who spent many a long evening alone while I pursued my education, your patience and encouragement meant so much to me. I dedicate this work to you in both of these roles you fill so well.
The ultimate measure of a man is not where he stands in moments of comfort and convenience, but where he stands at times of challenge and controversy.

Dr. Martin Luther King, Jr.
ABSTRACT OF THE THESIS

Achieving Electric Restoration Logistical Efficiencies during
Critical Infrastructure Crisis Response: A Knowledge Management
Systems Perspective
by
Teresa Lynn Durbin
Masters of Science in Homeland Security
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A great many business tasks are performed on computers today. After the 2007 Southern California wildfire events that wrought wide-spread damage to the area, event-assessment of the efficacy of spreadsheets and paper forms raised the question of whether alternative tools could have achieved greater efficiencies in the logistical support of command centers, the sites from which the local utility’s electric restoration personnel were deployed. The purpose of this study was to examine what approach would have enabled personnel working on the logistics of the command center effort to have easier-to-use, faster-to-access, command center data stored in, and provided via, a catastrophe resilient platform other than the traditional company computer network. Additionally, the capability to store basic command center requirements from previous emergency responses, to save time during the next emergency, was examined. The results of this action research acknowledged the 25 categories of the spreadsheet tool as potentially transferrable to an alternate tool. The action research suggests a need to apply the spreadsheet data in a practical format that would aid efficiency of the personnel supporting the logistics of the command centers. This study proposes a continuation of this research to develop specific alternatives that would be more effective in handling the logistics of emergency response and electric restoration activities.
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DEFINITION OF TERMS

The terms in this list are specific to this thesis. Those that are cited originate from a referenced publication. Those that are not cited have been specifically defined for the purpose of conveying terms related to this thesis.

**Blog:** A blog is a personally written entry by a user that has been posted on the internet. The postings are often “subject oriented, some personal, are all dated.”¹ A typical blog combines text, images, and links.

**California Public Utilities Commission:** A state agency that sets rates and regulates the services of privately owned utilities. The CPUC is made up of five members appointed by the governor. Its staff is comprised of attorneys, accountants, economists, and engineers. It is headquartered in San Francisco.

**Cloud Computing:**

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.

**Essential Characteristics:**

**On-demand self-service.** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service’s provider.

**Broad network access.** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource pooling. The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Rapid elasticity. Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured Service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

Service Models:

Cloud Software as a Service (SaaS). The capability provided to the consumer is to use the provider’s applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Cloud Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the
deployed applications and possibly application hosting environment configurations.

**Cloud Infrastructure as a Service (IaaS).** The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

**Deployment Models:**

**Private cloud.** The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

**Community cloud.** The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

**Public cloud.** The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

**Hybrid cloud.** The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).\(^2\)

**Command Center:** A central meeting site with a relatively convenient location from which to deploy restoration crews, distribute food, provide restroom facilities, and collect certain waste or recyclable materials. “With locations close to where repair and restoration

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work is being performed, command centers minimize crew driving time.”

Also identified were items including office trailers for field management planning, vehicle fueling tankers, temporary storage for poles and materials, and potentially, helicopter landing zones as components of the command center.

Constructivism: generally attributed to Jean Piaget, who articulated mechanisms by which knowledge is internalized by learners. He suggested that through processes of accommodation and assimilation, individuals construct new knowledge from their experiences; that when individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework.

Crisis Management: the process by which an organization deals with a major unpredictable event that threatens to harm the organization, its stakeholders, or the general public.

Dashboard: A visual display to provide users with an at-a-glance understanding of metrics of importance to them.

Department of Homeland Security: A Cabinet department of the United States federal government with the primary responsibilities of protecting the territory of the U.S. from terrorist attacks and responding to natural disasters.

Emergency Operations Center: A central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level in an emergency situation, and ensuring the continuity of operation of a company, political subdivision or other organization.

Emergency Response: An organized effort by public safety personnel or other agencies public or private, or citizens to mitigate the impact of an incident on human life and property.

Homeland Security Presidential Directive: A form of an executive order issued by the President of the United States with the advice and consent of the National Security

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Council, a Presidential Directive is a National Security instrument that articulates the executive’s policy, and carries the “full force and effect of law.

Knowledge Management System: a system created to facilitate the capture, storage, retrieval and reuse of knowledge.⁵

Knowledge Management: The practice of selectively applying knowledge from previous experiences of decision making to current and future decision-making activities for the express purpose of improving the organization’s effectiveness.⁶

Personal Protective Equipment (PPE): The safety-related protective items SDG&E personnel are to wear in the command centers. They include a hard hat, orange safety vest, closed-toe boots or shoes, and eye protection and work gloves, as appropriate.

San Diego Gas & Electric Company: An investor-owned regulated public utility that provides service to 3.4 million consumers through 1.4 million electric meters and more than 840,000 natural gas meters in San Diego and southern Orange counties, California, USA.⁷

SDG&E Emergency Operations Center (EOC): activated during major crises, it serves as a high-level central coordination and communications center. It is organized so that important decisions can be made and executed quickly with input from all the major functional groups within SDG&E. The EOC provides timely information to government agencies, law enforcement, fire departments, and briefings to the public via press conferences and media briefings. It is staffed around the clock as necessary with a lead executive, strategic leaders from seven primary functional groups, and a support group of subject matter experts. The seven primary groups include Electric Operations, Gas Operations, Business Support, Employee Support, Customer Service, External Affairs, and Communications. The EOC assumes responsibility for monitoring the big picture and making broad decisions related to the Company’s response efforts. The EOC handles general communications with

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⁶ Ibid.

employees, government agencies and the media, provides logistics in support of Company operations, and coordinates Mutual Assistance resources.  

*Smart Phone:* an integration of the mobile phone with a computer operating system, web browser, multimedia player, camera, and consumer applications, in a handheld instrument.

*Staging Area:* an area for material to be delivered from the company warehouse, a manufacturer, or other utility, for crews’ use in field. It includes portable sanitation facilities, wash stands, and waste bins.

*WIKIs:*

WIKI is a structured website, i.e. collection of pages sharing the same structure using templates. Uniqueness derives from the ease of user participation: To edit existing content, to add content, or even influence the structure of the template. Most WIKI’s are textual, yet rich. WIKI’s can be observed, including pictures, movies and audio. WIKI includes the ability to create together and to work-sharing. The templates guide the way people write and the easy use of these templates is what differentiates the WIKI from classical web contact management tools. WIKI engines, that enable building websites as defined, can be downloaded free from the net.

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8 San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff.”

9 Ibid.

10 Levy, “WEB 2.0 Implications on Knowledge Management.”
LIST OF ACRONYMS

Best Management Practices (BMPs)
California Public Utilities Commission (CPUC)
Department of Homeland Security (DHS)
Emergency Operations Center (EOC)
Homeland Security Presidential Directive (HSPD)
Knowledge Management (KM)
Knowledge Management Systems (KMS)
Personal Protective Equipment (PPEs)
San Diego Gas & Electric Company (SDG&E)
National Infrastructure Protection Center (NIPC)
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I would like to acknowledge Dr. Jeffrey McIlwain and Dr. Eric Frost for creating the Homeland Security Graduate Program at San Diego State University. Their support of our homeland, and the environment they have created that brings together the rich and diverse group of people who currently contribute, or will in the future, to our security in all of its many forms, is truly visionary. To Dr. Frost, thank you for your kind mentorship and friendship. I will always treasure it.

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I wish to thank Alan Marcher and John Ritter, who led the 2007 Firestorm One-Stop-Shop and BSL / Command Center effort with such patience and acknowledgement of what we were all giving. You made us feel very valued. Thank you as well to my three BSL partners, the late Carolyn Alkire, John Vermeule, and Rachel Romani – so many hours, so much accomplished, so much fun. Thank you Carolyn for finally telling me my hard hat was on backwards. I will never forget the 1:00am run to Wal-Mart we made to replace the mutual aid crews’ underwear that was lost by the laundry service. RIP.

To Dr. Suki Stone, thank you from the bottom of my heart for your guidance, friendship, and expertise. Your mentorship of my writing was invaluable. And finally, to my sisters Linda Jolliff and Diane Durbin, my son Andrew Phillips, my parents Jack and Maralyn Sardo, my brother Dr. Jim Sardo for blazing the trail, and all my friends and coworkers - thank you so much for the endless encouragement.
CHAPTER 1

INTRODUCTION

Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection (HSPD7) establishes a national policy for not only federal departments and agencies, but private sector companies as well, to identify and prioritize United States critical infrastructure and key resources and to protect them from terrorist attacks or natural disasters. While all threats cannot be eliminated, HSPD7 requires protection activities for the nation’s critical infrastructure be coordinated, including protection from damage to the private sector’s capability to ensure the orderly functioning of the economy and delivery of essential services. It acknowledges that critical infrastructure and key resources provide the essential services that underpin American society.\footnote{Department of Homeland Security, “Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection,” Department of Homeland Security, http://www.dhs.gov/xabout/laws/ge_1214597989952.shtm.}

In the years before the Department of Homeland Security was created, agencies and activities related to national security were not within a central command or consolidated governance. Terrorism perpetrated against American assets, and related intelligence and law enforcement activities were within the purview of more than “40 federal agencies, and an estimated 2,000 separate Congressional appropriations accounts.”\footnote{Department of Homeland Security, “Brief Documentary History of the Department of Homeland Security,” Department of Homeland Security, http://www.dhs.gov/xlibrary/assets/brief_documentary_history_of_dhs_2001_2008.pdf.}

Even prior to the events of September 11, 2001, analysis was underway by the U.S. Commission on National Security/21st Century (Hart-Rudman Commission) as to the best way for the United States to protect its citizens, property, and assets from national security dangers. This commission recommended changes at the executive and legislative branches of government to be better prepared, and to meet and overcome the grave potential dangers to American interests. This commission advocated for the creation of a National Homeland Security Agency, “to consolidate and refine the missions of the different departments and
agencies that had a role in U.S. homeland security.” Rep. Mac Thornberry (R-TX) introduced a bill in the House to enact the recommendations, and Senators Joe Lieberman (D-CT) and Arlen Specter (R-PA) introduced their versions in the Senate but no legislation ever resulted from those efforts.

Then the events of September 11, 2001 brought national security to the forefront of Americans’ attention. In the aftermath, citizens were wondering how something like that had been planned and executed without authorities being able to interfere with it, if not stop it altogether. President George W. Bush immediately announced he would institute recommendations of the Hart-Rudman Commission and created the Office of Homeland Security in the White House. He named Pennsylvania Governor Tom Ridge as the director. The mission was to coordinate a “comprehensive national strategy to safeguard the country against terrorism, and respond to any future attacks.”

President Bush’s Executive Order 13228 established:

- two entities within the White House to determine homeland security policy: the Office of Homeland Security (OHS) within the Executive Office of the President, tasked to develop and implement a national strategy to coordinate federal, state, and local counter-terrorism efforts to secure the country from and respond to terrorist threats or attacks, and the Homeland Security Council (HSC), composed of Cabinet members responsible for homeland security-related activities, was to advise the President on homeland security matters, mirroring the role the National Security Council (NSC) plays in national security.

Presidential directives are a 19th and 20th century codification of activities that began the first time our first president ever spoke, wrote himself, or had written, his direction for one action or another to start or stop, or some policy to be enacted. In these latter centuries, they were officially named, numbered, and appropriately publicized and archived. Over time they have had different names such as executive orders, or proclamations such as those found

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15 Ibid.

16 Ibid.
Critical infrastructure is defined in the USA PATRIOT Act of 2001 (P.L. 107-56), among other places, as systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters.

Delivery of gas and electricity to a region are considered essential services. They are critical infrastructure components central to sustaining the minimal comfort needs of the citizenry. This includes maintaining the public health infrastructure, the economy continuing to function, and the people’s ability to receive emergency notifications and news updates. One of the policy statements in HSPD7 (#34) references “…the recovery and reconstitution of essential capabilities…” and means, achieving the quickest restoration if those gas or electric services are damaged or disrupted.

Because the evolution of computer technology took place in all aspects of industrialized society over the last 50 years, emergency response and management benefit from these gains as well. This technology evolution provides opportunities for expanding and or improving response capabilities. As emergencies result in a wide variety of circumstances, responders’ work can often benefit from the speed and power of computers. The specific question of how computer technology can be leveraged to assist emergency response in logistical support of gas and electric restoration in support of HSPD7 will be examined in this paper.

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18 Department of Justice, “Report to Congress on Implementation of Section 1001 of the USA PATRIOT Act (as required by Section 1001(3) of Public Law 107-56),” Department of Justice, http://www.justice.gov/oig/special/s0708/final.pdf.

BACKGROUND

Gas and electric services in the County of San Diego are provided by San Diego Gas & Electric Company (SDG&E), an investor-owned public utility. Many useful issues can be analyzed from the wildfires that damaged SDG&E’s electric system in 2003 and 2007 and certain activities that supported efficient service restoration can be examined and used for comparative analysis for a terrorist attack scenario, wildfires, or any other event that might impact service delivery.

During the week of October 21, 2007, wind-driven wildfires raged across San Diego County burning more than 360,000 acres and destroying at least 1,700 homes. As soon as the fires had moved through an area, SDG&E crews were on-site to assess damage to the utility’s assets. As a result, 750 SDG&E employees, along with 203 neighbor-state mutual-aid personnel and, at peak periods, 78 contract electric crews and 129 digging crews, were deployed to perform the service restoration efforts. Service was restored for approximately 83,000 customers affected by the fire and SDG&E eventually replaced more than 2,170 utility poles, 338 transformers, and at least 35 miles of overhead electrical wire.20

Four years earlier, after San Diego County’s 2003 wildfires, SDG&E had refined a model for supporting the logistical components of establishing and supporting command centers. This model was ready for implementation during the next emergency event which began on October 21, 2007. SDG&E’s electric restoration response to the 2007 fires was supported by teams of employees from the following departments in this refined model; “…Fleet, Facilities, Environmental, Supply Management”21, Logistics & Warehousing, Fleet Services, Facilities, Real Estate / Land, Environmental, and Safety. The employees from these departments were tasked with supporting the logistical needs for electric construction crews allowing the construction foremen and supervisors to be available to perform their core competency of repairing or rebuilding the electric system.


21 San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff.”
Working in teams of approximately three people per shift, the support team employees were consumed for 10-15 hours a day for the first 10 days of the emergency in a significant logistical task. They had to respond to central points near the fire-damaged areas where they set-up command center camps to serve three meals a day. The command center sites as detailed by Alan Dulgeroff\textsuperscript{22} included restrooms, shaded rest areas, water, ice, and snacks to all the crews who were working 16-hour shifts. In addition, the command center sites needed mobile offices with internet connectivity (often via satellite due to the remote locations and/or damage to on-site power and telecommunications connections). Also required were helicopter landing areas for hard-to-access, power pole replacements, water trucks for dust mitigation in the rural settings, mobile radio repeaters, and dedicated space for all the materials to be staged for the crews’ use.

Preventative environmental checklists had to be followed at the rural sites. Straw wattle to prevent run-off, steel shaker plates to keep the vehicles from tracking loose dirt out onto the streets, and traffic control where the extra traffic related to the command center made an impact to normal traffic flow at the entrance were all required. Sites that were designated just as material lay-down locations, still needed restrooms and trash containers.\textsuperscript{23}

The region’s basic communications infrastructure was not impacted by the fires, therefore alternate communications systems were not needed in the 2007 firestorm. It is timely to note however that emerging technologies leveraging communications devices already being used are starting to be tested for response to emergencies impacting infrastructure. This very new type of infrastructure-less wireless network, such as Georgia Tech’s LifeNet model, which is formed out of consumer electronic devices such as laptops or smart phones was not needed in Southern California in 2007, but could have great utility in disaster scenarios impacting the traditional means of communications.

With the LifeNet model, each device acts as a host and a router, making a centralized governing body unnecessary. LifeNet offers a network that can grow incrementally by allowing any user to connect and disconnect from the network. The computers will stay connected as long as they are connected to at least one

\textsuperscript{22} Ibid.
\textsuperscript{23} Ibid.
other device in the ad hoc network, thus creating a continuous flow of communication.\textsuperscript{24}

Using consumer devices such as smart phones and laptops to remove dependence on a company’s local network infrastructure and data center is also addressed by the technology known as cloud computing, which is less an ad hoc, and more a commercial model.

In SDG&E’s 2007 response, the team members used cell phones and laptops with air cards to track all the support activities and items for command centers, on spreadsheets that were emailed back and forth to the manager leading the command center efforts. This enabled him to track the logistics of all command center sites in a consolidated manner. Each day the team members participated in two conference calls with their counterparts, during which they were given updates from other SDG&E departments supporting the logistical efforts.

\textbf{STATEMENT OF THE PROBLEM}

Two U.S. utilities, Duke Energy and Commonwealth Edison have enhanced the logistical efforts supporting their electric restoration efforts by converting from manual, and single-purpose software tools to greater technology-based solutions. Their impetus for implementing new methods to support emergency response arose from the severe ice storms experienced along the eastern seaboard and the Great Lakes areas in the last decade and the formerly manual way their activities were handled.\textsuperscript{25}

Based on these two utilities’ examples of converting from manual systems to technology solutions, SDG&E may be able to investigate a more technological alternative to convert its current system of spreadsheets and paper forms.

The SDG&E team members who were serving as business solutions liaisons (BSLs) between the construction supervisors leading the restoration and rebuilding efforts of the crews, and the departments that procure and oversee delivery of the material and services used to set-up the command centers, reported occasions when their requests for items needed


\textsuperscript{25} J. Singer, personal communication, January 22, 2008.
for the command centers were not conveyed exactly, or delivery was late. Other times requests were duplicated, or second and third calls were received from the providers to confirm if materials or meals were still needed, when the items had already been received. The BSLs’ daily submittal of the tracking spreadsheet to the manager’s administrative support required a significant consolidation chore and lacked real-time status. For example, an impact of the spreadsheet’s lack of timeliness was that if the BSLs needed to track something more timely than information from the afternoon before, they would have to participate in both conference calls each day, despite other tasks they might have been performing. Additionally, the BSLs needed to take their own notes as to what each command center team was reporting during the calls. Then, the spreadsheet combined with their handwritten notes provided them with more detailed information, but resulted in an abundance of paper. Further, the daily consolidation of spreadsheets from 17 different command centers contributed to the chance of errors being made. The possibility of achieving efficiencies through a more real-time method, rather than paper forms, repeated consolidation of emailed spreadsheets, and email requests first arose during the type of miscommunication reported above. This suggested an opportunity for investigation of a more real-time approach to handling the logistics related to the emergency response.

The rush to procure water, meals, tents, lights, portable bathrooms, and mobile offices is all performed in competition with other responding agencies in the region, public and private-sector. Any lag in response time could present the loss of the opportunity to obtain what is essential. Because of that competition for scarce resources, the first five days of a response are the most time-sensitive. Consequently, the potential for errors in the spreadsheets could have represented a loss of needed resources.

At this point it must be acknowledged that literature addresses the high percentage of errors in spreadsheets. Research discusses the range of spreadsheet errors from calculation errors, to one that is more germane to this study, errors in data quality. Caulkins, Morrison, and Weidemann26 cite these errors in data quality as one of three typical reasons that

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contribute to undetected errors in an alarming “91 percent of spreadsheets.” These authors contend that a simple task such as a “bad sort can destroy the integrity of a row, or a mismatch of units.” This is supported by Panko’s research in which he estimated 94 percent of spreadsheets contain errors. Therefore, it is clear that any solution must need no manual manipulation of the data such as is needed when using spreadsheets for database functions. An alternate solution must also have virtually no training-time requirements, since the employees assigned to the task in subsequent emergencies will likely have no experience with the solution, nor would they have the luxury of time to learn it. The possibility of SDG&E changing its approach to command center logistics tracking as Commonwealth Edison and Duke Energy were able to do, merits further study.

**PURPOSE OF THE STUDY**

After the 2007 fires, event-assessment and debrief of the command center support personnel included the subject being raised of the efficacy of spreadsheets and paper forms and the question of whether an alternate approach could have achieved greater efficiencies, especially in the areas where duplications and problems were encountered was posed. The purpose of this study is to address the following:

**Research Questions:** What alternative approach would have enabled the teams working on the command center effort of emergency response to have easier-to-use, faster-to-access data? What solution would include the capability to store basic command center requirements from previous emergency responses to save time in addressing the first or most crucial items needed during the next emergency? What resiliency could be built into command center logistics tracking in case the company’s network was rendered inaccessible at the same time as command centers were needed for service restoration activities?

Therefore, if SDG&E’s electric or gas system was damaged by terrorist activity or another natural disaster with equal or greater severity than the firestorms of 2003 and 2007, tracking the command center logistics could become exponentially more difficult

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27 Ibid., 22
28 Ibid., 23
proportionate to the severity of the disaster. An alternative solution designed for easy access by users in multiple areas could enhance the support of the logistical efforts to bring the region’s critical infrastructure back to normalcy in the most effective manner possible.

The current study is designed to investigate the possibility of an alternate, multi-user approach, in order to improve accessibility or timeliness of information in a further refinement of disaster response tools. Results could aid decision-makers in their planning for subsequent emergencies. The present body of knowledge will be expanded by the study of converting from spreadsheets and paper forms currently used for some emergency management activities to more effective tools of response.

THEORETICAL BASIS AND ORGANIZATION

The theoretical basis of this paper – how learned information is archived and shared so it has future benefit, provides the foundational understanding of the command center activities and basic tracking method described. The term Knowledge Management (KM) defines this concept. Jennex and Raman\(^{30}\) state, “Knowledge management (KM) is about capturing knowledge created in an organization and making it available to those who need it to make decisions.”\(^{31}\) Jennex\(^{32}\) had earlier illuminated the topic as, “…combined technical and organizational initiatives to manage structured and unstructured knowledge in order to help the organization improve its effectiveness through improved retention and reuse of knowledge.”\(^{33}\)

It is important to first examine the difference between information and knowledge. Viewed from Piaget’s constructivist perspective, Kamii and Ewing\(^{34}\) agree that information is known by relating it to that which is previously known. Piaget’s research was rooted in his scientific tradition allowing for the systematic study of knowledge from “its formation rather


\(^{31}\) Ibid., 187

\(^{32}\) Jennex, “What is knowledge management?”

\(^{33}\) Ibid., i

\(^{34}\) Kamii and Ewing, “Basing Technique on Piaget’s Constructivism.”
than examining only the end product.”  

A perspective from another researcher addresses this topic in the following way; “When something is known, it is information. When it is shared, it is still information. When the recipient with whom it was shared applies the information at the right time, it becomes knowledge.” Therefore, internalized information is transformed to knowledge through the process of sharing it via an accessible platform for action. From the knowledge-sharing perspective, action must be taken.

This researcher proposes combining Steinmark, Jennex, and Goh’s definitions of Knowledge Management in order to evolve from the more academic view to the practitioner’s business application where the theory does not apply without a system for delivery. Thus these KM experts provide the foundation for KM’s evolving definition as the facilitation of the capture of information, the use of which propagates knowledge which can be leveraged to enhance effectiveness of assets, and human capital for organizational objectives. This new definition implies a system for delivery of knowledge will now be inherent in the practitioner’s application of the concept.

The ability to apply KM to the 2007 command center logistical effort and how it can benefit future emergency responders, corresponds to Jennex’s work in the field of KM in support of crisis response. The underlying theoretical bases upon which this study is constructed are that information gained from one emergency can be applied as knowledge when shared with others to improve performance during a subsequent emergency. Additionally, improved performance will help an organization meet its goals or mandated objectives acceptably.

Comparing how the basic computer tools used in the 2007 command center set-ups performed against how an alternative process would perform, should demonstrate the need to

35 Ibid., para. 6.
36 A. Cruz, personal communication, February 25, 2010.
37 Jennex, “What is knowledge management?”
38 Jennex and Raman, “Knowledge Management.”
move towards tools that are multi-user, require no consolidation of data, and which can be used with little to no training in the fast-paced environment of an emergency.

**ASSUMPTIONS AND LIMITATIONS OF THE STUDY**

Budgetary constraints impact organizations from small to large, public to private. Even the investor-owned utility whose command center logistics are the focus of this paper has not had the resources to evaluate systems related to just one segment of the company’s overall response to very occasional emergency events. However, this study will still propose a justification for an alternate tool to be evaluated for use in support of SDG&E’s command center logistical tracking response. New knowledge is expected from assessment of the differences in how the data could be more effectively used to create categories and titles, stored, and accessed in the future. It is assumed that alternate tools that have been specifically designed for the purpose of tracking the logistics of command center set-up are effective.

It is assumed the differences between someone newly assigned to work the command center logistics effort in the next emergency, and the researcher - who had experience in the command center logistics effort in 2007 - would not skew the assessment of the ease-of-use or training curve associated with an alternate tool.

Without access to a product specifically designed for command center logistics tracking, it cannot be determined what more optimum results could be derived if there were budgetary resources to test them. It is assumed that implementing an alternate tool would enhance emergency response for command center set-ups based on the fact that 2007 support personnel quickly outgrew their basic computer tools as soon as the first 48 hours passed. It is also assumed that implementation of an alternate tool would include provision for creating a pool of assigned users who would receive initial training, then drill regularly in the use of the program. This assumption contains the limitation, however, that training and drilling on the tool would be limited to those assigned initially. A work-around to that limitation would be to have the initial pool of responders paired with new responders during deployment for knowledge transfer during the first day or two of the emergency.
CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

The following literature review addresses the area of emergency response and crisis management related to gas and electric utility services. The specific topics include a discussion of the evolution of the Department of Homeland Security, its critical infrastructure protection component, Knowledge Management, and knowledge management systems in support of crisis response. These topics come together as the backdrop to the 2007 Firestorm emergency that greatly impacted Southern California.

The traditional asset protection and restoration activities performed by gas and electric utilities have become codified under the federal government. Homeland security is examined as the unifying framework that has evolved to provide the ultimate authority-relationship over utility emergency management response. The area of Knowledge Management is an important foundation to explain how information gained from past emergency experiences is rendered useful to current and future crises. The last area discussed is systems for critical infrastructure crisis response activities. The currency of this component parallels the increasing vulnerability from both man-made and naturally-caused damage to utility systems in the 21st century and how they must be restored by teams of people working in crisis conditions.

Homeland Security

The protection of people, places and things in America, including American interests outside of formal American borders, has been officially practiced since the nation was founded. However, the literature suggests American interests coming under attack here and abroad, outside the context of a declared war, is a growing phenomenon of the last 25 years of the 20th century.

The writings most available on the topic increase in number specifically during Bill Clinton’s second term as president from 1998 to 2001. Up to, and including, World War II,
threats against American interests were referred to under the general theme of national security, and was usually in the realm of nation against nation. After World War II, the Cold War spawned the Civil Defense era when Americans and their institutions were worried about, and often made preparations for, a nuclear attack. The nuclear threat was posed by the Soviet Union, roughly America’s equal in that unique claim to global military dominance. Therefore, prior to the end of the Cold War era, neither individuals, nor rogue groups within or outside the country, were the focus of much published on the topic of national security. This is likely due to the fact that the perceived breadth of their threat was not viewed as having a wide-scale impact on America.

However, terrorist attacks against American interests or allies, perpetrated by individuals and small but violent groups, increased in the 1990s. The literature reflects the increasing concern of the Clinton administration and its involvement with four important events that happened during these years. The first was Executive Order 13010 – Critical Infrastructure Protection. Signed by President Clinton on July 17, 1996, its mission was to

...identify and consult with: (i) elements of the public and private sectors that conduct, support, or contribute to infrastructure assurance; (ii) owners and operators of the critical infrastructures,” to “...(c) assess the scope and nature of the vulnerabilities of, and threats to, critical infrastructures,” and “…(e) recommend a comprehensive national policy and implementation strategy for protecting critical infrastructures from physical and cyber threats and assuring their continued operation.39

The second event was the National Infrastructure Protection Center (NIPC) jointly created early in 1998 by the Department of Justice and the FBI. This was to assess the threat to the “efficient delivery of essential services.”40 on which the country, through the rapid growth of technology, was becoming increasingly dependent upon for normal functioning.41 The third important action, as a result of the NIPC creation, was from President Clinton who then issued Presidential Decision Directive 63 (PDD-63), “which called for the creation of a


41 Ibid.
national plan to protect the services on which we depend daily.”  

PDD-63 acknowledged that critical infrastructure at all levels of government and in the private sector was essential in maintaining national and economic security.

The fourth item was Secretary of Defense William S. Cohen’s authorization of the formation of the U.S. Commission on National Security/21st Century (Hart-Rudman Commission) to assess the status of international security from that time through the first quarter of the 21st century and steps the United States could take to navigate the anticipated dangerous times ahead.  

It included a forward-looking analysis of critical infrastructure protection.

Released in three phases, the first report was entitled *New World Coming: American Security in the 21st Century: Major Themes and Implications*.  It was released to the American public on September 15, 1999.  It contained the committee’s view of the future in 12 points, and drew 14 conclusions including the belief that America would continue to be a target of attack, and that the national security of all economically strong countries would be influenced by a global economy.  It acknowledged the fact that energy would continue to be a strategic economic currency and source of leverage.  It looked ahead to the decreasing sanctity of borders and the increased potential for attacks committed against civilians.  It further called for a cohesive national security strategy.


The Phase III Report, *Road Map for National Security: Imperative for Change*, made the following recommendations:

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42 Ibid.


We therefore recommend the creation of an independent National Homeland Security Agency (NHSA) with responsibility for planning, coordinating, and integrating various U.S. government activities involved in homeland security. NHSA would be built upon the Federal Emergency Management Agency, with the three organizations currently on the front line of border security—the Coast Guard, the Customs Service, and the Border Patrol—transferred to it. NHSA would not only protect American lives, but also assume responsibility for overseeing the protection of the nation’s critical infrastructure, including information technology.46

This dependence on, and interdependence of, essential services was an important characteristic finally articulated. Two years later, National Aeronautics and Space Administration (NASA) Inspector General, Roberta Gross, released a statement entitled How Safe Is Our Critical Infrastructure? in a senate committee hearing reviewing the progress of the implementation of PDD-63. She acknowledged that in assessing what had been accomplished towards implementation, the Inspectors General found that “mixed progress”47 had been made. However, she also said that important work had finally been started in the identification of, and protection plans for, critical infrastructure. On the whole, the nation was in a better position than before PDD-63 was issued. Her statement was dated September 12, 2001.48 That same day, the damage to the critical infrastructure in lower Manhattan as a result of the World Trade Center collapse was becoming very apparent.

Although congressional hearings had been held on the House and Senate versions of bills related to the Hart-Rudman recommendations, no final legislation had been enacted. Homeland Security as a Cabinet-level department wasn’t created until after the September 11, 2001 attacks, but it drew its basic tenets from Hart-Rudman Commission.49 The creation of the Department of Homeland Security impacted the structure of the federal government, and includes a particular guiding principal that states,

Use an All-Hazards Approach. Our Nation faces threats from both natural and man-made sources. We will take an all-hazards approach to emergency

46 Ibid., 8
48 Ibid.
management that allows us to respond effectively to all emergencies, whether caused by acts of nature or by our enemies.  

These references to threats from natural sources, and emergencies caused by acts of nature, have their roots in civilized society’s tradition. People have always attempted to protect what is considered valuable, whether they are owners of businesses, participants in governments or non-governmental entities at any level, or private citizens. As the industrial era advanced, America and other civilized nations enjoyed the creation of structures that aided basic human needs such as roads, water, sanitation, systems of delivery for gas and electricity, telegraph, and telephone.

Not long after the creation and initial use of these structures and/or systems of delivery, their maintenance needs began. As owners or custodians of structures or facilities with value, their protection needs eventually demanded attention. Whether that happened because of the prudence of the owner to proactively address protection, or whether some damage, man-made or of natural origin, befell the structure, the need for protection of that which was valued was only prudent stewardship.

In fact, a search of the topic indicates that literature related to critical infrastructure protection grows in number, again coincident to the passing of the USA Patriot Act of 2001 (P.L. 107-56) and the resulting creation of the Department of Homeland Security. Section 1016 Findings Part 3 of the Patriot Act Section 42 USC §5195c, Critical Infrastructures Protection Act of 2001 states that “A continuous national effort is required to ensure the reliable provision of cyber and physical infrastructure services critical to maintaining the

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52 Ibid.

national defense, continuity of government, economic prosperity, and quality of life in the United States.”

Further, Policy Part 2 states, “that actions necessary to achieve the policy stated in paragraph (1) be carried out in a public-private partnership involving corporate and non-governmental organizations.” The definition of critical infrastructure for purposes of this federal law is given as, “…critical infrastructure’ means systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health, or any combination of those matters.”


The literature includes reviews of the progress of HSPD7 during the following six years. In a Report for Congress dated October 1, 2004, John Moteff and Paul Parfomak of the Congressional Research Service (CRS) Resources, Science, and Industry Division review the definitions and identification of critical infrastructure and key assets. They start by acknowledging that the “meaning of critical infrastructure in the public policy context has been evolving for decades and is still open to debate.” The authors refer back 20 years to the definition of infrastructure as public works and equipment to provide social services. They trace the rise of terrorism and the advancements of technology as the main drivers to the evolution of the definition, the resulting increased governmental attention, and change in public policy. They discuss the general grouping of types of infrastructure into sectors, the

54 Ibid., sect. 1016(e)
55 Ibid., sect. 1016(e)
56 Ibid., 131
58 Ibid.
addition of the chemical industry and greater references to cyber security, and the arrival at a very granular level of what constitutes vital/critical infrastructure.

This report also discusses the continued requirement, since PDD-63, to prioritize critical assets and develop a protection strategy. The authors touch upon the challenging issue of the different approaches taken by each sector and point out the continued need for the DHS to "develop a uniform methodology…." They ask whether Congress should care if the overall list of critical infrastructure remains fluid, and whether that fluidity could lead to "inefficient security policies." The authors ask a provocative question of whether redirecting resources from safety activities to security and protection activities, might make them less prone to risk from terror, but leave the public at greater overall risk.

In a speech to the Brookings Institution on September 5, 2008, Homeland Security Secretary Michael Chertoff shared his view of the progress made on assessing and dealing with threats to the critical infrastructure and what he envisioned over the next five years. Secretary Chertoff specified two approaches. The first is a government-centric model in which all functions of homeland security are handled by the federal government. It would dictate to the private sector what it must do to reduce vulnerabilities to the infrastructure. He termed this the "20th century style command and control model of how to protect things." But he also admitted that it is "impossible and impossibly expensive for the government to handle 100 percent of homeland security preparedness, prevention, response, and recovery in the 21st century."

The second approach, which Chertoff favors, is a collaborative model with the private sector. It recognizes that the private sector has an inherent self-interest to protect itself for continued viability, and knows the best, most efficient, and cost-effective way to do that. In the Secretary’s view this leverages private sector capabilities with incentives from the federal

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59 Ibid.  
60 Ibid.  
61 Ibid.  
63 Ibid., para. 25
Mr. Chertoff also acknowledged that critical infrastructure “outlasts the terms of office of the people in government”\textsuperscript{65} and therefore a long-term approach must be embraced. Programs with lengthy implementations however, run the risk of losing enthusiasm, and commitment. When that happens, private sector companies might be tempted to put off the continued spending necessary to maintain protection. Secretary Chertoff reiterated the criticality of maintaining and protecting our aging systems from failures, both man-made and natural. His remarks recognize that politics influence typical budget-cycle spending. He admitted that spending for planning and maintenance on New Orleans’ 17\textsuperscript{th} Street canal would have been expensive. However if the canal had been maintained properly, that cost would have been a great deal less than the amount that was eventually spent on rescue, relief, and rebuilding efforts, not to mention the loss of life, and property that can never be recovered as a result of its failure during Hurricane Katrina.\textsuperscript{66} Secretary Chertoff’s reference to lessons learned from the disaster that befell New Orleans, advances the discussion to Knowledge Management and its impetus for how information from previous experiences can be used to improve future performance in emergencies.

**Knowledge Management**

Murray Jennex, in his role as editor of the International Journal of Knowledge Management (IJKM), has summarized the definitions of the leading academicians and practitioners of this topic in an effort to determine if there was an agreed-upon description of KM.\textsuperscript{67} What he determined was that even as late as 2005, leading academicians and professionals in this field were all operating from unique viewpoints of KM and had not as a

\textsuperscript{64} Ibid.
\textsuperscript{65} Ibid., para. 81
\textsuperscript{66} Ibid.
\textsuperscript{67} Jennex, “What is knowledge management?”
community embraced a unifying definition. He assembled those individuals’ definitions in his IJKM Editorial Preface, *What is Knowledge Management?* The Jennex view is that “KM is the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization’s effectiveness.” Jennex then called for more research and workshops to further discuss what the best definition should be.

The article acknowledged a commonly used taxonomy for knowledge based on Polanyi’s and Nonaka’s discussion of tact and explicit knowledge. In fact, the literature indicated many subsequent researchers on this topic agree with Jennex.

The concept of organizational learning versus individual learning, and how both are foundational to learning by doing, is explored by Jennex relative to knowledge management. Further, Jennex juxtaposes an alternate view from Sandoe et al. that “organizations do not learn; rather only individuals learn.” The unifying theme however is that learning related to one’s organization will continuously evolve whether the change is at the impetus of the organization or the individual. The results will be somewhat different; more explicit for the organization, and more tacit at the individual level. This Jennex article lays important groundwork concepts for this topic.

Laurence Prusak, in his 2001 paper, *Where Did Knowledge Management Come From?* reported that the computerization of the globe, and the speed and reach with which lives are impacted due to it, puts a premium on knowledge that cannot be “digitized, codified,

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68 Ibid.
69 Ibid., i
or easily distributed.”

He theorized that knowledge that cannot be derived from component pieces of information without the benefit of human thought is what is ultimately the most valuable asset to an individual or organization in the global environment. He reasoned this tacit knowledge is where the real value in information still resides in light of how much information is available for free or little cost.

Prusak, too, discussed organizational learning and how its output, in the context of the firm’s and the individuals’ experiences, is knowledge management. He described knowledge management as the process of value for which executives are willing to plan and spend, to codify and memorialize what they did on their watch to support and capture past experiences in the organization. Prusak’s paper also traces what came first in the evolution to knowledge management, from the learning from past experiences philosophy to analyzing the learning strategies in an organization, and reasons for performance variation.

Prusak introduced the impact on the study of knowledge analysis, and management of the results, due to economic, sociologic, philosophical, psychological, and practical influences. The practical aspect though is detailed by Prusak, to have the most currently recognizable shaping of knowledge management. He includes in this discussion of the practical, “…information management, the quality movement, and the human factors/human capital movement.”

It is interesting to remember that Prusak’s paper was written in 2001 when his closing remarks visualized the two paths knowledge management might take in the future. They include his fear that knowledge management could be seen similar to the fad of reengineering, which resulted in often being viewed as championed by opportunistic consultants selling down-sizing as the beneficial output of that effort. Instead, Prusak shares his hope that knowledge management will follow the path of the quality movement in which the “key ideas became so deeply embedded in practices and organizational routines that they

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75 Ibid., 1002
76 Ibid.
77 Ibid.
78 Ibid.
79 Ibid., 1005
became more-or-less invisible,”80 and “contributing valuable and sustainable concepts, vocabularies, and work processes to the pursuit of organizational effectiveness.”81 Based on the subsequent work of Jennex, Goh, Holsapple, and several others, it would seem that Prusak’s hope for the more positive legacy of knowledge management as a theory, was realized.

Within two years of Prusak’s 2001 work, Burstein and Linger wrote Supporting Post-Fordist Work Practices: A Knowledge Management Framework For Supporting Knowledge Work82, in which they explore knowledge management at the task level. This paper, too, acknowledges that modern organizations make it a point to leverage the experiences and knowledge of their people in order to gain value from their tacit knowledge, which, when transferrable, has great value.83 However, Burstein and Linger take a “bottom-up”84 approach to knowledge management and state that this method “aims to acquire, represent, preserve, and distribute knowledge, created as a result of performing a specific task, at both individual and organizational levels,”85 when they cite their earlier 2002 work. They explain how incorporating the functions of planning, design, and performance are counter to the Taylorist view of the separation between planning and production.86

This task-based approach to knowledge management required credence being given to organizational memory as it supports learning, and therefore the “actors performing the tasks.”87 Burstein and Linger proposed a model of work that resulted in the following core expressions of knowledge management:

“the actors’ ability to:

• represent their conceptualization of the task (inscriptions);

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80 Ibid., 1006
81 Ibid., 1006
83 Ibid.
84 Ibid., 290
85 Ibid., 290
86 Ibid.
87 Ibid., 293
• record, retain, and reuse knowledge and experience (organizational memory);
• apply past experience to current situations (instantiation);
• be supported in their knowledge work practices (intelligent decision support); and
• reintegrate the ‘production’ and ‘planning’ functions (post-Fordist work practices).  

Ultimately, Burstein and Linger feel they contributed to the body of knowledge management by their “reconceptualizing of KM.” They posit that by articulating the output of workers and validating it, value is added to the organization when that knowledge can be reused and exploited.

Knowledge Management Systems (KMS)

This repeated concept of reusing and benefiting from previous experiences emerges as the unifying theme in most of the knowledge management literature reviewed for this thesis. Capture, and having available, information from past events or experiences must be systematically performed. That set of tasks is made practical by computers. What would have been painstaking to record, output, and circulate by means other than computers in days past, is now a possible project to accomplish because of computers. The memorializing of events, their sequence, their details, their participants, what was important, what wasn’t needed, what could be done better, etc., can be captured with relative ease and low cost due to computer technology. These uses of computers to capture knowledge and respond to disasters is discussed early in computer-related disaster response literature including the Belardo, Karwan, and Wallace work, *Managing the Response to Disasters Using Microcomputers.*

The point at which computers became widely affordable and portable while their computing ability increased with great speed, is the point at which computers began to be integrated as disaster response tools. Belardo et al. explore the theory of decision-making

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88 Ibid., 298
89 Ibid., 302
91 Ibid.
related to disaster managers, and the idea that their decisions must be made inside an optimal window, outside of which, decision-quality can degrade.

Belardo et al. state that “the quality of decisions individuals make in crisis settings is a function of the quality of the information received, their cognitive abilities, and whether the trade-offs associated with various alternatives are appropriately assessed and evaluated.”92 They further explain that a great deal depends on the system for capturing the information.93 As early as this paper would seem to be in the discussion of using computers in disaster response and decision-making, the literature suggests Belardo et al. were correct in their foresight. They detailed that a computer system’s display and user interface would connect the decision-maker and the system. Further, they concluded that unless a disaster response computer tool was appropriate to what the decision-maker needed, the tool would not be adopted.94

Murray Turoff’s 2002 paper, Past and Future Emergency Response Information Systems95 restates the use concept; “an emergency system not used on a regular basis before an emergency will never be of use in an actual emergency.”96 He also made the point that information should be as timely as possible to aid decision-makers.

Another aspect of the literature that was articulated in detail by Lee and Bui,97 and examined by other researchers subsequently, was the benefit to be gained from compiling, organizing, and entering previous disaster data into a computer system, in order to reduce having to compile similar data in the next disaster. This template-based approach was posited as reducing errors, and saving time. Further, Lee and Bui thought it would reduce stress on the decision-makers, and make the computer system more familiar, and therefore more likely to be used. Additionally, this capture of tacit knowledge from previous

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92 Ibid., 30
93 Ibid.
94 Ibid.
96 Ibid., 29
emergencies would make it easier to compare those events to a current emergency for better
decision-making. Lee and Bui suggest that the optimum time to create templates for a next
emergency is immediately after a crisis has passed, when the events are fresh in the decision-
makers’ minds. This implies further support of leveraging of tacit information for future benefit.

As noted in the previous section’s discussion of knowledge management literature,
Murray Jennex has summarized many researchers as to the theory itself. He advances the
discussion, in many instances, to the systems related to knowledge management. Jennex’s
collaboration with Olfman, Assessing Knowledge Management Success/Effectiveness
Models,99 acknowledges two approaches to building systems for knowledge management,
one based on the “process/task”100 approach which does not specifically capture tacit
knowledge but instead relies on the users to know the information they need to know
beforehand.101 The second approach deals with the “infrastructure/generic.”102 concept that
strives to capture context along with the technical details to support inexperienced users’
successful use of the system.

Jennex and Olfman provide a framework in which models for knowledge
management systems can be evaluated for their success factors. Pertinent to this thesis are
the criteria of “knowledge storage/repository considerations, how information and knowledge
are organized so that the KMS can be searched and items can be linked to appropriate events
and use.”103 They also made a point that is very timely to network capacity discussions in
2010, “access locations (because users rarely access the KMS from a single location, which
leads to network needs and security concerns), and the work activities and processes that

98 Ibid.
99 M. E. Jennex, and L. Olfman, “Assessing Knowledge Management Success/Effectiveness Models,” in
Proceedings of the 37th Hawaii International Conference on System Sciences (Waikoloa, HI: Institute of
Electrical and Electronics Engineers Computer Society, 2004), 1-10.
100 Ibid., 1
101 Ibid.
102 Ibid., 1
103 Ibid.
utilize the KMS,“104 as being important. This article stipulates a clear foundation of Jennex’s writings on knowledge management systems and how they support crisis response.

Jennex and Raman examine the role knowledge management systems play in organizations’ crisis response in their paper, Knowledge Management In Support of Crisis Response105. They acknowledge the differing viewpoints set forth by Von Krogh106 and Davenport and Prusak107 for implementing KMS in organizations, and highlight the Davenport and Prusak view the “KMS can support an organization in planning for and dealing with crises.”108

Jennex and Raman109 compiled a comprehensive list of what constitutes crises, including Millar’s110 nine attributes of a crisis, the 16 categories as classified by the Institute for Crisis Management (ICM), Fink’s111 definition, the Seeger et al.112 broader interpretation, Booth’s113 suggestion, and the Chandler and Wallace114 study. This compilation reinforces the certainty that all organizations will be faced with some kind of crisis sooner or later, and that they likely would benefit from using systems to manage their response to it.

104 Ibid., 2
105 Jennex, and Raman, “Knowledge Management.”
108 Jennex, and. Raman, “Knowledge Management,” 188.
109 Ibid.
It is acknowledged by Jennex and Raman\textsuperscript{115} what makes up a crisis response system, based on the Belardo et al.\textsuperscript{116} model, and the expanded Jennex expanded refinement as discussed in Jennex and Raman\textsuperscript{117}, that a crisis response system is “more than the basic components of database, data analysis, normative models, and interface.”\textsuperscript{118} It also includes, “dynamic, integrated, and collaborative (yet possibly physically distributed) methods to communicate between users, and between users and data sources, protocols to facilitate communication, and processes and procedures used to guide the response to and improve decision making during the crisis.”\textsuperscript{119} The utility of a template-based approach is supported by Jennex and Raman, as is their reinforcement of the need to capture tacit and explicit knowledge.

The question of why crisis response needs KM is asked by Jennex and Raman and answered when they convey the speed at which decisions need to be made, and the difficulty for organizations to have people with the right experience filling the right tasks, when needed. They suggest that systems that have been well designed to capture tacit knowledge from earlier experiences, aid this need. They also state that decisions can be made faster when more resources are available sooner.\textsuperscript{120}

The phases of crisis response including their stresses and support needs were also examined. Jennex and Raman suggest that basing a crisis response system on operational needs, testing it regularly, and having resources allocated to it, help to alleviate the stresses associated with crisis. They point out that effective communications throughout the response are essential. They reiterate training as a component of successful knowledge management system implementation.\textsuperscript{121}

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\textsuperscript{115} Jennex and Raman. “Knowledge Management.”
\textsuperscript{116} Belardo, Karwan and Wallace, “Managing the Response.”
\textsuperscript{117} Jennex and Raman, “Knowledge Management.”
\textsuperscript{118} Ibid., 190
\textsuperscript{119} Ibid., 190
\textsuperscript{120} Ibid.
\textsuperscript{121} Ibid.
\end{flushright}
Jennex and Raman provided an example of a knowledge management system for emergency response based on an “object-oriented database design” using the internet as the “medium of choice for presenting textual and graphical information to a distributed community of users.” They highlight the efficacy of the Information Management System for Hurricane disasters as a type of effective design due to the rapid pace of change in a disaster and this system’s ability to represent those changes.

The Strong Angel III disaster drill was also examined for the integration of “knowledge bases into visualization systems resulting in smart displays.” The effectiveness of the visual results from “tying social and demographic data and knowledge to images and maps,” in transferring tacit knowledge related to the crisis, across the spectrum of emergency responders, was acknowledged. Further fusions of data, systems, and platforms are expected, and will continue to be made possible by the advances of computer-based technologies. Jennex and Raman have summarized many issues, definitions, and reasons why effective crisis response very clearly needs knowledge management systems. For completeness however, there needs to be a consideration of the activities that are addressed by those systems, crisis response logistics support.

**Crisis Response Logistics Support**

The literature related to logistics activities in support of crisis response is not robust outside of the humanitarian arena. However, a review of business logistics during a crisis, demonstrates more similarities and alignment with humanitarian logistics than with the traditional business logistics model.

Humanitarian agencies are involved with logistics in the high-profile world of natural and man-made catastrophes. They include distribution of food, water, medical supplies and

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122 Ibid., 195  
123 Ibid., 195  
124 Ibid., 196  
125 Ibid., 196  
126 Ibid.  
basic housing to people in times of natural or man-made disaster.\textsuperscript{128} Similarly, crisis response logistics in support of business must also be executed during disasters. The commonalities, according to Van Wassenhove,\textsuperscript{129} include being essential to operations success, serving as the link between strategic sourcing and delivery to operations, and a supply chain nexus between the base of operations and the emergency operations in the field. These components represent the highest cost of an emergency to both the private sector and humanitarian responses.\textsuperscript{130}

The literature illustrates similarities between the private sector and humanitarian logistics when considering the large number of potential stakeholders involved for both types, and their vested interests in the outcome.\textsuperscript{131,132} The differences are demonstrated by the diverse types of stakeholders. For humanitarian efforts; dissimilar donors, the military, religious organizations, the affected population – often the very poor, and medical responders. Whereas in the private sector, stakeholders to crisis response logistics include, company shareholders, suppliers, operations personnel, back office functions, and executive management. Common to both are the media, governmental agencies, and means of distribution.

The literature further examines the “two main streams of humanitarian logistics as including continuous aid work, and disaster relief” as well as the need for real-time communications.\textsuperscript{133} A distinction between private sector and humanitarian logistics is illustrated by noting that private sector logistics deals with often-known and stable demand or quantities. Humanitarian responses most often encompass unstable situations, influencing

\begin{itemize}
\item Ibid.
\item Ibid.
\end{itemize}
the sustainability of the population during disasters. This results in unknown types and quantities of needs, although they generally fall into the categories listed above.\textsuperscript{134}

\textbf{SUMMARY}

The topics included in this literature review traced the high-level evolution of the Department of Homeland Security and how the protection of critical infrastructure is an activity that keeps increasing in importance for providers of gas and electric services, whether in public or private sector, such as San Diego Gas & Electric. Knowledge Management, applying things learned from previous experiences to new activities to improve performance, was introduced to provide context to the desire for continued improvements in SDG&E’s command center activities. That desire for enhancing processes, where possible, is supported by understanding how information is learned, stored, and later used, to improve organizational performance.

Using knowledge management systems in support of crisis response is introduced as the foundation for subsequent recommendations. Incorporating three elements of enhanced computer technology in SDG&E’s command center support activities is suggested. The literature acknowledges that knowledge management systems can be more effective than traditional emergency response processes in crisis response, thus knowledge management systems are explored as one means for compliance with critical infrastructure protection mandates. Finally, the area of crisis response logistics support was explored with the comparisons between the private sector and humanitarian efforts revealing similarities as well as differences related to logistical support from these disparate functions.

\textsuperscript{134} Ibid.
CHAPTER 3

METHODOLOGY

The purpose of this chapter is to describe the methodology associated with analyzing the potential efficiencies to be achieved by conversion from paper forms and spreadsheets to an alternate tool for tracking command center logistics supporting electric restoration activities in the aftermath of an emergency.

DESIGN OF INVESTIGATION

This thesis is a case study using action research, to assess whether future activities by the command center support teams can be influenced to convert from paper forms and spreadsheets to something more real-time, as a new solution for crisis response. The data is applied research from the 2007 Firestorm responses of San Diego Gas & Electric’s command center support. Their spreadsheets, emails, phone calls, including the personal observations of the researcher, who was a participant in the effort, provided the data for this thesis. The action research format is appropriate for this thesis because the research process involved manipulating outputs containing the command center logistical details and their role in the activities in the organization’s response to emergency situations.

After much debate and analysis, learned participants in the First Symposium on Action Research in Brisbane, Australia in 1989, formulated a set of perspectives on the definition of action research, including some of the situations in which it is appropriately used. The working definition from Zuber-Skerrit\textsuperscript{135} incorporated situations when people reflect and improve (or develop) their own work and their own situations by; tightly interlinking their reflection and action; and also making their experience public not only to other participants but also to other persons interested in and concerned about the work and the situation, i.e. their public theories and practices of the work and the situation, and in which the situation is increasingly: data-gathering by participants themselves (or with the help of

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others) in relation to their own questions; participation (in problem-posing and in answering questions) in decision-making, self-reflection, self-evaluation and self-management by autonomous and responsible persons and groups.\(^{136}\)

Improving an existing business process draws justification from the theory of action research as discussed in the Technology Acceptance Model (TAM) of perceived usefulness.\(^{137}\) TAM addresses the realm of computer technology and validation of the usefulness of employees’ outputs. Davis verifies the usefulness of the employees’ outputs based on their belief of how they performed in that activity.\(^{138}\) Additionally, Bandura reiterated the general concept with his self-efficacy model of people’s response and reaction being based on their perception of their competency in face of new technologies resulting from the computer and internet evolution.\(^{139}\) Bandura stated, “A capability is only as good as its execution.”\(^{140}\) Based on this, converting the paper forms and spreadsheets used for the command center logistical effort in 2007, to an alternative tool, might be indicated. The action research of this thesis is the reporting of the information tracked in the spreadsheets and the explanation of the areas for applying the transfer of spreadsheet information to a more technological format for easier and faster access in emergency response. Therefore, this serves as the impetus for improving the existing emergency response process via a technology tool.\(^{141}\)\(^{142}\)\(^{143}\)

Using the action research concepts, this researcher has reflected on the activities and work output of the 2007 Firestorm response of herself and her peers, including the roles of the key participants in the process, what tools they had to work with or processes they had to

\(^{136}\) Ibid., 413


\(^{140}\) Ibid., 122

\(^{141}\) Ibid.

\(^{142}\) Davis, “Perceived Usefulness.”

\(^{143}\) Venkatesh, Morris, Davis and Davis, “User Acceptance of Information.”
follow, and which ones they used the most, and the least, in the fast-paced support work of that emergency response. This reflection was conducted to determine whether there is an opportunity to propose a new approach to the work, to assist the organization in enhancing its response to future emergencies.

**DESCRIPTION OF THE SETTING**

After the Southern California fires of 2003, the Sempra Energy utilities’ vice president of Business Solutions, and Directors leading the support-type departments of Supply Management/Logistics, Fleet Services, Facilities, Real Estate/Land, Environmental, and Safety, formulated a program to further enhance their support to field operations areas in their response to emergencies. That new program was enacted for the first time during the 2007 Southern California fires. Under a dotted line reporting relationship to a manager responsible for all command center and staging area sites, “Business Solutions Liaisons” (BSLs) fulfilled a strategy that was designed to provide them as central points of contact. They were to interface between the operating centers’ field operations and SDG&E’s high-level central coordination and communications Emergency Operations Center (EOC), during emergencies that necessitated the set-up of staging areas and/or crew deployment areas. The BSLs were selected from a qualified pool of employees from the support departments, and based on their availability to respond to remote locations for ten-hour shifts. The BSLs were intended to be the “one-stop-shop” for all requests instead of field supervisors having to make requests of many areas for their needs.144 The BSLs are not examined in this thesis as a population. Their data output, however, is the sample examined in this thesis.

The BSL program would be activated under certain conditions including the following:145

- The utility experiences a major event

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144 San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff.”
145 A. Marcher, personal communication, April 1, 2010.
- The EOC is activated
- One or more off-property staging areas are needed
- It is requested by EOC staff

The BSLs had to be ready to mobilize at the beginning of an event through response and recovery. They were to engage with operating groups and coordinate with existing emergency response systems. In addition, the BSLs were to be familiar with field operations activities, be prepared for inclement weather, and be field-ready. Their responsibilities were defined by SDG&E\(^{146}\) as:

**Business Solutions “One-Stop-Shop”:** The BSL is the Business Solutions central point of contact for operating centers during major emergencies or events affecting the system. The BSL is responsible for:

- ensuring the operating center’s requests for support are handled in an efficient, systematic manner
- completing the appropriate Service Request Form and then communicating that request to the appropriate Business Support EOC Representative
- documenting requests in the BSL Service Request Log for record-keeping purposes and to ensure smooth transition to subsequent shifts.

**Report to Assigned Location:** The Business Support EOC Strategic Lead will assign BSLs to specific operating centers or command center locations. The BSL is responsible for:

- reporting to the location and checking in (and out) with the operating center person-in-charge
- checking in (and out) with the Business Support EOC Strategic Lead (or delegate).

**Ensure Personal Safety:** The BSL should attend Safety meetings at that location to ensure that he/she is fully aware of the hazards of that area. The BSL is expected to:

- wear appropriate clothing
- make proper use of all appropriate Personal Protective Equipment (PPE).

**Bring Phone and BSL Binder:** The BSL shall bring

- a cell phone
- the binder

\(^{146}\) A. Marcher, personal communication, April 1, 2010.
• any other equipment necessary to carry out the functions as described.

The BSLs were provided binders that contained:

**Services Provided by Supporting Departments:** for example, Fleet Services’ listing of equipment support and maintenance support (see Appendix)

**The BSL Service Request Log:** used to capture all the requests made by a BSL in one list (see Appendix)

**Service Request Forms:** paper forms with fields to log details of what was being requested (see Appendix)

**List of EOC support:** department desks (positions) contact information in the EOC (see Appendix)

**BSL Listing:** included a list of contact information on all available BSLs (see Appendix)

Teams of two BSLs were assigned to each location to cover two shifts per day. Sites were determined by identifying areas where the utility’s system had sustained significant damage, for economies of adjacency in location decisions (see Figures 1 and 2). If there was suitable land, and the area met strategic placement guidelines, a command center was located there.¹⁴⁷

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¹⁴⁷ San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff.”
In the first three days of the emergency, the Facilities department was activating its baseline set of plans, to achieve the earliest response to the expected need for some type of field command centers or staging areas. Therefore, they already had contingency plans in place for rapid procurement of several large tents to house the resting and dining functions for the emergency response, generators, lighting, drinking water, catering, and portable sanitation services (see Figure 3). As soon as they reported to their assigned command center locations with their laptops and air cards, cell phones, and personal protective equipment, BSLs checked-in with the construction supervisors to receive any logistical requests and support them in their core mission of directing system repair for service restoration of the utility system.

As the emergency unfolded, appropriate numbers of utility personnel, mutual assistance crews, and contract construction company crews were deployed to repair damaged
segments of the system. The BSLs were apprised by the construction supervisors, of the crew size increases or decreases, as work progressed across the damaged areas, and as mutual assistance crews arrived. The command center needs were adjusted depending on that crew movement.

In order of priority, meals, water, ice, and sanitation facilities were the most important of the many things needed at the command centers. Shelter (tents), electricity, portable offices, internet connectivity, and garbage containers and garbage collection were next in order of priority (see Figures 4, 5 and 6). A fuel tanker to refuel the crew trucks and a pad for a helicopter to land, including a water truck to mitigate dust from the helicopter and the vehicle traffic, followed in priority (see Figures 7, 8, 9 and 10).

148 Ibid.
149 Ibid.
Figure 4. Portable office.

Figure 5. Dumpsters for trash and recycling.
Figure 6. Fuel truck for refueling construction vehicles.

Figure 7. Helicopter landing zone.
Figure 8. Water truck for dust mitigation.

Figure 9. Hand-washing stands.
As soon as the BSLs reported to their assignments, they were to review the template documents in their binders, time permitting. There were often requests and/or people waiting for the BSLs as soon as they got to their locations, and the BSLs provided rapid response and follow-up on all requests. The One-Stop-Shop was an exceptionally successful response model because the construction supervisors’ needs were continuous and the BSLs execution of the ordering and tracking was a better use of company resources.

It quickly became apparent to this researcher that the paper request forms in the binder were unworkable, for two main reasons. The forms were meant to be handwritten, then faxed to the EOC representative for that request category, however, there were no fax machines available, at least in the first several days of the emergency. Further, the forms required name, date, and time information. The natural inclination of the BSLs was to call the EOC representative and initiate the request via cell phone call, then complete an email note with the same information as a written confirmation, and for ease of follow-up. The email notes automatically recorded name, date, and time information, and the BSL added the other shift’s BSL in the carbon copy line. Early in the process, the paper request forms
served as helpful visual cues for the details that needed to be included in the phone and email requests, but beyond that were hardly used.

Similarly, the paper BSL Service Request Log was viewed as inconvenient given the Sent Items feature which saves sent-email in a folder in the sender’s Outlook program. Not all of the BSLs used this paper Log knowing their Outlook Sent Items function captured and archived them automatically and more permanently in case the information was needed at a later time. Given that the other shift’s BSL had been copied on any emails, that alternate shift BSL did not need to review the paper Service Request Log to ensure smooth transition of information.

The 2007 San Diego County wildfires were comprised of three main blazes; the Witch Creek Fire which started in the Witch Creek area near the community of Santa Ysabel in northeast San Diego County and burned west, the Harris Fire which started in the town of Potrero in southeast San Diego County and burned northwest, and the Rice Fire which started near the community of Fallbrook in northwest San Diego County and burned northwest.\(^{150}\)

Each of these fires damaged electric transmission and distribution assets owned and operated by SDG&E. The areas of damage to the system were quite dispersed across the service territory necessitating multiple command centers and staging areas be established in the discrete areas impacted by the fires.\(^ {151}\) The distribution of the crews across the command center landscape was somewhat fluid as crews would finish a set of tasks in one area then move to join other crews, thus increasing the output of the newly formed, larger crew and reducing the expected time for work in an assigned area, and therefore, its associated command center, as well as other important activities.

Conference calls were conducted each day at 10:00am and 3:00pm so the manager could be updated on these crew movements and how that translated to changing command centers at which they were supplied. Participating in these two-a-day conference calls provided the BSLs notice of the impending changes, so they could assess the adequacy of provisions on hand, adjust the meal counts as needed, and keep the manager apprised as to the changing population at the command centers.

\(^{150}\) Geier, “Investigation on the Commission’s.”

\(^{151}\) San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff,” 14
To capture and consolidate the information related to the command centers, the manager used a spreadsheet to track the information, by location. The valuable rented, and company-owned assets located at each site were closely monitored by the process of the BSLs completing and emailing the spreadsheets back to the manager after the afternoon conference call. Early the next morning, the manager’s administrative support began the arduous task of updating more than ten versions of the spreadsheet into a single spreadsheet for the manager’s consolidated view and update to the EOC and regularly, to the Executive team. This represented approximately one to two hours per day.\textsuperscript{152}

Considering the numbers of requests the BSLs made during the activation of the Command Centers, it is notable that the information and requests were passed so well and the data was tracked so closely. Yet there were instances when their requests for items needed for the command centers were not conveyed exactly or delivery was late. Other times requests were duplicated, or second and third calls were received from the providers to confirm if materials or meals were still needed, when the items had already been received.

**Sample**

The data that were analyzed related solely to the support of the command center camps and what it took to sustain their mission as bases from which to deploy the electric restoration personnel during the power outages. The details surrounding the ordering, receiving, inventoring, handling, staging, and deployment of construction materials, such as poles and wires, were not the purview of BSLs’ work in support of the command centers. Material handling was the responsibility of the Logistics and Warehousing groups.

The spreadsheet listed 25 categories of information that included the following column headings: Region, Need for Site: Yes/Pending, Site Name, Command Center/Staging Area, , Site Coordinator & Phone #, Thomas Brothers page, Address, Start Date, Estimated End Date, Total # of People, Food Counts, #B, #L, #D, water buffalo Y/N or 5 gal H2o, # of Porta Potties, Trash bin type: trash/cable/metal/treated wood/recyclables, # of hand-wash stands, Portable Office Trailer, Copier, Lights, Generator(s), Parking Space Reqmnts (Requirements), Material Laydown Space Reqmnts (Requirements), Security, # of Vehicles,

\textsuperscript{152} P. Henschel, personal communication, March 23, 2010.
Phone /Data/Radio/Printer, BMP Materials, Notes/Comments. These 25 categories are
detailed in Chapter 4.

The data that were examined were three versions of the spreadsheet, Firestorm 2007 -
Command Centers and Staging Areas, during the time frame of October 24, 2007 through
November 10, 2007, to demonstrate the progression of the command centers’ expansion and
contraction over time. The spreadsheet also displayed the types of items being tracked at a
consolidated level. A possible conclusion can be drawn as to the time-consuming manual
nature of tracking by the spreadsheet method (see Appendix).
CHAPTER 4

FINDINGS AND DATA ANALYSIS

The findings and data analysis discussed in this chapter address the following research questions: What alternative approach would have enabled the teams working on the command center effort for emergency response to have easier-to-use, faster-to-access data? What solution would include the capability to store basic command center requirements from previous emergency responses to save time in addressing the first or most crucial items needed during the next emergency? What resiliency could be built into command center logistics tracking in case the company’s network was rendered inaccessible at the same time as command centers were needed for service restoration activities?

The 2007 Southern California fires damaged a large amount of San Diego County’s territory including, in some areas, SDG&E’s means of delivery of electric service, its poles, wires, cable, and transformers.\textsuperscript{153} SDG&E coordinated a full-scale effort to restore service for its customers as soon as possible. “To provide forward support closer to the actual field locations where the bulk of the repair and restoration work was occurring, SDG&E established ‘command centers’ and ‘staging areas’ in strategic locations.”\textsuperscript{154} Establishing and maintaining the command centers and staging areas to support the crews in their restoration efforts, and ultimately closing them down, involved approximately 56 employees from supporting departments, for approximately three weeks in a significant logistical exercise.\textsuperscript{155}

The process began with: (1) baseline requirements needed for a command center or staging area, (2) personnel assigned to the location to be the points of contact, called Business Solutions Liaisons (BSLs), and (3) the BSLs’ laptop computers with air cards for internet connectivity, the BSLs’ cell phones, a master spreadsheet to track all the details of

\begin{itemize}
\item \textsuperscript{153} Ibid.
\item \textsuperscript{154} David L. Geier, “Investigation on the Commission’s,”, 14
\item \textsuperscript{155} San Diego Gas & Electric, “Prepared Direct Testimony of Alan Dulgeroff.”
\end{itemize}
all the command centers and consolidate them into one view, and paper forms on which BSLs could make requests for items needed at the sites. The spreadsheets did not look at the causes of the emergency, but helped manage the responses.

This researcher, a team lead of the SDG&E supply chain systems team, served in the BSL capacity. The people who received the requests and information from the BSLs and fulfilled them were support department representatives manning their specific EOC positions. Each EOC position was staffed around the clock at the beginning of the emergency, and as appropriate later in the response, was reduced to 16 hours per day of coverage.

The BSLs received all the requests associated with taking the command centers from their baseline configuration to fully-functioning field operations support, by working as the interface between the construction supervisors, the EOC representatives, and on occasion, directly with the vendors. The defined method for initiating a request for materials or services was the library of paper forms included in the BSLs’ handbook (see Appendix).

In practice however, instead of using the paper forms to initiate requests, there were two preferred methods by which BSLs sent requests to the EOC representatives. The first method was via cell phone call. The second method was via company email which was available via air card internet connectivity and VPN computer network access. These emails were often written follow-up to the initiating phone call. Also, since they were accessing the network via VPN, all internal drives and intranet pages and systems normally available to BSLs were accessible. The EOC representatives were on-site at SDG&E’s company headquarters location, and had the full company network available to them and received BSL email communications in that manner.

The main tool used to handle the command center logistics effort was a spreadsheet. The spreadsheet details included:

1. Region: Which SDG&E district or area of control it is related to, particularly with regard to emergency response, described as:

   **Construction and Operations Districts:** SDG&E maintains six geographically determined Construction & Operations Districts (a.k.a. districts or “C&O Centers”) and two satellite operations. The districts are identified by name as:

   Construction Metro (or Metro)
   Beach Cities
   North Coast
Orange County
Northeast
Ramona (satellite to Northeast)
Eastern
Mountain Empire (satellite to Eastern)

Each district is staffed with a management team, administrative support staff, engineering and planning personnel, fleet and logistics support, and a variety of highly trained and qualified field technicians represented by Local 465 of the International Brotherhood of Electrical Workers (IBEW). Construction and Operations personnel are primarily responsible for maintaining, operating, and upgrading the existing gas and electric distribution systems. This includes routine maintenance and new construction, as well as responding seven days-a-week, 24 hours-a-day, to routine gas and electric outages and emergencies affecting SDG&E’s customers. When large emergencies occur, the districts collaborate to redeploy resources from an unaffected region to locations in need of additional support or specialty equipment.156

2. Need for Site: Yes/Pending. If it is known from the start of the emergency response that a site will be used for a command center or a staging area, it would be designated as Yes. If it is feasible a site will be used, depending on factors such as how bad the damage in an area is determined to be, it would be designated as Pending in order for a firm determination to be made, and final details related to permissions for its use to be completed.

3. Site Name: Site names were either the name of the Construction and Operations District listed in item 1 above, from which certain crews, and many supporting personnel were operating from, or the command center / staging area generally determined by its most identifiable location feature.

4. Command Center/Staging Area: The type of location must be specified. A command center is defined as a central meeting site with relatively convenient location from which to deploy restoration crews, distribute food, provide restroom facilities, and collect certain waste or recyclable materials. With locations close to where repair and restoration work is being performed, command centers minimize crew driving time. They include office trailers for field management planning, vehicle fueling tankers, temporary storage for poles and materials, and potentially, helicopter landing zones.157 Staging Areas are areas for material to be delivered from the company warehouse, a manufacturer, or other utility, for crews’ use in field. It includes portable sanitation facilities, wash stands, and waste bins.158

156 Ibid., 22-23
157 Ibid.
158 Ibid.
5. Site coordinator and phone number: Usually an electric construction supervisor, assigned to have functional oversight of the location.

6. Thomas Brothers page: The corresponding page and grid coordinates for each command center or staging site location, as listed in the commonly-used Rand McNally Thomas Brothers Street Map books.

7. Address: The street address of the site, if applicable. When not applicable, the name of the intersection at which the site was located, or other specific text to aid in identifying a command center or staging area location. For example, South end of Main Street in flat dirt field with metal gates at entrance.

8. Start Date: The anticipated date on which the command center or staging area would need to begin providing its services.

9. Estimated End Date: The anticipated date on which restoration activities related to a particular command center or staging sites were low enough that a determination was made to close the site down.

10. Total number of People: The total number of personnel expected to deploy from, or provide support from or to a site, including the emergency response activities conducted from locations included in item 1 above.

11. Food Counts, #B, #L, #D: The number of breakfasts, lunches, or dinners that generally would be needed to be served at each command center.

12. Water buffalo Y/N or 5 gal H2O: A Water buffalo is the colloquial in-house term for a small double-axel trailer with a 500 gallon water tank mounted on it. If a site did not have a water trailer, cases of five gallon water bottles were an option.

13. Number of Porta Potties: The number of portable restrooms at each site. This number is determined by one portable restroom per every 20 people of expected use.

14. Trash bin type: The waste generated by both the command center, and the waste that was brought to the command center from the field.

15. 40 yd recycle bins: The waste from the field brought to the command center which must be kept separate. Types include: burned electrical cable, metal, treated wood, recyclables such as aluminum cans, bottles, paper.

16. # of hand-wash stands: The number of portable hand-washing facilities needed at a location. This number is determined at approximately one hand-wash stand to every 10 portable restrooms.

17. Portable Office Trailer: Office space contained in a trailer, complete with lights and electrical connections, ready for office work in the field.

18. Copier: A photo copy machine often used to copy maps and electrical system prints for further distribution to field crews deploying from a command center.

19. Lights/Generator(s): Portable lights on wheels for illuminating a large outdoor area, powered by their on-board generator.

20. Parking Space Reqmnts: Whether or not a site needed to accommodate crew trucks, boom trucks, and other visiting vehicles within the command center boundaries.
21. Material Laydown Space Reqmnts: The dimensions of an area large enough to hold the construction materials that would be staged for use in the construction effort.

22. Security: Whether or not a site needed a security guard and the hours of coverage.

23. # of Vehicles: An approximate number of vehicles needing fueling to determine the size of tanker to assign to a site.

24. Phone /Data/Radio/Printer: Types of communication connectivity.

25. BMP Materials: Environmental best management practice kits for handling soils, etc exposed to vehicle traffic, burn effects, and weather.

The spreadsheets are three samples of the daily iterations of the 2007 Firestorm command center and staging area consolidated information. All of the categories represented essential items needed to support response to the emergency. Many of the BSLs’ actual practices did not include filling-in the paper forms, which meant the paper forms provided in the binder went unused. The service request log in the binder was also not used by the BSLs as they preferred the daily-updated spreadsheets that conveyed the entire command center landscape. The spreadsheet in its consolidated form was the most significant tracking output of that effort. The main benefit of the spreadsheet was the ability to track, albeit a day later, the logistical details of the command center, which included upward reporting to and by the manager. This information was kept current by the BSLs completing and emailing the spreadsheets back to the manager after the afternoon conference call, for his administrative support’s updating. The inherent inefficiency of its manual consolidation prompted the research questions. The main disconnects are discussed in Chapter 5.

A consideration of efficiencies to be gained and opportunities to track more categories of information, if needed, might reveal a new structure for the process, using an alternative approach to the paper forms and the spreadsheet. Consequently, the analysis of efficiency of the spreadsheets compared to real-time access to data, might include a new technology or a combination of several. An examination of the details of forms on smart phones, dashboards, blogs and wikis, and cloud computing would be timely, as SDG&E continuously strives for improvement of its crisis response.
CHAPTER 5

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

INTRODUCTION

This action research addressed the following questions: What alternative approach would have enabled the teams working on the command center effort for emergency response, to have easier-to-use, faster-to-access data? What solution would include the capability to store basic command center requirements from previous emergency responses to save time in addressing the first or most crucial items needed during the next emergency? What resiliency could be built into command center logistics tracking in case the company’s network was rendered inaccessible at the same time as command center activities were needed?

This chapter includes a summary of the data, and implications and recommendations for further research. Based on the data resulting from SDG&E’s 2007 Firestorm command center support response analysis, two hours a day of conference call attendance, paper form requirements, and editing of the spreadsheet by each BSL team, indicates opportunities to improve efficiency exist. Several possibilities for alternative approaches to command center logistics tracking are growing in use and popularity. To address the first research question on what alternative approach to emergency response logistics tracking would be easier-to-use and provide faster access to data, rendering forms on smart phones in replacement of paper forms, blogs for BSLs to convey new situations or information they encounter, via a posting on a webpage, making it readily searchable for the next crisis, wikis, which can capture blog information of a more formal or permanent nature to document processes or procedures, and dashboards as a means to display the real-time, consolidated, command center information, links, and metrics, in an easy-to-access manner is suggested.

Although not the only alternatives, the discussion explains the use of the database supporting dashboards related to the second question, and the concept of cloud computing related to the third research question. This combination of alternatives incorporates the
concept of building resiliency into a company’s activities supporting critical infrastructure response work, as well as reducing duplicative or outdated methods. It also can be viewed through the lens of Jennex and Raman’s expanded crisis response system model. The expanded system they define encompasses more than “the basic components of database, data analysis, normative models, and interface.” Enhancing that model, Jennex and Raman offer the addition of:

trained users (where users are personnel using the system to respond to or communicate about the emergency and consist of first responders, long term responders, the emergency response team, and experts), dynamic, integrated, and collaborative (yet possibly physically distributed) (sic) methods to communicate between users and data sources, protocols to facilitate communication, and processes and procedures used to guide the response to and improve decision making during the crisis.

This expanded crisis response system model is applicable to the discussion of combining alternatives in order to better respond to the logistics tracking activities of SDG&E’s emergency response. Specifically, the dashboards fulfill the model’s condition for a dynamic method of communication, based on the real-time nature of the information received and displayed. The potentially constantly updated information supports the optimum display of what is residing in the underlying data sources to users and, further, to non-users such as executive teams, and decision-makers. The dashboards further fulfill the model’s component of integrated and collaborative protocols by their attribute of displaying multiple types of information from multiple sources or contributors, that would not normally be displayed together in a single display, or viewable by so many different parties. Further, the nature of the field operations and the EOC functions being physically separated conforms to the model’s almost-certain distributed teams, sites, and means of communications.

The sometimes inefficient and duplicative effort associated with the BSLs’ use of paper forms and follow-up phone calls, and the time-consuming consolidation of that information in a spreadsheet with limited visual display characteristics, implied one or all of these alternatives may have efficacy in improving BSL-related data output in subsequent

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159 Jennex and Raman. “Knowledge Management in Support of Crisis Response,” 190

160 Ibid., 190
emergency efforts, as supported by the Jennex expanded crisis response system model. The result of analyzing enhanced concepts to the command center tracking needs, suggests further study of forms on smart phones, and dashboards connected to a robust back-end database already populated with baseline data, residing on remote servers in a private cloud. It is further suggested that by virtue of these data and software programs being sent and accessible via cloud computing, the results would be a multi-user, easy-to-access, resilient, actionable platform to replace the spreadsheets and paper forms for command center logistics tracking. To address the second research question on storing command center requirements for saving time at the start of future emergency responses, the robustness of the backend database suited to a sophisticated dashboard may be a viable alternative to hold baseline data captured from previous major electric restoration events. A site on which any participant in the command center effort could blog about any special experience for sharing with the other team members would be timely as well as easy to access. Problems or issues discussed in the blogs and successfully addressed could be elaborated upon or documented in a more formal and thoroughly developed way and posted as a wiki, as a more permanent and searchable archive. The third research question on resiliency in case of unforeseen inaccessibility, suggests the use of private cloud computing, which would result in a virtual, secure, remote location for SDG&E-related command center activities to be developed, housed, and delivered. The need for secure software and data is important because of the proprietary nature of the information. Therefore, the practical solution to help the utility in case of a catastrophic loss of its computer network might include private cloud computing, explained in the discussion section. Possibilities of other technological alternatives may be suited for transforming the spreadsheets and the paper forms, and displaying command center logistics however, the intricacies of technology need to be addressed as further suggestions.

DISCUSSION

The viability of the following technologies in support of alternative systems for crisis response is derived from the Jennex and Raman concept.\textsuperscript{161} The forms on smart phones, blogs and wikis, cloud computing, and the dashboards similar to those developed by SDSU’s

\textsuperscript{161} Ibid.
Visualization Center for flu tracking in San Diego county,\textsuperscript{162} when implemented together, can all be considered components in the fusion of KM systems.\textsuperscript{163} Filling out paper forms and completing the spreadsheets was actually just the manual assembling of a list of data in columns and rows and not a meaningful transfer of ideas, needs, and information. When ideas, needs, and information are assembled without further need for consolidation or user adaption, and then easily rendered visually, it results in expedient crisis response through impactful visual cues and a more efficient transfer of knowledge.

Tacit knowledge from BSLs’ previous experiences can not be appropriately conveyed in a single file when the information is simply housed in a spreadsheet’s columns and rows format. However, the multi-dimensional, graphical layering, and photographic images displayed in a dashboard format heralds the emergence of knowledge transfer that would benefit the evolution of SDG&EE’s emergency response model. Blogs to capture BSLs special experiences or issues, and wikis to more permanently archive the blog posts that lend themselves to formal processes and procedures, provide a searchable, easy to access forum for command center participants’ specific information. Handling the knowledge in support of crisis response in this manner substantiates the Jennex and Raman assertion that, “decision makers, when under stress, need systems that do more than just provide data, they need systems that can quickly find and display knowledge relevant to the situation in a format that facilitates the decision maker in making decisions.”\textsuperscript{164}

The research related to the spreadsheets revealed that they performed in an adequate manner based on the fact that the command center logistics tracking was generally accurate and the consensus among the interfacing groups was that the command center model performed very well. However, the lag time in displaying updated information on the distribution of the crews across the command center landscape during a day, and how that impacted meal counts which, potentially dramatically affected the crews’ perception of well being, can be surmised due to the manual consolidation effort necessary to keep spreadsheet data current. The literature validates the significance of the crews’ perceived well being as

\textsuperscript{162} E. Frost, personal communication, April 19, 2010.  
\textsuperscript{163} Jennex, and Raman, “Knowledge Management in Support of Crisis Response.”  
\textsuperscript{164} Ibid., 196
having substantial importance. Burnell et al. as cited in Jennex & Raman, state, “the role of having accurate and up-to-date information is vital particularly when organizations deal with a turbulent environment.”

Relative to the discussion of the crews’ well being, a tangent factor of the BSLs’ efforts in the command center support was their stated feelings of satisfaction related to their accomplishments, as discussed in a BSL debrief meeting in November, 2007, attended by this researcher. The perceived usefulness of their efforts and their feelings of self-efficacy gave an indication of how likely BSLs would be to embrace alternative approaches to the work if it meant further improvement in their response to a crisis. While this relates to implementing knowledge management systems in support of crisis response, it must be acknowledged that the responsibility for efficient and timely restoration of essential services is still a mandate from the federal government as codified in HSPD7. Despite SDG&E’s culture of dedicated restoration activities, the BSLs’ satisfaction in support of the company mission, or the opportunity to leverage computer technology and knowledge management systems to enhance the logistical support, the restoration activities would still be required by the federal government even in the absence of those company requirements and employee satisfaction drivers.

It must be acknowledged that there could be a scenario when the normal systems for achieving compliance with HSPD 7’s requirements would be completely interrupted. In the event of a loss of SDG&E’s computer network infrastructure, an alternative to the company network would be needed to handle the on-going restoration tracking efforts. One alternative to the traditional and local company network would be via cloud computing.

Cloud computing is defined in the following way by Buyya, Yeo, Venugopal, Broburg, and Brandic:

A Cloud is a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resource(s) based on service-level

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165 Jennex, and Raman, “Knowledge Management in Support of Crisis Response.”
166 Ibid., 192
167 Ibid.
agreements established through negotiation between the service provider and consumers.169

In the event SDG&E’s computer network was rendered unusable, whatever applications were needed for the command center response could be housed on virtual servers in the cloud, and accessed via the internet, likely through wireless connectivity such as the BSLs’ air cards. The implication is SDG&E could continuously access its disaster response support tools if they were housed and delivered outside the company network. The security aspect would be addressed by using the cloud computing model known as the private cloud, in which processing, storage, networking, and the application, are via an intranet, allowing for user authentication, and encryption of the company’s proprietary data.

Computing via the cloud allows for applications to be used on a pay-as-you-go pricing schedule.170 This would allow the cost of an important emergency response tool, after its initial development costs, to be borne only at the time the company is experiencing an emergency. Responding to emergencies often carries great costs, some of which can be recovered in rates if SDG&E’s governing regulatory agency grants such a request. Matching the costs of a pay-when-used type of emergency response support tool to the infrequent occasions of emergencies impacting SDG&E’s critical infrastructure, supports a position of careful stewardship of costs the company will eventually request to recover. Further, using cloud-based tools to house an emergency response logistics tracking application securely outside SDG&E’s territory and having it be accessible via any internet-based connection along with VPN, provides a resilience to catastrophic wildfire- or earthquake-caused network destruction that would interfere with tracking of, although not halt, SDG&E’s restoration activities in the field.

Analysis of the manual, and not-well-used paper forms for BSLs to send requests to the EOC, demonstrated the need for an alternate request method. As was demonstrated by practice, phone calls and follow-up emails were preferred to the paper forms. However, the


email was duplicative to the phone call, which suggests a less-than-optimal use of the BSLs’
time. The rendering of a paper form for display and user input on a smart phone has
potential utility as the technology to replace the paper forms for command center logistics
requests.

Data initiated by a request is needed to execute the activity and provides the EOC
recipient with record of the exact details needed for accurate fulfillment, almost always better
than a phone call request, but usually not faster. Yet, the BSLs all had cell phones and
continuously made requests initiated by a call then followed-up with email for solid
confirmation. Figure 11 shows an example of using a smart phone form to replace both the
paper form and email. The slide portrays a smart phone with a form accessed from the
phone’s embedded memory. The similarities to the BSLs’ basic form for requesting Fleet
services (Appendix) can be seen. An efficiency of using the hand-held portability and instant
communications of a cell phone, while having the accuracy and full detail inherent in a form,
can both be achieved with this technology. Further, the electronic forms housed in the smart
phones’ memory could also be available in a library of request forms, as a secondary and
back-up location to the smart phones. The practices of the BSLs in the field imply this
alternative merits further investigation and possible piloting during future SDG&E
emergency drills.

**IMPLICATIONS**

The implications for future research, addresses the need to experiment with the
dashboard for the current spreadsheet data and links to other BSL-needed information to be
transformed. A dashboard would be provided to the BSLs, their decision-makers, and related
support departments for further determination of the efficacy of the technology. The user
requirements of both dashboard and cloud computing would be structured by the technical
staff at SDG&E to test whether cloud computing and dashboards are viable to alternatives to
replace the current spreadsheet.

The spreadsheet as the most significant tracking output of the BSLs’ efforts is
important when considering how such a single, relatively simple file was the source for
tracking a great deal of valuable SDG&E-owned or rented assets, providing the manager with
the ability to report to the EOC and the Executive team the extent of the command center support of field operations, and his decision-making related to consolidations of sites, or needed geographical changes, particularly while the fires were still burning. Considering those substantive uses of the spreadsheet, the lag time in the data’s accuracy due to the need for consolidation, indicates the audiences could be better served as more real-time technologies become achievable for this specific purpose. Furthermore, the recognition of the potential need of other categories and/or sources of information implies the spreadsheet format was already at the limit of its utility. The need for a tool with the ability to display data in a visual, real-time format, with links to helpful or related sources of information such as BSL-related blogs and wikis, is indicated. Such a tool is available in the form of dashboards.

A dashboard provides internet-browser display of many categories of data from potentially many sources. It provides for understanding of performance indicators of importance to a specific audience, by summarizing them and often displaying them by
graphical icon. The summarized data displayed in a dashboard can often be the starting point to drill down to their detail. Conveying the data in a summarized, graphical way represents a significant, behind-the-scenes effort of collection, consolidation, and presentation of the data that starts to transfer tacit knowledge when the consolidation allows for decision-making based on the whole picture that is drawn by the dashboard.

Michael Kennedy of Shee Atiká Technologies built the San Diego Resilience Network Response Information Portal dashboard shown in Figure 12 for SDSU’s Visualization Center. It was built on a military model with deep software capability in the back-end, and was demonstrated in Washington DC to groups at the National Library of Medicine, including people helping lead the H1N1 flu virus response for the White House.\textsuperscript{171} It provides insight into how effective a dashboard can be to relate information in a graphical, summarized way. It includes a map viewers can drill-down on with detailed links into specific data sets. Google flu trends for the area were displayed as arrows showing flu cases on the rise, decline, or status quo.

Figure 12’s dashboard supports two important points made by Turoff when he suggested the Office of Emergency Preparedness formulate a philosophy that included statements such as, “supplying the best possible up-to-date information is critical to those whose action may risk lives and resources” and that an emergency response information system must be, “an integrated electronic library of external data and information sources”.\textsuperscript{172} The data in SDG&E’s command center tracking spreadsheet has the potential to become enhanced decision-making information and therefore knowledge that can be applied by its users through the use of baseline data from past command center experiences to respond to a present emergency.

Using the Figure 12 dashboard as an example, displaying the following data taken from the spreadsheet categories in a more actionable manner could enhance decision-making or at the least, readability and timeliness. The \textit{Overall Status} display in the top center box could display the number of electric circuits that are damaged and out of service in red,

\textsuperscript{171} E. Frost, personal communication, April 19, 2010.
\textsuperscript{172} Turoff, “Past and Future Emergency Response.”
Figure 12. Example of a dashboard from an emergency response.

repaired and back in service in green, and in progress in yellow, as this was a significant item that was reported on in the daily conference calls, but was not displayed in writing for that population. The **Op Graphics** box displaying the San Diego County map in the center could display SDG&E’s service territory with the command centers and staging areas flagged by unique indicators. It could be overlaid with burn-area maps, and road closures around the County. Road closures especially affecting the command centers could be displayed in blinking red. Drilling-down on the command centers could display all the data housed in the spreadsheet. This data could be kept in real-time by all the parties to the effort having access to a back-end database where they enter changes as they occur.

The **Significant Events** center bottom box could hold the same type of communications as shown on the example slide, with a name or position stamp of the poster included. The **Important Information** box on the top right could house items such as lists of mutual aid responders en route, in field, and released. This box could also hold all hotel and contact information for the mutual aid and contract construction crews, and list their assigned company liaisons/supervisors. This box could also display the policies related to activities in
the field such as the Environmental Best Management Practices, and Safety policies and procedures, and wikis with relevant content, so all participants have that information readily at hand.

The *Links* box on the bottom right could include all important links for the command center effort including City, County, Fire, Police, Military, Tribal, Federal Government, and State Agencies. It could also link all the predesigned reports that might be needed for printouts and sharing either in field, with media, or general communications, as well as a link to participant blogs for sharing experiences and commenting on each others’ postings. The *Area Status* in the top left box could house each command center’s statistics and whether it is increasing or decreasing in size, or remaining the same. Drilling down on each command center name could also link to all the details currently captured in the spreadsheet, as well as which BSL is currently on shift and what time their shift ends.

The *Local Agencies* box in the middle left could instead house all the important contact lists for the command center effort such as the EOC representatives contact information, their shift list, the supporting department contact information, the lists of items available from the supporting departments, the BSL contact list, and the BSL shift list. The Feedback box in the bottom left could be an instant message-type chat window for EOC representatives and BSL’s and could include the ability to chat with one or more people.

The summarization and display of all of these types of information sources in a single dashboard enables viewers to drill down to access other websites, company intranet pages, participant blogs, related wikis, detailed data from maps and databases, and have it all accessible real-time. It would be a significant enhancement to the ways this information was available to SDG&E’s emergency response support teams in previous emergencies. This “practice of selectively applying knowledge from previous experiences during turbulent moments of decision making, to current and future decision making activities with the express purpose of improving the organization’s effectiveness, would be possible via a knowledge management system”\(^{173}\) such as a dashboard along with its underlying means of delivery.

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\(^{173}\) Jennex and Raman, “Knowledge Management in Support,” 193
RECOMMENDATIONS

This thesis proposes further research for an alternative to SDG&E’s paper request forms for command center needs, and suggests the use of request forms rendered on smart phones assigned to the BSLs for the duration of the effort. In addition, the development of dashboards, including links to command center participant blogs and wikis, is suggested as an effective alternative to spreadsheets to track the command center logistics, and provide easy to access information. And finally, more research on the use of private cloud computing on the internet as the development platform and host of an SDG&E dashboard application along with its database is recommended as a timely evolution to a knowledge management system approach to achieve logistical tracking efficiencies, as the company analyzes and further refines its critical infrastructure protection processes.
REFERENCES


APPENDIX

TABLES
Table 1. Example of Types of Fleet Services Available

<table>
<thead>
<tr>
<th>SERVICE PROVIDED</th>
<th>DEPARTMENT</th>
<th>WHO TO CALL</th>
<th>ON DUTY CONTACT PERSON AS DIRECTED BY THE EDC COORDINATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Support Service</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Vehicle Maintenance Support</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Vehicle Fueling Service</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Portable Equipment Fueling Service</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Mobile Maintenance Repair Service</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Vehicle Field Breakdown Service</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Fleet Employee Shift Work Coordination</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Vehicle Maintenance Mowing Needs</td>
<td>Fleet Services</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Operations Support Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order Support</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Water Truck Support and Service</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Material Transportation Service</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Pole Transportation</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
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<tr>
<td>Vendor Related Crane Rental Support and Service</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
</tr>
<tr>
<td>Vendor Related Equipment Rental Service</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
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<tr>
<td>Heavy Equipment Operation Service</td>
<td>Fleet Operations</td>
<td>EDC</td>
<td></td>
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<tr>
<td>Vendor Related Services</td>
<td></td>
<td></td>
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<tr>
<td>Portable Equipment Rental Service</td>
<td>Fleet Rental Services</td>
<td>EDC</td>
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<tr>
<td>Light Duty Vehicle Rental Service</td>
<td>Fleet Rental Services</td>
<td>EDC</td>
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<tr>
<td>Heavy Duty Vehicle Rental Service</td>
<td>Fleet Rental Services</td>
<td>EDC</td>
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<tr>
<td>Vehicle Towing Services</td>
<td>Fleet Rental Services</td>
<td>EDC</td>
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<tr>
<td>Shuttle Coordination Service</td>
<td>Fleet Rental Services</td>
<td>EDC</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. BSL Service Request Log

<p>| BUSINESS SOLUTIONS LIAISON SERVICE REQUEST LOG |
|------------------------------------------------|------------------------------------------------|
| Site Name:                                     | Site Address:                                  |
| Site Address:                                  | Thomas Bros. Page/Quadrant:                    |
| Primary Site Contact Name/Phone:               | Secondary Site Contact Name/Phone:             |
| Site Liaison Name/Phone:                       | Submitted To: Fall in the Fishbowl, Envelope,  |
|                                               | Legation Letter, Shirt                         |</p>
<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Requestor Name/Phone</th>
<th>Request Incident Description</th>
<th>Submitted To</th>
<th>Date/Time</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Table 3. Example of BSL Service Request Form

<table>
<thead>
<tr>
<th>Fleet Services</th>
<th>IMERGENCY OPERATIONS CENTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fleet Request Form</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td>Time:</td>
</tr>
<tr>
<td>Requested/Primary Contact Name:</td>
<td></td>
</tr>
<tr>
<td>Requested/Contact Phone:</td>
<td></td>
</tr>
<tr>
<td>Assistance/Delivery Address:</td>
<td></td>
</tr>
<tr>
<td>Thomas Bros. Page/Quadrant:</td>
<td></td>
</tr>
<tr>
<td>Secondary Contact Name:</td>
<td></td>
</tr>
<tr>
<td>Secondary Contact Phone:</td>
<td></td>
</tr>
</tbody>
</table>

**Maintainance Support Services**

<table>
<thead>
<tr>
<th>Service</th>
<th>Type</th>
<th>Quantity</th>
<th>Service Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Which Building</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Operation Support Services**

<table>
<thead>
<tr>
<th>Service</th>
<th>Type</th>
<th>Quantity</th>
<th>Service Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door Support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Task Support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After Hours Task Support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Transporation</td>
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</tr>
</tbody>
</table>

**Vendor Support Services**

<table>
<thead>
<tr>
<th>Service</th>
<th>Type</th>
<th>Quantity</th>
<th>Service Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Duty Vehicle Repair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy Duty Vehicle Repair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Task Support</td>
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<tr>
<td>Heavy Task Support</td>
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<td></td>
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<tr>
<td>Light Vendor Support</td>
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<tr>
<td>Heavy Vendor Support</td>
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<td></td>
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<tr>
<td>Vendor Equipment</td>
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</tbody>
</table>

**Miscellaneous Services**

<table>
<thead>
<tr>
<th>Service</th>
<th>Type</th>
<th>Quantity</th>
<th>Service Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous Services</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Miscellaneous Services</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Example of Contact Lists Provided in BSL Binders: EOC Contact Information

<table>
<thead>
<tr>
<th>BUSINESS SUPPORT</th>
<th>PHONE NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Services</td>
<td>555-555-1111</td>
</tr>
<tr>
<td>Strategic Lead</td>
<td>555-555-1112</td>
</tr>
<tr>
<td>Environmental Rep</td>
<td>555-555-1113</td>
</tr>
<tr>
<td>Facility Rep</td>
<td>555-555-1114</td>
</tr>
<tr>
<td>Fleet Rep</td>
<td>555-555-1115</td>
</tr>
<tr>
<td>Human Resources Rep</td>
<td>555-555-1116</td>
</tr>
<tr>
<td>IT Rep</td>
<td>555-555-1117</td>
</tr>
<tr>
<td>Logistics Rep</td>
<td>555-555-1118</td>
</tr>
<tr>
<td>Safety Rep</td>
<td>555-555-1119</td>
</tr>
<tr>
<td>Security Rep</td>
<td>555-555-1120</td>
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<tr>
<td>BSL Lead</td>
<td>555-555-1121</td>
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Table 5. Example List of BSLS

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<tr>
<th>EMPNAME</th>
<th>ASSIGNMENT</th>
<th>WORK PHONE1</th>
<th>WORK PHONE2</th>
<th>CELL PHONE1</th>
<th>CELL PHONE2</th>
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<td>David F.</td>
<td>Beach Cities</td>
<td>858-555-1111</td>
<td>858-555-1112</td>
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<td>Project Operations - South</td>
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<tr>
<td>Teresa D.</td>
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<td>858-555-2222</td>
<td>858-555-2223</td>
<td>Supply Management</td>
<td>System Administration</td>
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<td>Rachel R.</td>
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<td>858-555-3334</td>
<td>858-555-3335</td>
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<td>Andy R.</td>
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<td>858-555-4446</td>
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<td>Susan P.</td>
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Table 6. Example of BSL Staffing Schedule

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<th>Monday 10/29/07</th>
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<th>Wednesday 10/31/07</th>
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Table 7. Expected Location Assignment of Mutual Assistance Crews

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<tr>
<th>COMPANY</th>
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<th>ARRIVAL DAY</th>
<th># CREWS</th>
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<tr>
<td>SOCAL GAS</td>
<td>NORTH EAST</td>
<td>Thursday 10/24</td>
<td>4</td>
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<tr>
<td>PG &amp; E</td>
<td>NORTH EAST</td>
<td>Friday 10/26</td>
<td>10</td>
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<tr>
<td>SALT RIVER PROJECT</td>
<td>NORTH EAST/ RAMONA</td>
<td>Friday 10/26</td>
<td>7</td>
</tr>
<tr>
<td>SIERRA PACIFIC</td>
<td>EASTERN/ MT EMPIRE</td>
<td>Friday 10/26</td>
<td>2</td>
</tr>
<tr>
<td>SOCAL EDISON</td>
<td>KEARNY</td>
<td>Friday 10/26</td>
<td>2</td>
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<tr>
<td>IID</td>
<td>NORTH COAST</td>
<td>Sat 10/29</td>
<td>2</td>
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<tr>
<td>NEVADA POWER</td>
<td>EASTERN/ MT EMPIRE</td>
<td>Sat 10/29</td>
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<tr>
<td>ARIZONA PUBLIC SERVICE</td>
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<td>Sunday 10/30</td>
<td>10</td>
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<tr>
<td><strong>Total Crews</strong></td>
<td><strong>39</strong></td>
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**Legend**

- **PGE**: PACIFIC GAS & ELECTRIC
- **SP**: SIERRA PACIFIC
- **APS**: ARIZONA PUBLIC SERVICES
- **IID**: IMPERIAL IRRIGATION DISTRICT
- **NP**: NEVADA POWER
- **SCE**: SOCAL EDISON
- **SALT RIV**: SALT RIVER PROJECT
- **SoCal Gas**: Southern California Gas Co
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<tr>
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<th>Need for Site (Yes or Pending)</th>
<th>Site Name</th>
<th>Command Center or Stage Area</th>
<th>District Contact Name &amp; Phone #</th>
<th>Thomas Bros. Address</th>
<th>Length of Time Needed</th>
<th>Start Date</th>
<th>Monday Through Friday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
<th># People</th>
<th>Notes/Comments</th>
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<td>Possibles</td>
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<td>L</td>
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<td>North</td>
<td>Yes</td>
<td>Dulzura Center</td>
<td>Twin Peaks &amp; Breast Point</td>
<td>Yes</td>
<td>1055-5</td>
<td>4 Yd Bins + Small Roll</td>
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<td>T &amp; O Crew</td>
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<td>Ken G 1190-E2</td>
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<td>Area of Twin Peaks</td>
<td>4 Yd Bins + Small Roll</td>
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<td>T &amp; O Crew</td>
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<td>John V/Oliver G</td>
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<td>4 Yd Bins + Small Roll</td>
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**Notes:**
- **Food:** Yes/No
- **People:** Yes/No
- **Total:** Number of people
- **Miscellaneous:** Notes on additional resources or comments.
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<th>Site</th>
<th>Need for Site</th>
<th>Command Center or Stage Area</th>
<th>Site Coord &amp; Phone #</th>
<th>Length of Time Needed</th>
<th>Total People</th>
<th>Recycle Bins</th>
<th>Handwash</th>
<th>Portable Office</th>
<th>Trailer</th>
<th>Copiers</th>
<th>Lights/Generators</th>
<th>Material Laydown Space Reqmts</th>
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<td>Sweetwater Food Tent</td>
<td></td>
<td>N/A</td>
<td>John D. Dino D. 1291-E2/3</td>
<td>November 4wks 100</td>
<td>@5:30pm</td>
<td>@6:30pm</td>
<td>Start dinner on 11/3/11/4/?</td>
<td>8</td>
<td>2 light towers</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>1(printer)</td>
<td>2 light towers at gen and refueling</td>
<td>TBD: Start with 20 people and ramp up to 85 ever other night (start on 11/4)</td>
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**CLOSED SITES**

New Staffing Area Sites - Cindy T. Marie G.
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<th><strong>Week 10</strong></th>
<th><strong>Command Center Locations</strong></th>
<th><strong>November 10, 2007</strong></th>
<th><strong>10:49am Version</strong></th>
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<td><strong>Site Name</strong></td>
<td><strong>Address</strong></td>
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<tr>
<td><strong>RFS sites-containers only</strong></td>
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<td><strong>San Diego</strong></td>
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<td>Site Name</td>
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<td>6</td>
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<td>Twin Peaks &amp; Budwin Lane Poway</td>
<td>11/1</td>
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<td>7</td>
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