Knowledge Management in Support of Crisis Response

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ABSTRACT

Most organizations face difficult challenges in managing knowledge for crisis response, but it is crucial for response effectiveness that such challenges be overcome. Organizational members must share the knowledge needed to plan for emergencies. They also must be able during an emergency to access relevant plans and communicate about their responses to it. This article examines the role and relevance of knowledge management (and knowledge management systems therein) in support of crisis response. We begin by discussing what knowledge management and crisis response mean. We move on to suggest why crisis response efforts within an organizational context, might benefit from knowledge management initiatives. Specific examples of how knowledge management efforts have supported crisis response in the past are then presented. We end by offering researchers with some suggestions for future research work in light of this subject domain. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Please insert keywords.

INTRODUCTION

Knowledge management (KM) is about capturing knowledge created in an organization and making it available to those who need it to make decisions. Crisis response is about making decisions under stress and time pressure. While it would seem natural to use KM to support crisis response decision making; a review of the literature pertaining to implementation of KM and KM systems finds that the emphasis in KM research is focused on KM impacts on organizational performance and competitive enhancement (Von Krogh 1998; Hackbarth 1998; Davenport and Prusak 1998; Alavi and Leidner 2001, Jennex and Olfman, 2006, Raman et al., 2006). However, events such as the 9/11 terrorist attacks, the London subway bombings, the 2004 tsunami, and Hurricane Katrina have spurred interest in research in crisis/disaster/emergency
preparation/response (henceforth referred to as crisis response). This has led to a small but growing body of research focused on examining KM and KMS support for crisis response. Accordingly, the purpose of this article is to help researchers and managers to better appreciate and understand the relationship between KM, KMS, and crisis response.

The objective of this article is to discuss how knowledge needed for crisis response can be managed more effectively by integrating KM into crisis response efforts. We offer several examples of how KM has been used to support crisis response efforts and the issues that were faced therein.

The article proceeds as follows. Section 2 examines fundamental aspects of KM and KM systems. Next we offer an overview of what crisis response is particularly with reference to the core issues involved in crisis management from a decision making perspective. Section 4 provides a brief account of the history and functions of emergency response systems, which leads to a logical discussion about how and why crisis response can benefit from KM principles. Sections 6 highlight the role of KM in different phases of a crisis situation. This is followed with several examples of prior work about KM systems applied to the context of crisis response. We end with several suggestions of future research that can be done to extend the ideas that we have presented here.

KNOWLEDGE MANAGEMENT AND KNOWLEDGE MANAGEMENT SYSTEMS

Jennex (2005) used an expert panel to generate a composite definition of KM as 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. Alavi and Leidner (2001, p. 114) define a KM System, KMS, as “IT (Information Technology)-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application.” They observed that not all KM initiatives will implement an IT solution, but they support IT as an enabler of KM.

The purpose of implementing KMS in organizations varies. Von Krogh (1998) takes a business perspective, stating that KMS help increase competitiveness. Hackbart (1998) suggests that KMS lead to greater innovation and responsiveness. Davenport and Prusak (1998) provide three reasons why KMS are implemented in organizations: (i) to enhance visibility of knowledge in organizations through the use of maps, hypertexts, yellow pages; directories, etc., (ii) to build a knowledge sharing culture, i.e., create avenues for employees to share knowledge, and (iii) to develop a knowledge infrastructure, not confined to technology solely, but create an environment that permits collaborative work. Work by Hackbart (1998) and Davenport and Prusak (1998) imply that KMS can support an organization in planning for and dealing with crises.

EMERGENCIES, DISASTERS AND CRISIS MANAGEMENT

Princeton University defines an emergency as “a sudden unforeseen crisis (usually involving danger) that requires immediate
Another Web resource defines an emergency as “any abnormal system condition, which requires immediate manual or automatic action to prevent loss of load, equipment damage, or tripping of system elements which might result in cascading and to restore system operation to meet the minimum operating reliability criteria.”

The notion of disaster management can be viewed in the broader lens of crisis management. This article uses the term ‘emergency’ synonymous to the term ‘crisis’. Majority of literature on crisis management use the term crisis to describe both emergency and disaster situations, which includes but not confined to man-made and natural disasters (Fink, 1986; Booth, 1993; Myers, 1999; Seeger et al. 2003, Herman, 1965; Miller, 2004).

Charles Herman is one of the pioneers in developing crisis management models. Herman (1965) states that any crisis situation consists of three key elements:

- “It threatens high priority values of the organization goals
- It presents a restricted amount of time in which decisions can be made and
- Is unexpected or unanticipated by the organization” (p. 64).

Herman’s definition implies that crisis management is unstructured and complex in nature. This view of crisis is similar to that of Miller (2004) who defines a crisis based on nine attributes. Miller states that a crisis:

- “Suddenly occurs
- Demands quick reaction
- Interferes with organizational performance
- Creates uncertainty and stress
- Threatens the reputation, assets of the organization
- Escalates in intensity
- Cases outsiders to scrutinize the organization
- Permanent alters the organization” (p. 19).

The Institute for Crisis Management (ICM) classifies crisis situations into sixteen categories (Miller, 2004-p.21): business catastrophe, class action suits, defects/recalls, environmental damage, financial damage, labor disputes, sexual harassment, white-collar crime, casualty accident, consumer action, discrimination, executive dismissal, hostile takeover, mismanagement, whistle blowing and workplace violence.

Fink (1986) defines a crisis as an “unstable time or state of affairs in which a decisive change is impending - either one with the distinct possibility of a highly undesirable outcome or one with a distinct possibility of a highly desirable and extremely positive outcome” (p.15). This definition is somewhat different compared to standard definitions of emergency/crisis situations (for example Chandler and Wallace, 2004; Claremont Colleges Disaster management Plan 2004 ), where the notion of an emergency is often associated to a negative outcome. Fink goes on to suggest that the purpose of managing crisis is to eliminate any potential risk to the organization.

Seeger et al. (2003) offer a broader definition of organizational crisis management relative to Fink’s (1986) definition. They define organizational crisis as an “unusual event of overwhelmingly negative significance that carries a high level of risk, harm and opportunity for further loss” (p.4). The authors cite spills, floods, and explosions as examples of crisis situation that can impact individual careers, health, and well being in
addition to preventing organizations from resuming regular operations.

Booth (1993) suggests that every crisis is unique and cannot be accurately planned for. Fink (1986) suggests that emergency management teams in organizations ask themselves the following questions when developing a crisis management plan: “Who is responsible for notifying employees? Who is the backup? Who is responsible for notifying the media? Which local, state, or federal government agencies may need to be notified, and who will do so? Your switchboard operators are your first line of defense (or offense). What will they tell reporters or the public at large when they call? Who is responsible for briefing them? And do they need to be bilingual?” (p.60).

Chandler and Wallace (2004) studied emergency response in organizations throughout the United States. Their study compares the emergency response efforts between 2001 and 2004, with a specific focus on organizational resources devoted to disaster planning. The survey was administered at the Disaster Recovery Journal (Spring 2004) world conference. The highpoints of their study are summarized as follows. On September 11, 2001, close to 20% of companies represented in the study did not have any formally documented crisis management plan. By mid-September 2002, 66% of companies studied increased overall organizational commitment and efforts in planning for emergencies. Post 9/11, 36% of companies increased resources devoted to emergency response; 53% reported a modest increase. Only 9% said that there was no change in the organization’s view of emergency response after the incident. Terror threats, bomb threats, biological hazards, and dealing with explosive materials are ranked higher in terms of risks, after 9/11. In terms of written policies, the survey respondents said that following 9/11, the emergency response/disaster recovery plans for their respective organizations now include procedures to handle “bomb threats (70%), computer crime (49%), terrorism attacks (47%), mail threats (47%), chemical release (43%) and hazardous material release (43%).

Chandler and Wallace (2004) describe four areas that should be incorporated by crisis planners in their respective policies: (i) determining guidelines and standard policies for resuming business as usual after a crisis situation, (ii) real-time tracking of implementation plans, (iii) use of simulation in training staff involved in crisis response, and (iv) prioritizing what needs to be in the organization’s crisis planning process.

Myers (1999) uses the term disasters to describe a crisis. He suggests that organizations should develop a four-stage disaster response plan: (i) prevention, which includes preparedness training, (ii) development of an organized response with a focus on damage containment, (iii) protection of cash flow by using alternate procedures, and (iv) restoration of facilities by resuming normal operations. Myers identifies the essential issues, which should be part of a crisis response plan: “Notification to employees and customers; damage assessment; rerouting incoming phone calls and/or messaging; initiating restoring computer processing capability; physical security; and relocating personnel” (p.9).

**CRISIS RESPONSE SYSTEMS**

Crisis Response Systems are used by organizations to assist in responding to a crisis situation. These systems support commu-
Communications, data gathering and analysis, and decision-making. Crisis Response Systems are rarely used but when needed, must function well and without fail. Designing and building these systems requires designers to anticipate what will be needed, what resources will be available, and how conditions will differ from normal. A standard model for a Crisis Response System is from Bellardo, Karwan, and Wallace (1984) and identifies the components as including a database, data analysis capability, normative models, and an interface. This model is only somewhat useful as it fails to address issues such as how the Crisis Response System fits into the overall crisis response plan, Crisis Response System infrastructure, multiple organization spanning, knowledge from past emergencies, and integrating multiple systems.

To address the weaknesses of the Bellardo, Karwan, and Wallace (1984) model Jennex (2004) summarized the literature and used findings from Y2K to generate an expanded crisis response system model. These systems are more than the basic components of database, data analysis, normative models, and interface. A more complete crisis response system model includes these basic components plus 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) 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. The goals of the crisis response system are to facilitate clear communications, improve collaboration between users needing to collaborate, improve the efficiency and effectiveness of decision-making, and manage data to prevent or at least mitigate information overload. Designers use technology and work flow analysis to improve system performance in achieving these goals.

Prior to the establishment of the Homeland Security Department, the task of managing information pertaining to crisis situations and crisis management in the United States was under the jurisdiction of the Office of Emergency response (OEP) (Turoff, 1972). The information requirements for the OEP were largely handled by a group of consultants from both business and academia. Over time, the OEP recognized that a system that could provide timely and relevant information to crisis responders was needed (Turoff, 1972). In 1970, twenty-five people working on crisis response were able to collaborate via a computerized Delphi system (Turoff, 1972). Computerized Delphi techniques can be administered via the web today (see for example Cho and Turoff, 2003 and Turoff and Hiltz, 1995).

In 1971, the OEP was assigned the task of monitoring a new form of crisis called the "Wage Price Freeze" (Turoff et al., 2004). This new role for the OEP included among others, to “monitor nationwide compliance, examine and determine requests for exemptions and prosecute violations” (p. 5) in relation to wage and price changes in the economy. This led to the advent of a flexible system called the Emergency Management Information System and Reference Index (EMISARI). EMISARI was a system designed to facilitate effective communication between people involved in monitoring the Wage Price Freeze situation. The system was designed to integrate people and data into a common platform.
that could be updated regularly by people who were non-technical administrators (Turoff et al., 2004). The EMISARI system was flexible and enabled several hundreds of people to collaborate in responding to a crisis (see for example Rice 1987, 1990 and Turoff, 2002).

Lee and Bui (2000) documented vital observation with the use of a crisis response system during the massive earthquake that hit Kobe, Japan in 1995. Several key lessons for crisis management system designers based on Lee and Bui’s work were identified. Relevant information should be included in the crisis response system prior to the actual crisis situation. This is to ensure that crisis responders have sufficient information to guide the decision-making processes in responding to a crisis. Lee and Bui (2000) imply that the task of gathering relevant information to support crisis response should be incorporated into part of the crisis response strategic initiative. Information from prior experiences should become part of the crisis management system. The system should somehow be able to capture both tacit and explicit knowledge about how prior crisis situations were dealt with. Lessons, which are learned, can be used to guide future action. Lee and Bui (2000) in this regard imply that the design of any crisis response system should support some form of organizational memory component.

In addition to designing relevant systems features to support crisis planning and response, researchers suggest that successful implementation of any crisis management system is contingent on how well people are trained to use such systems (Patton and Flin, 1999; Turoff, 1972; Lee and Bui, 2000). Patton and Flin, for instance, suggest that crisis management systems be incorporated into crisis response related activities such as training, simulations, drills, and evacuation exercises. Turoff (1972) states that crisis management systems that are not normally used will not be used when an actual crisis situation occurs.

The majority of post 9/11 literature on crisis management is confined within the realm of commercial entities (Braveman, 2003). Developments within the domain of crisis management information systems have accelerated over the past few years, particularly after the 9/11 events (Campbell et al., 2004). The authors accurately mention that issues such as resources, expertise, and personnel should be addressed at the onset, prior to designing crisis management systems within the context of local and state level communities. They call for development of “a generic set of requirements” (p.2) that can be used by both the state and local authorities to support crisis planning and response. The researchers however do not base their study on any particular theoretical foundations. Campbell and associates (2004) examine the effect of asynchronous negotiation given “a structured task and a specified negotiation sequence” (p. 3), in the context of crisis responders.

**WHY CRISIS RESPONSE NEEDS KM?**

Crises can happen at any time making it difficult for organizations to have the right resources where and when they are needed. Most organizations don’t have experience with real emergencies so they need to take advantage of all available experience as decisions need to be made fast and under stress and high tension circumstances. The complexity of communicating, collaborating, and decision making processes in the
context of crisis response efforts cannot be undermined.

The above paragraph implies that an organization’s ability to survive given dynamic changes within its environment is contingent upon its ability to quickly respond to change, in a crisis mode. This includes the ability to effectively manage its knowledge resources. Burnell et al. (2004) assert that “an effective knowledge-based organization is one that correctly captures, shares, applies and maintains its knowledge resources to achieve its goals” (p.203). This echoes the view of March and Simon (1958) who state that successful organizations are able to adapt to any dynamic environment.

The information processing theory states that the role of having accurate and up to date information is vital particularly when organizations deal with a turbulent environment (Burnell et al., 2004). Integrating KM processes can support managers to proactively respond to a highly turbulent environment and will benefit an organization (Burnell et al., 2004). This would include organizations that plan and prepare for emergencies and crisis response situations (Kostman, 2004).

Figure 1 can be used to further discuss why KM can support crisis response efforts. A crisis response center (often led by a crisis response manager) deals with various stake-

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**Figure 1. Complexity of emergency response**

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holders during a crisis situation. Different stakeholder groups often have different skills, resources, technical expertise, and more importantly experience in responding to a particular crisis. For any crisis response center, issues such as managing different stakeholder expectations, priorities, and the various resource and skill sets they bring into an actual crisis response mode, is complex and dynamic. This could lead to difficulties in making accurate decisions, under time-pressured and intense situations, while responding to a particular crisis. In this context, we suggest that a KMS can be used to capture and then re-use of specific crisis response knowledge which can be used to support decision making when a crisis actually occurs. The 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 KMS. In addition, we further add that given the dynamic nature of crisis situations, coupled with different inputs and requirements from various stakeholder groups, a crisis response manager and centre therein, is subject to information overload, which can prevent timely and accurate decision making. A well tested and implemented KMS in this context can helps to decide what to look at, what decisions to focus on, and what decisions can be made automatically and/or in advance.

KM is an action discipline; knowledge needs to be used and applied for KM to have an impact. Crisis response relies on the use of knowledge from past situations to generate current and future response procedures. Lessons learned and the understanding of what works best in given situations (both examples of knowledge) enables emergency managers to prepare planned responses as a counter to the stress of the emergency and to ensure all relevant issues are considered during emergency response decision making.

CRISIS RESPONSE PHASES AND SYSTEMS

For the purposes of the article, crises are high stress situations that require organizations to respond in a manner that is different from their normal operating procedures (Turoff, 2002). Patton and Flin (1999) discuss these stresses on emergency managers and how to reduce them. Emergency stressors, in addition to fatigue, include dealing with a complex, unpredictable and dynamic response, time pressure, and communications, dealing with the media, and operating within an integrated crisis management context. Crises are also a series of four phases: situational analysis (SA), initial response (IR), crisis response (ER), and recovery response (RR); and five decision/hand off points: the initiating event (IE), the control event (CE), the restoration event (RE), the normalizing event (NE), and a terminating event (TE). Figure 1 (Jennex, 2007) shows the phases and decision points and includes a general plot of the amount per unit time of immediate responses and decisions that need to be made as a timeline plot following some initiating event, IE. Note that figure 1 (Jennex, 2007) is not drawn to scale and is a generic drawing of a crisis timeline. Also, a TE point is not shown. The TE is for ending the crisis and would occur if the crisis was determined to be false, or if another crisis took precedence, or any event that would cause the cessation of response to the crisis. The TE
can occur in any phase and at any time so for that reason is not shown.

Figure 2 (Jennex, 2007) shows that organizations are constantly in the first crisis phase, SA, which is a data gathering and assessment phase that has a base level of activity. These base level activities are monitoring of a set of predetermined conditions, analysis of these conditions for unusual or pre-identified deviations, identification of the IE, and training and preparation of the crisis response team. A crisis begins when during the SA phase an IE is observed. This causes the IR phase to be entered. This is expected to be a very short duration phase that consists of confirming the crisis, generating early warning notices, initiating preplanned initial actions, and entering the crisis response plan. The ER phase is entered immediately upon assumption of control by the crisis response team, the CE, and generally after completion of the immediate response actions and early warning notifications. The ER phase implements the crisis response plan and begins coordinating responders and other resources. Additionally, this phase is the command and control phase that requires the crisis response team to monitor conditions and to coordinate response accordingly. This phase rises to the peak activity level. This phase ends with the RE. The RE is the point where the crisis response team concludes that the crisis conditions are over or are under control and crisis response actions are no longer needed and the crisis control center can cease command operations. At this point, the crisis enters the RR phase. This phase confirms the crisis is under control, controls and coordinates long term actions and reconstruction, guides the organization back to normal conditions, and identifies and captures lessons learned. This phase has a declining level of activity and concludes when the NE is announced. The NE is the point where all crisis response actions are completed, long term crisis response actions and a base level of reconstruction is completed, the crisis response team is secured, and the organization returns to normal operating procedures and the routine SA phase.

Figure 2. Phases and timeline of activity level for a typical emergency

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Each of these phases has its own stresses and support needs. To reduce these stresses, crisis response plans and systems should be based on operational demands, tested regularly, and have resources allocated. These plans should not be based on implicit and untested assumptions that reflect routine operational requirements and conditions as plans based on assumed capabilities are less effective than anticipated and will increase ad hoc demands on managers. Working in teams is required during crises and having a well trained, experienced team will reduce the impact of team dynamic stressor. Additionally, crises may require inter agency coordination and dealing with interagency conflict and terminology increases stress.

These stresses can be reduced if these agencies are integrated in their response and participants train together so that they are familiar with each other and comfortable with the integrated crisis response plan. Finally, communication systems are necessary for getting the right information to the right people, but they will not reduce stress unless participants are trained and practiced in their use. In addition to the stresses identified by Patton and Flin (1999), Bellardo, Karwan, and Wallace (1984) identify the stress of decision-making during crisis response and recommend the creation of a Crisis Response System to assist decision makers.

**SPECIFIC EXAMPLES**

The large number of groups that may respond to an emergency all need access to a wide range of real-time information and knowledge that requires coordination. Groups have proposed and created KM enhanced Emergency Response systems that allow for more efficient use of data and faster response. One example that has been proposed is the Information Management System for Hurricane disasters (IMASH) (Iakovou and Douligeris, 2001). IMASH is an information management system based on an object-oriented database design, able to provide data for response to hurricanes. IMASH was designed with the premise that the World Wide Web is the medium of choice for presenting textual and graphical information to a distributed community of users. This design is much more effective in the fast-changing environment of a natural disaster than the historical use of static tools which, out of necessity, have been the tools used in disaster response. Kitamato (2005) describes the design of an information management system, Digital Typhoon, designed to provide a hub of information on the Internet during a typhoon disaster.

The Digital Typhoon provides access to information from official sources (news, satellite imagery) as well as a forum for individuals to provide information (local, personal). It effectively became a hub of information, but created questions about organization, filtering, and editing. Systems used for Hurricane Katrina response realized the benefits and difficulties of these systems. Like IMASH, the systems described below use the Internet to distribute data to a community of users, and like the Digital Typhoon, the knowledge management systems described for Hurricane Katrina response became hubs of information that required data management to reduce repetition and allow for editing. Murphy and Jennex (2006) added knowledge management, KM, to the expanded Crisis Response System model proposed by Jennex (2004) and showed how it was used in open source developed systems used
to aid in the response to Katrina through the implementation of the Peoplefinder and Shelterfinder systems.

These systems were unique in that they were developed independent of government support or resources. Development was through volunteers and the systems used a web interface tied to a knowledge base to gather information and knowledge on survival stories and sources of shelter. Experience with these systems showed the value of using open source, commercial tools, and wikis to build Emergency Response Systems. Success of these systems was dependent upon the interface and the quality of the knowledge stored and retrieved from the systems.

Another application of KM to emergency response is in identification of the decision/hand off points. KM is applied through the generation of guidelines, rules, and procedures that govern these points. As experience is gained and lessons learned, the criteria guiding the declaration of these points is modified to incorporate this experience. The benefit to emergency responders is that decision making with respect to these points is simplified and guided, reducing the stress on the decision maker.

Finally, future trends into emergency response systems were demonstrated during the Strong Angel III civilian-military integrated disaster response demonstration held in San Diego, California during August 2006. Demonstrations were held integrating knowledge bases into visualization systems resulting in smart displays. In particular, the use of knowledge bases within a GIS as demonstrated by the San Diego State University Visualization Laboratory illustrated the power of tying social and demographical data and knowledge to images and maps. This integration created an emergency response system that could be ad hoc queried with results displayed visually. This facilitated knowledge creation and knowledge transfer among emergency response personnel.

Wide spread emergencies such as Katrina and the 2004 Tsunami have shown the difficulty of building stand alone Emergency Response Systems (systems whose sole purpose is to respond to emergencies). These systems are expensive and it is difficult to not use them for routine activities when resources are low. Exercises preparing for a possible avian flu pandemic and for a pandemic coupled with a terrorist attack on critical infrastructure (Operation Chimera and Strong Angel III) are focusing on training large numbers of people in emergency response while using and developing open source emergency response systems (Jennex, 2006). Strong Angel III in particular focused on creating and using an emergency response system based on open source development and commercial off the shelf components. The goal is to reduce the cost, time, and effort involved in building and implementing an emergency response system while maintaining system security, especially when using the Internet and other commercial, civilian communication networks, and providing a structure for integrating diverse data and knowledge sources and bases. Additionally, Raman, et al. (2006) discusses the use of wiki technology to facilitate KM for emergency response systems. It is expected that open source technologies such as wiki technology will be used to improve connectivity and communications between diverse groups needing to communicate during an emergency. It is expected that increased use of knowledge based systems and KM will continue for emergency response. Improved KM technologies for storing, searching, and retrieving knowledge will be used.
to integrate KM into emergency decision making (Murphy and Jennex, 2006).

Worms like Slammer which infected 90% of all vulnerable systems connected to the Internet within 10 minutes of its release in 2003 (Panko, 2003) show the vulnerability of cyber emergency response. Currently organizations rely on intrusion detections systems, IDS, which have some alarm functions, to detect such attacks and on firewalls to protect their networks. Emergency response under these conditions is still primitive with most organizations relying on emergencies being recognized and then responded to via sets of incident response procedures. It is expected that new, fast acting emergency response systems will have to be developed that will rely on knowledge based analysis and decision support to improve emergency response times to fit emergencies such as Slammer.

In summary, there is a fusion of crisis response systems with KM. This is because 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. It is expected that Emergency Response System evolution will continue to utilize KM concepts and approaches as experience in responding to disasters is showing that these systems are more effective than traditional Emergency Response Systems. Examples of how KM aids emergency/crisis response includes using knowledge of past disasters to design communication and data/information capture protocols and templates, capturing emergency response knowledge in procedures and protocols; incorporating lessons learned into response team training, interface and display design, and the generation of heuristics guiding decision making; and using knowledge to guide the creation of experience knowledge bases that responders can use to generate emergency response actions.

AREAS FOR FUTURE RESEARCH

KM is a relatively young field. The fusion of crisis response with KM is even younger. Thus far, only two articles on KM and crisis response have been published in the International Journal of Knowledge Management. Many questions are yet to be answered in this research domain. Cases on crisis management and how KM efforts were used or are applicable to them are always needed. This would be of value to the KM and crisis management practitioner community. Secondly, issues inherent in the context of transferring knowledge between crisis responders in all three phases of pre, during, and post crisis periods would be of interest, particularly issues involved with codification and transfer of tacit knowledge embedded within experienced crisis responders. Other areas from a more technical perspective that warrants research is in examining the role and relevance of semantic websites, use of ontologies, data fusion and visualization technologies, collaborative technologies and sense making technologies in light of crisis response efforts.

CONCLUSION

Emergency response in the United States of America, USA, is evolving from something that was locally handled to something that is standardized under Federal control. The
USA implemented the National Incident Management System, NIMS, in 2004. NIMS established standardized incident management protocols and procedures that all responders are to use to conduct and coordinate response actions (Townsend, 2006). Townsend (2006) discusses lessons learned from Katrina that include communications infrastructure, knowledge about emergency response plans, integration of civilian and military response activities, and critical infrastructure and impact assessment issues. Review of these issues suggests there were failings in the emergency response systems that could have been prevented only if effective KM systems were in place.

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