

# Chapter XVI

## Knowledge Management Systems for Emergency Preparedness: The Claremont University Consortium Experience

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### **ABSTRACT**

This article is about the design and implementation of an information system, using Wiki technology to improve the emergency preparedness efforts of the Claremont University Consortium. For some organizations, as in this case, responding to a crisis situation is done within a consortium environment. Managing knowledge across the various entities involved in such efforts is critical. This includes having the right set of information

that is timely and relevant and that is governed by an effective communication process. This study suggests that Wiki technology might be useful to support knowledge management in the context of emergency preparedness within organizations. However, issues such as training in the use of a system(s), a knowledge-sharing culture among entities involved in emergency preparedness, and a fit between task and technology/system must be there in order to support emergency preparedness activities that are given such structures.

## **INTRODUCTION**

Research about emergency management information systems has accelerated since the September 11, 2001 events (Campbell, Van DeWalle, Turoff, & Deek, 2004). However, researchers do not use a common terminology to describe emergency management information systems. Jennex (2004, 2005), for instance, calls these systems emergency information systems (EIS). Campbell et al. (2004) use the term emergency response systems. Turoff (2002) uses the term emergency response management information systems (ERMIS) and extends this idea to the notion of a dynamic emergency response management information system (DERMIS) (Turoff, Chumer, Van De Walle & Yao, 2004). Nevertheless, the majority of the researchers in this area seem to agree that, despite different naming conventions, emergency management information systems should be designed to support emergency preparedness and to guide effective response during an actual crisis situation. In addition, although researchers explicitly do not link the idea of emergency management information systems to knowledge management, the influence of the latter on emergency management systems is evident in the literature.

This article presents a case study about the implementation of a Web-based knowledge management system to support the Claremont University Consortium (CUC) and the Claremont Colleges, in general, in emergency preparedness. The academic nature of this study centers on how an information system (specifically, a knowledge management system) can improve emergency preparedness within a consortium environment. The practical nature of the research concerns how CUC was made more ready to respond to and recover from emergencies that it might experience.

This study suggests that Wiki technology might be useful to support knowledge management in the context of emergency preparedness within organizations. However, issues such as training in the use of a system(s), a knowledge-

sharing culture between entities involved in emergency preparedness, and a fit between task and technology/system must be there in order to support emergency preparedness activities given such structures.

Turoff et al. (2004) take a design stance in discussing emergency management systems. We suggest that design of any emergency management system can be tied to knowledge management principles. In addition, our findings suggest that, in addition to design, issues such as training with technology fit between tasks and technology and the existence of a knowledge-sharing culture are crucial when an organization intends to implement a knowledge management system to support emergency preparedness efforts.

The article proceeds as follows. Section two provides a snapshot of literature relevant to our study. Section three presents the methodology used, with emphasis on the case setting and the problem domain therein. Section four discusses how Wiki technology was used as an instantiation of a knowledge management system to overcome some of the emergency preparedness issues within the Claremont Colleges. Section five presents an evaluation of the system, which is presented in the form of qualitative data. The article ends with a discussion of how our findings might impact knowledge management theory and practice in the context of emergency preparedness.

## **RELEVANT LITERATURE**

A knowledge management system in this study refers to any information technology (IT) based system that is “developed to support and enhance the organizational knowledge processes of knowledge creation, storage, retrieval, transfer and application” (Alavi & Leidner, 2001, p. 114). Gupta and Sharma (2004) divide knowledge management systems into several major categories, as follows: groupware, including e-mail, e-logs, and wikis; decision support systems; expert systems; docu-

ment management systems; semantic networks; relational and object oriented databases; simulation tools; and artificial intelligence.

Jennex (2004) defines an EIS as any system that is used “by organizations to assist in responding to a crisis or disaster situation” (p. 2148). He further adds that an EIS should be designed to (1) support communication during emergency response, (2) enable data gathering and analysis, and (3) assist emergency responders in making decisions.

Lee and Bui (2000) document vital observations about the use of EIS during the massive earthquake that hit the city of Kobe, Japan, several years ago. Key lessons for emergency management systems designers that are based on Lee and Bui’s (2000) work are as follows:

- Relevant information should be included in the emergency response system prior to the actual disaster situation. This is to ensure that emergency responders have sufficient information to guide decision-making processes when responding to an emergency. The authors imply that the task of gathering relevant information to support emergency response should be incorporated as part of the emergency preparedness strategic initiative.
- Information from prior experiences should become part of the emergency management system. The system somehow should be able to capture both tacit and explicit knowledge about how prior crisis situations were handled. Lessons learned can be used to guide future action. The authors in this regard imply that the design of any emergency preparedness system should support some form of organizational memory component.

In addition to designing relevant systems features to support emergency planning and

response, researchers suggest that successful implementation of any emergency management system is contingent on how well people are trained to use such systems (Lee & Bui, 2000; Patton & Flin, 1999; Turoff, 1972). Turoff et al. (2004) state that emergency management systems that normally are not used will not be used when an actual emergency situation occurs.

In summary, researchers indicate that emergency management information systems should support the following features inherent in any knowledge management system: (1) enable individuals and groups to create, share, disseminate, and store knowledge (Turoff, 1972; Turoff et al., 2004); (2) offer the ability to document experiences and lessons that have been learned to form the overall organizational memory for dealing with crisis situations (Lee & Bui, 2000); (3) support asynchronous and collaborative work (Campbell et al., 2004); (4) provide emergency response-related information that is relevant, accurate, and presented in a timely manner (Jennex, 2004; Turoff, 1972; Turoff et al., 2004); and (5) enhance the overall communication process among people involved in emergency preparedness and response by inserting more structure into the manner in which information is organized and documented (Turoff, 1972; Turoff et al., 2004).

## **METHODOLOGY**

This article uses canonical action research to conduct this study (Davidson & Martinsons, 2002; Lindgren, Henfridsson & Shultze, 2004; Susman & Evered, 1978). Both qualitative and quantitative data were collected and analyzed throughout the research process.

One of the authors worked for CUC for three years as the Emergency Management Assistant. The research process in canonical action research starts with the involvement of the researcher with an identified organization. This is followed

by the problem diagnosis by the researcher to determine issues and challenges faced by the organization.

The diagnosis leads to action planning; that is, a formal proposal is made to the client/organization in terms of a proposed solution/system. Upon approval by the client, the proposed solution is implemented. Action or intervention then occurs. Evaluation and reflection of the solution/system that is implemented then is conducted.

### **The Case Setting**

The Claremont University Consortium (CUC) provides services to the seven members of the Claremont Colleges<sup>1</sup> by operating programs and central facilities on their behalf. Each college maintains its own emergency preparedness plan. Every plan calls for the activation of a college-level emergency operations center (EOC) in the event of an emergency. The Multi Agency Coordination Center (MACC) exists to coordinate responses among the seven colleges and CUC. MACC's action plan is guided by the Claremont Colleges Emergency Preparedness Plan. This plan defines an emergency as preparing for and responding to any situation "associated with, but not limited to, disasters such as earthquakes, life threatening incidents, terrorist attacks, bio-terrorism threats and other incidents of a similar capacity" (p. 1).

MACC is a group that becomes active whenever emergencies occur at any of the colleges and at CUC that could impact any one or more of the consortium members. It is intended to (1) coordinate among the colleges and external agencies, (2) prioritize and fill requests for assistance from central resources, and (3) assist the colleges in returning to normalcy as soon as possible.

### **The Problem**

Prior to embarking on the systems design and implementation initiatives, interviews were conducted with nine representatives from five colleges

and CUC who were involved in emergency preparedness. Through these interviews, it was found that the top three issues pertaining to emergency preparedness at CUC (and within the Claremont Colleges at large) are (1) communication between college level EOCs and the MACC, both before and during an emergency can be improved; (2) coordination between CUC and college-level EOCs, in terms of activities and overall efforts in preparing for an emergency, can be enhanced; and (3) emergency related information/knowledge could be shared seamlessly. This includes access to information about drills; policy documentation; emergency notification protocols; access to college level emergency plans; and status and availability of emergency resources such as debris removal equipment, housing, and medical expertise. The following statements offer several examples:

*Communication issues across the colleges in terms of who knows what, when they know it is vital, but I don't think that we are there yet. For example, in a recent incident, I was informed after five hours only. So communication is an issue. My struggle with that was, if we are indeed mobilized, we need to know and be contacted earlier. The communication of when there is an incident, when a contact is made, this is a concern for all of us.*

*Communication between colleges can be improved. We need a load of practice in this area to ensure better informational flow. Mutual aid agreement, sharing of resources to handle localized incidents needs to be shared and communicated. Training, and this would include training conducted in a jointly organized fashion. Use of technology during drills that are simulated can help the above.*

*We rely on written plans and rely on documentation when we need information. This can take time and cost. When we need to update some document we need to make sure that everyone has updated their respective documents. Again, time and cost*

is involved. The documents that we have are easy to read, but knowing exactly what to do when something happens, remains a challenge.

We at this college do have some of the information available online, on the Web [pdfs] which is used by the building managers. These are secured and restricted to those involved in emergency preparedness. Again, the information may not be easy to retrieve, even in Web format. We need more quick links, shortcuts, and need to know what is new when it comes to emergency preparedness.

### Extended Problem Diagnosis

In stage two of the problem diagnosis, interviews were conducted with an additional 25 CUC personnel involved in emergency preparedness. The objective was to focus on the knowledge management issues in the context of emergency preparedness within the Claremont Colleges. A 15-question questionnaire was developed in order to ascertain the critical success factors for implementing a knowledge management system for CUC. These questions were based on the KMS

Table 1. Linking the KMS success model to emergency preparedness at the Claremont Colleges

	Concept (From the KMS Success Model)	Constructs (From the KMS Success Model)	Min	Max	Mean	Std. Deviation
CUC has the necessary resources to develop a KMS to support emergency planning/preparedness	System Quality	Technological Resources	1.00	5.00	3.16	1.07
CUC has the necessary resources to update a KMS to support emergency planning/preparedness	System Quality	Technological Resources	1.00	5.00	3.16	1.03
CUC has the necessary resources to maintain a KMS to support emergency planning/preparedness	System Quality	Technological Resources	1.00	5.00	3.12	1.01
More information about emergency preparedness at CUC can be converted to Web format	System Quality	KMS form	2.00	5.00	4.04	0.79
Knowledge about emergency preparedness from individuals can be made available online	System Quality	Level of KMS	2.00	5.00	4.12	0.83
Knowledge about emergency preparedness from relevant groups can be made available online	System Quality	Level of KMS	2.00	5.00	4.24	0.72
Information about emergency preparedness could be automated, shared, and retrieved from a single Web interface	Knowledge/ Information Quality	Richness	2.00	5.00	4.16	0.90

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*Table 1. continued*

	<b>Concept (From the KMS Success Model)</b>	<b>Constructs (From the KMS Success Model)</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>Std. Deviation</b>
A KMS for emergency preparedness should simplify searching and retrieving of information	Knowledge/ Information Quality	Richness	2.00	5.00	4.24	0.72
A KMS can enhance the strategic planning process for teams involved in emergency preparedness	Knowledge/ Information Quality	Knowledge Strategy/Process	3.00	5.00	4.32	0.69
A KMS should provide timely information for staff involved in emergency preparedness to support emergency planning	Knowledge/ Information Quality	Richness	3.00	5.00	4.32	0.69
A KMS should provide accurate/up-to-date information for staff involved in emergency preparedness to support emergency planning	Knowledge/ Information Quality	Richness	3.00	5.00	4.40	0.58
A KMS should provide relevant information for staff involved in emergency preparedness to support emergency planning	Knowledge/ Information Quality	Richness	3.00	5.00	4.36	0.57
A KMS to support emergency planning should provide linkages to external and internal information sources	Knowledge/ Information Quality	Linkages	3.00	5.00	4.56	0.58
Top management support is needed in implementation of a KMS to support emergency preparedness	Service Quality	Management Support	3.00	5.00	4.40	0.71
I welcome the idea of being trained in using a KMS to support emergency preparedness activities at CUC	Service Quality	Management Support	1.00	5.00	4.28	1.02

Success Model (Jennex & Olfman, 2005). The KMS Success Model is based on three main constructs: System Quality, Knowledge/Information Quality, and Service Quality (Jennex & Olfman, 2005). The respondents were asked to rank the extent to which they either agreed or disagreed with the statements on a five-point Likert scale.

Table 1 lists the statements and how these map to the KMS Success Model constructs. Table 1 also provides a summary of the data analyzed using SPSS.<sup>2</sup>

The average scores for the statements ranged from 3.12 to 4.56. The high average scores for most of the statements that relate to the key success

factors of implementing a Web-based knowledge management system suggest the following:

- The system should provide key features of managing emergency related knowledge, such as being able to provide timely and relevant information.
- The system should provide links to both internal and external sources of knowledge about emergency preparedness.
- The top management within CUC must support the system implementation.
- The system must support committees involved in emergency preparedness to make strategic decisions.

The first three statements relate to post-implementation resource issues. The average scores for these statements (from 3.12 to 3.16) are relatively lower than the other statements. The majority of the respondents feel that CUC may not have the necessary resources to develop, update, and maintain a knowledge management system to support emergency preparedness. This is due to the fact that involvement in emergency preparedness activities, for the majority of the staff, is not part of their main job function. In addition, CUC has a limited budget for emergency preparedness activities.

## **PROPOSED SYSTEM**

The potential use of Wiki technology as an instantiation of a knowledge management system to support emergency preparedness within the Claremont Colleges was discussed with the CEO and key IT personnel. Three criteria guided the selection of a suitable Web-based knowledge management system to support CUC's emergency preparedness efforts.

- **Cost.** During the initial discussion with the CEO, she made it clear that for the time be-

ing, any system developed to support CUC's emergency-related activities had to rely on open source solutions. This is due to the fact that CUC does not have a sufficient budget to implement any commercially available knowledge management system.

- **Our Experience.** We were allowed to develop any system with which we were familiar, so long as it was in the best interest of the organization in the context of its emergency preparedness initiatives.
- **Issues Faced.** The system that is developed has to address the key emergency preparedness issues/concerns faced by the Claremont Colleges, as described earlier.

These criteria then were used to examine the list of options available to CUC. Gupta and Sharma's (2004) categorization of knowledge management systems was used to examine if a particular category met the three system selection criteria discussed previously. It was decided to implement an instantiation of a knowledge management system using Wiki technology, given budgetary and resource constraints, with regard to emergency preparedness faced by CUC. The technology also was selected because of our familiarity with using Wikis for teaching and learning (Raman & Ryan, 2004).

## **Why Wikis?**

Wiki is a Hawaiian word that refers to being quick. Leuf and Cunningham (2001) define a Wiki as "a freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information—a database where each page is easily editable by any user with a forms-capable Web browser client" (p. 14).

Leuf and Cunningham (2001) suggest that Wiki technology can support knowledge management initiatives for organizations. The authors state that three collaborative models are available over the network today: e-mail exchanges, shared

*Table 2. Knowledge management system tasks and sources of knowledge*

Knowledge management system type	Knowledge source	Task
Conversational technologies	Distributed	Ad hoc
FAQ C	entralized R	epetitive
Search engine	Distributed	Repetitive
Portals	Distributed-Centralized	Ad hoc-Repetitive

folders/file access, and interactive content update and access. They suggest that use of e-mail systems solely may not enable effective management of knowledge for an organization, based on the following reasons: (1) e-mail postings cannot be edited easily; (2) a central archiving system might be necessary to support effective documentation of information, which implies that using some form of database that hosts various postings directly might be a more effective manner of managing information flow for the organization; and (3) e-mail systems necessarily may not support shared access to a particular information base.

The second model to support collaborative work and knowledge sharing is the shared access system (Leuf & Cunningham, 2001). The main difference between a shared file system and an e-mail system is that the former enables users to access a common information base. In this regard, different users could be allowed to edit/update, “based on varying degrees of freedom” a particular information base (Leuf & Cunningham, 2001, p. 6). Nevertheless, this system is still similar to an e-mail system in that discussions and knowledge sharing is contingent upon threaded postings or, in a worst case, governed as a regular e-mail system (Leuf & Cunningham, 2001).

Wiki technology is an example of the interactive server model that offers users a newer avenue to share knowledge and to participate in online

collaborative work (Leuf & Cunningham, 2001). The main components of an interactive server model are the database, the Web server, and user access to a common front end. The authors suggest that the main benefits of using collaborative server models include, among others: (1) allowing more effective organization of information by individuals and groups and (2) enabling ad hoc groups to collaborate on specific projects.

Wagner (2004) examines the use of different knowledge management systems that can be categorized based on two dimensions: (1) how knowledge is distributed in organizations and (2) the nature of the task involved. He asserts that in an organizational context, the source of knowledge is either centralized or distributed. The nature of the task is either ad hoc or repetitive. Based on these two dimensions, he proposes a particular form of knowledge management system to support a particular organizational need to manage knowledge. Table 2 summarizes the “knowledge management system fit based on knowledge distribution and task repetitiveness” in an organizational context (Wagner, 2004, p. 267).

Wagner’s (2004) framework suggests that an organization’s need for a knowledge management system is contingent upon the nature of the task involved and where knowledge resides in the organization. Use of FAQs, for instance, is suit-

able when knowledge is centralized and when tasks are repetitive in nature. Conversational knowledge management systems, in contrast, are more suitable when the source of knowledge is distributed. Wagner's classification of knowledge management systems implies that conversational technologies might be relevant to support emergency preparedness activities at CUC, because emergency preparedness at CUC involves tasks that are ad hoc and dependent upon knowledge that is distributed across the different EOCs and among the MACC members. Wiki technology can support numerous knowledge management requirements for organizations, including filtering knowledge from noise, ensuring knowledge quality, providing search functions, tracing the source of knowledge, building/enhancing knowledge continuously, and supporting the need for dynamically changing information content in a given system (Wagner, 2004). The system selection criteria, our prior experience with Wikis, and support from relevant literature led us to choose Wiki technology.

### **TikiWiki: Emergency Management System for the Claremont Colleges**

The first step during the intervention stage of the project was to install and test a prototype Wiki clone. In December 2004, TikiWiki version 1.7.4 was installed on a test server. TikiWiki is only one instance of Wiki technology. TikiWiki bundles the requirements for a Web server (Apache), a database server (MySQL), and the front-end Web pages (written using Python).

Components of the TikiWiki that were viewed as relevant to the requirements specified by the users then were selected for activation. Only two features have been enabled in the current prototype of the system: the TikiWiki module and linking features. The module feature (administered by the system administrator) was used to create particu-

lar groupings of quick links to information about emergency preparedness. For the purpose of the prototype, the following modules were created:

- **CUC Links:** Provides links to key information sources about emergency preparedness for CUC. This module is based on CUC EOC's organizational structure. It has links to the information requirements for each of the EOC members, based on her or his respective job functions. The planning and intelligence coordinator, for instance, has access to weather information, notification protocols, phone trees, hazardous material information, lessons learned from tabletop sessions, and online maps of the Claremont Colleges.
- **MACC Information:** A quick link and reference to emergency resources and supplies available through CUC's Central Services/Physical Plant. The MACC module now is extended to include other key elements relevant to the MACC.
- **Calendar of Events:** Information about meetings, meeting summaries, drills, training events, and other related activities. The objective of this module is to assist all EOCs and the MACC in coordinating their respective activities.
- **Knowledge Base:** This module has links to local weather conditions, transcripts from tabletop (drill) sessions, and links to federal and local emergency response agencies.
- **Maps:** Online maps for the Claremont Colleges and CUC.
- **Linking:** Permits users to create multiple links within the system, which can be done through the use of the back link function. For example, through a back link, the CUC overview page is linked to the system's home page. TikiWiki also permits users to create links to external sources.

The focus of systems design and implementation in Stage 2 was to improve the communication issues related to emergency planning at CUC. When a crisis of a particular magnitude occurs within the Claremont Colleges, the MACC is activated. The MACC consists of members from CUC and a representative from all the Claremont Colleges. The MACC members provide input to the MACC Chair and Operations Co-coordinator, based on information received from the respective college EOCs. Based on the current protocol, the information flow between MACC and the colleges is facilitated through the use of telephones and information that is documented on a 6 x 8 foot white board located inside the MACC room.

The CUC was aware that during a crisis, the flow of information between the MACC and the college EOCs, was subject to noise and inaccuracy. The CUC also was aware, based on participation in drills, that the MACC does not have sufficient information about actual crisis situations within the respective colleges. This makes response efforts rather difficult during certain incidents. In order to overcome the communicational issues, an additional module in the system called the MACC Situation Board was developed. This module consists of the following four main elements:

- **Situation:** This section enables the MACC representatives to document real-time information about a particular situation at their respective colleges.
- **Action:** This section is used to document specific actions that a college/CUC has taken to address a particular emergency situation.
- **Need:** Links to another page that consolidates the emergency resources (i.e., debris removal equipment, temporary housing, search-and-rescue teams, food, and first-aid supplies) needed by all colleges and CUC in order to respond to an emergency. The MACC Chair and Operations Coordinator were given access to the consolidated

resource needs page, which can be used to guide the decision on resource allocation between CUC and the colleges. The consolidated information about resources needed is expected to improve the communication between MACC and the respective college EOCs.

- **Sharing:** Links to another page that consolidates all information about resources that each college and CUC is willing to share to support a particular emergency response initiative. The type/category, quantity, and status of emergency related resources within the Claremont Colleges will be made known to all MACC members through the system in the near future.

The purpose of this module is twofold. First, as mentioned, it is designed to facilitate documentation of resources required by respective colleges during an emergency. Through this module, member institutions can record a particular type of resource that they need and are willing to share with other colleges when a particular emergency situation occurs. This information, unlike before, is now available via the Web, easily accessible to every EOC and MACC member. Second, the information can be used by the MACC Operations Coordinator to facilitate resource allocation among the colleges when an emergency occurs.

## **EVALUATION**

Effectiveness of the system was evaluated through a series of one-on-one interviews with the MACC members who had participated in two separate training sessions in February 2005, where the system was used. Thirteen individuals were interviewed. The instrument used to facilitate the process had 10 open-ended questions that were divided into two categories: (1) general feedback/overall impression of the system and (2) extent of goal achievement, or the ability of the

system to facilitate the knowledge management requirements within the context of emergency preparedness.

## Findings

The following subsections list several of the respondents' answers to the open-ended questions. The responses are organized according to the two categories mentioned earlier. Given the action-oriented nature of this study, we acknowledge the potential bias of our involvement in the project and the findings, particularly with reference to the use of Wiki technology.

### Category 1: General Feedback/Impression

Overall, the respondents were pleased with the system. The feedback was largely positive. The majority of the respondents felt that the system was simple to use. One of them said the following:

*My immediate reaction was very good. I thought that the ease of use of the system was there and that the visual layout was very clear. That's not how I often feel when I am exposed to new systems. It was logical too. Visually it made sense to me. I don't always react very positively to new systems. My immediate reaction was very positive. In prior cases, I have had the experience of feeling "Oh My God," what do we have here? This was not the case this time.*

However, not everyone was totally comfortable using the system. One respondent mentioned the following:

*It is a key step but it is a little daunting in some ways. One must be a computer savvy person to really play with the system. I look at it from an end user standpoint, particularly how it can be used better. But it sure seems like we are moving in the right direction especially after the last drill*

*at the MACC when there was chaos in there—that was really wild. This is a good start, but there are issues that we need to address.*

Another respondent suggested that the system could improve the overall communication process. Specifically, she said:

*It seemed like it would be a very useful tool and could eliminate many of the previous problems with communication. I was excited to hear there would be a standard protocol for us to transfer information from our campus EOCs to the MACC.*

### Assisting Emergency Preparedness Efforts

On balance, the majority of the respondents felt that the system could assist CUC and the colleges in emergency preparedness efforts. However, this is contingent upon continuous training, access control, and willingness of emergency planners to update the system with relevant information. The following statements offer evidence:

*I do think that the system can assist emergency preparedness. Specifically, the system can provide better and quicker access to information. However, before this works, people need to populate the system and be diligent in updating the information base in the system. I am not sure about controlled access through with the Wiki technology. Anyone can update or delete the information. People can go in and mess around even though we can assume that they would not.*

The system provides for an additional method of communication between all entities involved in emergency preparedness. The system facilitates a more effective written communication process. This can reduce any misunderstanding between the emergency responders. After all, visual aids are better to process and faster to comprehend, as well. By providing a place where various hu-

man and material resources can be listed prior to being needed, enables more common space and a means of documenting what happens during a response.

### **Aspect of Emergency Preparedness Supported**

The general consensus from the respondents was that the system might support the following aspects within emergency preparedness: (1) coordinating planning efforts; (2) offering a better mechanism to document processes; (3) assisting in communication efforts; and (4) sharing emergency related information. The following statements offer evidence:

*I am tempted to say that the system helps emergency planning, but I don't think the system supports planning solely. If used well, the system can save us all a lot of time in terms of communication. It provides us with an overview of what is happening across the colleges when an emergency occurs, through the MACC Situation Board Module. The campus status for every college is right there. This is why I say that it will help us in all future emergency planning efforts.*

*I think the system supports both information storing and the emergency response communication process. In terms of communication, the information that is available readily to the users can help them communicate more effectively. The right word might be information that is immediately viewable or accessible can support the communication process. Also, the system provides a quick way of getting information. The system surely helps to capture knowledge as well. As I mentioned, you have everyone from the respective colleges who report to MACC there, and they post their*

*knowledge and information into the system. This seems like a very organized way of capturing information.*

### **Category 2: Goal Achievement**

#### **Improving Communications**

The majority of the users felt that the system can enhance emergency-related communication both before and during an actual emergency. One respondent even suggested that the system might benefit recovery communication with external agencies such as FEMA. However, before this happens, issues such as training, willingness to share information, and trust among one another must be resolved. The following statements offer examples:

*The system can improve the overall communication process. This is due to the fact that all the schools have access to the system, and all the schools should be posting information relevant to emergency response. And one can access the system from anywhere. It does not matter which part of the world you are from, you can get to it, as it is Web-based.*

*The system helps us to communicate better even after an emergency has ended, as the information will be at everyone's fingertips, which could later be served as data for any report or justification in an inquiry, such as FEMA and other agencies that may need that information.*

*The system can facilitate communication during an emergency. However, before this works, we need to make sure that people are willing to trust each other. For example, under the resources-to-share and resources-needed pages, people need*

*to be aware that just resources available as they have been posted pre-crisis may not necessarily be available when an actual crisis occurs.*

### Emergency Preparedness Knowledge Capture

The users also generally felt that the system can facilitate some aspects of knowledge management. Specifically, benefits such as being able to archive information, capture knowledge and information about emergency preparedness, and offer a more structured way to manage information were noted. The following statements offer evidence:

*I think that it will help us create an archive of every drill, actual emergency, and also any other related activities that we conduct. This tells me that the system might serve as a useful knowledge book or "book of knowledge," so to speak. People must be willing to contribute to this book, though.*

*The system can help us capture information/knowledge about emergency planning and response. The scribe could copy and paste information into any Microsoft program such as Excel or Microsoft Word for later usage.*

*The system allows us to better manage emergency related information, because now we have a written record of everything that is done and by whom. This is useful for future references, too. The system also provides a common platform/space, structuring of information.*

### Knowledge-Sharing

The users were also optimistic about the ability of the system to facilitate knowledge and information sharing among individuals and entities involved in emergency preparedness. However, this is contingent upon the willingness of people to share information and trust the source of informa-

tion/knowledge that resides in the system. Some of the responses to this issue are as follows:

*Frankly, I don't think all the members from the various colleges have a knowledge-sharing culture. Based on my experience here, my guess is that people need to share more information about emergency planning with each other. It seems easier to share with some relative to others. I guess we are comfortable with speaking directly with people and may not be willing to share information in an open platform. This needs to change though. People must be willing to share information with each other.*

*As mentioned, easy access to the system and a fairly direct way to input ideas will allow people to share knowledge about emergency preparedness with each other. It will allow them to populate the database or to fill in the blanks. But people must be willing to do this.*

*The system has useful refreshing abilities and allows users to share information and knowledge with each other instantaneously. It provides timely information and, therefore, can help better communication between the EOCs and the MACC.*

### General Concerns

Several issues must be addressed before the value of the system to support emergency preparedness within CUC and the Claremont Colleges is maximized. The respondents mentioned the following general concerns:

*I think for the system to work, training is key. People at MACC need to be trained to use the system. But, as you know, the people that report to MACC either don't show up for training sessions or keep changing. Then, there is this issue of the information sharing culture that I spoke to you about. This must change for the system to be*

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*used effectively. People should put personality differences aside and be willing to share and communicate with each other. The technology itself seems powerful and is a great idea. It can handle different and very dynamic sets of information when an actual crisis occurs. But at the heart of all of this is the willingness to be trained and share information. For this to happen, emergency preparedness must become part of peoples' job function. With the exception of a few people on MACC, for the majority of us, emergency preparedness is not of a primary concern. We prepare only when we think about drills; otherwise, it seems to be lost in our daily primary functions.*

*I would be concerned if we don't have Internet connectivity. I think we need a paper-based system as a backup. This is really my only concern. And I saw during our drill, some people are not too Web savvy. There might be issues with training; people who are not familiar with a Web-based system need to be trained. Also the colleges keep sending new people to the MACC. If we have new people who don't know how to use the system or have not been trained to do so, this could cause some problems as well. In the event of an emergency there might not be any IT staff to support the use of the system. This again could become an issue. Ongoing training for staff involved in emergency preparedness is necessary.*

*I think the challenge is keeping everyone constantly abreast of the system. I think the idea of playing with the system every month when the MACC meets is welcomed. Your relearning time or startup time will become longer if this is not done. We need to make sure that people know where to fill information and not do this inaccurately. Also, people should not edit other people's information.*

*I think people need to be trained continuously. In addition, it only makes sense if the EOCs for all colleges use this system, too; after all they*

*need to provide MACC representatives with the information needed.*

If it is used properly, updated, and maintained, then this will work. However, this is subject to some budget being approved for a system-resource or admin staff that helps in this task. Also, we need to make sure that people do not mess up due to poor access control.

## DISCUSSION AND LESSONS LEARNED

Feedback from the evaluation phase suggests that the system that has been implemented can impact emergency preparedness activities for CUC and the Claremont Colleges in two ways: (1) improve communication and (2) assist in emergency preparedness knowledge/information sharing.

### Communication

Key staff members involved in emergency preparedness now realize that, through the project, the Web-based system can assist the overall emergency preparedness communication process as follows:

- Provide a centralized information base about emergency situations, campus action, resource status, and MACC action, which are now accessible to all relevant groups and individuals involved in emergency planning.
- Minimize the overflow of information within MACC and thereby reduce the possibility of communication chaos.
- Empower staff members involved in emergency preparedness to update information as and when it is received, without the need for relying on the MACC scribe to do so.

- Provide a structured way to document emergency-related information, which can support external communication and recovery efforts (e.g., claiming reimbursement from FEMA and other federal agencies). Wiki technology has a function called history, which documents exactly what was entered into the Wiki, by whom, and when.

### **Knowledge Sharing**

Anyone can contribute to a Wiki page in a given Wiki community (Leuf & Cunningham, 2001). Wiki technology thrives on the principle of being open (Wagner, 2004). Emergency preparedness and response within the Claremont Colleges involves both knowledge and experience from a diverse set of individuals. Within CUC alone, there are staff members that have been trained in particular emergency preparedness areas. Examples are people who are trained in search and rescue, earthquake evacuation procedures, hazardous material handling, CPR, and first aid response.

### **Critical Success Factors**

Our findings suggest that the positive outcomes of the system can materialize fully only if the following factors are taken into consideration by the CUC's top management involved in emergency preparedness:

- People involved in emergency preparedness are willing to share information with one another. The MACC Situation Board module, for instance, can support the Operations Coordinator to plan for and allocate resources during an actual crisis, only if the resource-available template is filled a priori by the respective college EOCs. As one respondent mentioned, "I am not sure

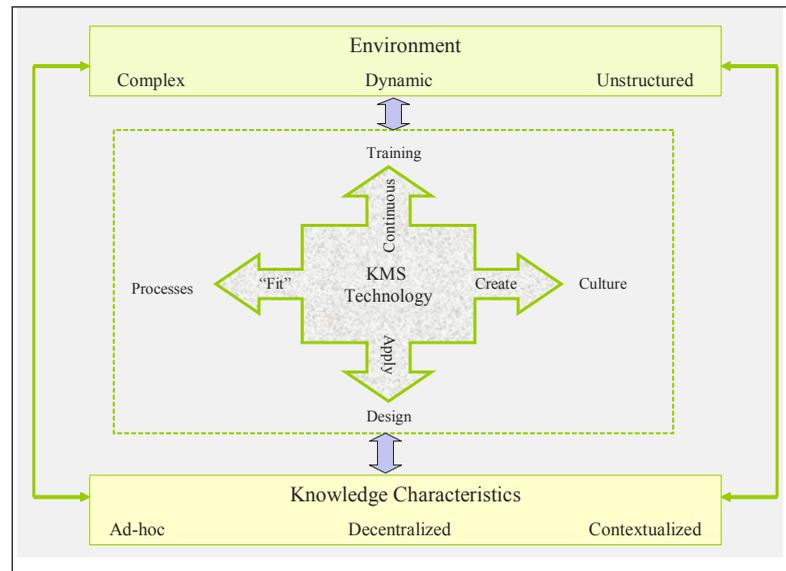
if people will be willing to share information with one another, particularly about the status of their resources."

- The technology is designed to support a knowledge-sharing culture. However, we are uncertain if this culture exists among every EOC and individuals involved in emergency preparedness in this case.
- The system must play a vital role in every emergency response drill and training session. Unless the system is used during drills and such events, it will not be used during an actual emergency.
- The technology must support and not hinder the existing emergency response protocol. In this context the CEO indicated the following concern, "Everyone [with reference to the EOCs] can act prematurely and go talk directly to one another without going thorough the central body (MACC) to coordinate efforts. The system should support existing protocols that we have. People should be trained to use it to ensure that the technology supports MACC's role. This can be done."

### **THEORETICAL IMPLICATIONS**

Figure 1 illustrates how the project findings might further inform theory about emergency management information systems. This study suggests that the environment faced by emergency responders is complex, dynamic, and unstructured (Burnell, Priest & Durrett, 2004; Kostman, 2004; Van Kirk, 2004). The majority of literature about emergency management information systems does not state clearly that systems designed to support emergency preparedness are associated with knowledge management. This study suggests that the environment faced by emergency responders forces them to deal with the following characteristics of knowledge:

*Figure 1. Theoretical framework*



- **Ad Hoc:** Knowledge within emergency responders at the Claremont Colleges is largely tacit and utilized as and when an emergency occurs. Individuals and groups involved in emergency preparedness may not necessarily think about responding to a particular situation beforehand. This implies that the knowledge that they need to respond to an emergency is ad hoc in that it is required as and when a crisis occurs.
- **Decentralized:** The knowledge repository to respond to a particular crisis in a consortium environment is predominantly decentralized. In the case of the Claremont Colleges, this knowledge resides within eight EOCs and the MACC.
- **Contextualized:** Emergency preparedness requires responders to deal with knowledge that is highly contextualized. Every crisis is unique and requires a different set of ideas and response initiatives (Burnell et al., 2004).

Given these characteristics, the findings of this study suggest that any system designed to support emergency preparedness should be linked closely to ideas inherent within the domain of knowledge management. A particular technology selected to support emergency preparedness should cater to knowledge that might be decentralized, ad hoc, and highly contextualized.

We suggest that Wiki technology might be a simple yet cost-effective option for organizations that intend to use or design any information system to manage information and knowledge related to emergency preparedness. Wiki technology is appropriate for knowledge that is dynamic and decentralized (Wagner, 2004). Nevertheless, technology alone is not sufficient to foster effective emergency preparedness initiatives. The system should be designed to cater to the requirements of emergency responders and must be used in every drill and emergency training activities (Turoff et al., 2004). Figure 1 suggests that, in addition to effective design and training considerations,

the following two additional factors are required when thinking about emergency information management systems:

- A fit between the knowledge management system and the existing emergency preparedness policies must be sought. Stated differently, the technology should support and not hinder emergency response initiatives.
- There is a need to foster a knowledge-sharing culture among various entities involved in a given emergency preparedness organizational structure. In the case of CUC, this refers to the willingness of different EOCs to share information and knowledge with one another.

## CONCLUSION

An organization's emergency preparedness activities might involve collaborative efforts among various entities. A vital activity is responding to an actual crisis situation that hits one or more of the member organizations or entities. For some organizations, as in this case, responding to a crisis situation is done within a consortium environment. Managing knowledge across the various entities involved in such efforts is critical. This includes having the right set of information that is timely, relevant, and governed by an effective communication process. Given such organizational structures and a need to manage knowledge in these environments, IT, which manifests itself in the form of knowledge management systems, might play a crucial role. However, before this occurs, the following issues must be considered: (1) sufficient training in the use of a system(s) must take place; (2) a knowledge-sharing culture among entities involved in emergency preparedness should exist; and (3) a fit between task and technology/system must be guaranteed.

## REFERENCES

- Alavi, M., & Leidner, D.E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issue. *MIS Quarterly*, 25(1), 107–136.
- Burnell, L., Priest, J., & Durrett, J. (2004). Developing and maintaining knowledge management system for dynamic, complex domains. In J. Gupta, & S. Sharma (Eds.), *Creating knowledge based organizations* (pp. 203–229). London: IGP.
- Campbell, C.L., Van De Walle, B.V., Turoff, M., & Deek, F.P. (2004). A research design for asynchronous negotiation of software requirements for an emergency response information system. *Proceedings of the Americas Conference on Information Systems*, New York.
- Claremont University Consortium. (2006). *The Claremont Colleges emergency preparedness plan*. Retrieved February 20, 2006, from <http://www.cuc.claremont.edu/emergency/emergplan.pdf>
- Davidson, R., & Martinsons, M. (2002). Empowerment or enslavement? A case of process-based organizational change in Hong Kong. *Information Technology and People*, 15(1), 42–59.
- Gupta, J.D., & Sharma, S.K. (2004). *Creating knowledge based organizations*: Hershey, PA: Idea Group.
- Jennex, M. (2004). Emergency response systems: Lessons from utilities and Y2K. *Proceedings of the Americas Conference on Information Systems*, New York.
- Jennex, M.E. (2005). Emergency response systems: The utility Y2K experience. *Journal of Information Technology Theory and Application*, 6(3), 85–102.
- Jennex, M., & Olfman, L. (2005). Assessing knowledge management success. *International*

*Journal of Knowledge Management*, 1(2), 33–49.

Kostman, J.T. (2004). 20 rules for effective communication in a crisis. *Disaster Recovery Journal*, 17(2), 20.

Lee, J., & Bui, T. (2000). A template-based methodology for disaster management information systems. *Proceedings of the Hawaii International Conference on Systems Science*, Hawaii.

Leuf, B., & Cunningham, W. (2001). *The WIKI way: Quick collaboration of the Web*. Boston: Addison-Wesley.

Lindgren, R., Henfridsson, O., & Shultze, U. (2004). Design principles for competence management systems: A synthesis of an action research study. *MIS Quarterly*, 28(3), 435–472.

Patton, D., & Flin, R. (1999). Disaster stress: An emergency management perspective. *Disaster Prevention and Management*, 8(4), 261–267.

Raman, M., & Ryan, T. (2004). Designing online discussion support systems for academic setting—“the Wiki way.” *Proceedings of the Americas Conferences on Information Systems*, New York.

Susman, G., & Evered, R. (1978). An assessment of the scientific merits of action research. *Administrative Science Quarterly*, 23, 583–603.

Turoff, M. (1972). Delphi conferencing: Computer based conferencing with anonymity. *Journal of*

*Technological Forecasting and Social Change*, 3(2), 159–204.

Turoff, M. (2002). Past and future emergency response emergency response information systems. *Communications of the ACM*, 45(4), 38–43.

Turoff, M., Chumer, M., Van De Walle, B., & Yao, X. (2004). The design of a dynamic emergency response management information systems (DERMIS). *Journal of Information Technology Theory and Application*, 5(4), 1–35.

Van Kirk, M. (2004). Collaboration in BCP skill development. *Disaster Recovery Journal*, 17(2), 40.

Wagner, C. (2004). WIKI: A technology for conversational knowledge management and group collaboration. *Communications of the Association for Information Systems*, 13, 265–289.

## ENDNOTES

<sup>1</sup> There are seven colleges within the Claremont Colleges: Claremont Graduate University, Harvey Mudd College, Scripps College, Pomona College, Keck Graduate Institute, Pitzer College, and Claremont McKenna College (<http://www.claremont.edu>).

<sup>2</sup> N=25.

<sup>3</sup> Adapted from Wagner (2004), Figure 1, p. 267.

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