United We Respond: One Community, One Voice*

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You can't fight in here, this is the War room!
Dr. Strangelove

ABSTRACT

When emergency situations cross borders, or when newly formed groups need to work together, decision making can suffer from threat rigidity and pertinent information can be bypassed. We describe a Dynamic Delphi system under development that can create and sustain a group "voice" for an emergency response Community of Practice (CoP). We further describe its intended use for a CoP consisting of local, state and federal government responders, civilian emergency response teams (CERT), and volunteers. Community members can brainstorm, explore ideas, debate and vote iteratively to best reflect the group's opinion at any moment in time. Ongoing studies demonstrate that an online system implementing Dynamic Delphi characteristics along with Thurstone's Law of Comparative Judgment will prove conducive for building a repertoire of ideas, rules, policies or any other aspect of the community's 'voice', in such a way that the individual voices are juxtaposed in harmony to create a single song.

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INTRODUCTION

As defined by Wenger, et al (2002), "Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis." Fontaine (2001) describes them as housing "the valuable knowledge and practice of how things really get done in an organization." The professional association that meets face to face is a traditional CoP; increasingly, CoP are moving online, instead of or in addition to using traditional means of communication such as meetings and newsletters.

CoP that are virtual communities present challenges as well as opportunities as people cross into the digital world and break from their traditional means of communication/interaction. Online computer mediated communications (CMC) present a platform conducive for decision making as more individuals have accessibility and therefore can contribute, leading to more ideas and creating a group intelligence as a direct result of this collaborative effort (Hiltz and Turoff, 1978, Turoff, et al, 2002, Li, et al, 2001, White, et al, 2007). A key objective is to capture each group member's thoughts, input and vote into any given situation where their expertise makes for a valuable opinion. The following challenge is how to most accurately portray the group's opinion, creating a single scale, where each

member feels as if their voice is heard and that they are a contributor. This scale can be used as an analytical instrument providing informative feedback, indicating one member's viewpoint and providing a direct comparison of that against the group opinion.

There are problems when building the knowledge base of a CoP from its members, utilizing the groups' opinions as they form a virtual community. Successfully initiating a virtual community of practice (VCoP) requires encouraging probable participants to interact, which can be difficult; and finding motivations strong enough to get them to join and a means to quickly coalesce different points of view about their goals and policies and actions, which can be even more difficult. It's important that a group use a system before an emergency event occurs. There are many reasons for this such as to build trust, to be familiar with functionalities so that they come naturally during stressful times, and to build a knowledge base that can be organized and utilized later. (Turoff, et al, 2004).

In emergency management, combining efforts from existing CoPs such as CERT, Citizen Corps, First Responders, and volunteer groups, with the availability of technology on a grand scale, can create a type of 911 community response grid system (Schneiderman, and Preece, 2007) further utilized as a Knowledge Exchange Center (Turoff , 2007). This concept would be synonymous with how 911 is perceived in the United States, but with a much greater functionality and more usability for the users, creating a dynamic emergency interactive tool that is highly accessibly utilizing CMC and the Internet. Individuals could report useful data on the Internet with any number of telecommunication devices which presently exist and are used by a large proportion of the population. CoP can aid as an extension to response efforts when local resources are overwhelmed by the size of the event.

In this paper, we present a methodology that can leverage existing technology and increase the probability of the successful cultivation and utilization of a CoP. A Delphi technique is implemented which uses a systematic interactive procedure for obtaining estimates, viewpoints or forecasts from a panel of experts about the topic. The participants must represent the various points of view or stakeholders; for instance, for disaster recovery, they should include victims, insurers, government agencies, not for profit agencies etc. Traditional Delphi systems distribute questionnaires in two or more rounds, and after each round, a summary of the voting results and of the reasons they provided is presented to the users. Our system is characterized as a "dynamic" Delphi because voting and the display of results are continuous rather than fixed in 'rounds'. This system will aid in the collaborative process of bringing together multiple points of view from members and allowing the members to formulate one group opinion which can be subject to change based on the merits of the arguments.

First, we will review the existing literature findings indicating what the major problems are, who the major players will be and what the major goals should be. Next we introduce a Dynamic Delphi system, showing how this helps a newly formed community to develop. An example is provided for emergency management and response tasks, which is the particular application area for which we are designing our system. Last we cover ongoing research in this area and describe future plans for this work.

LITERATURE REVIEW

Communities of Practice

Communities of Practice are groups who have a common interest, who share a common set of goals and enjoy learning from one another as well as together as a team. "Their involvement in their community is based on interest in the topic, not on formal affiliation. Their relationships are collegial rather than hierarchical" (Wenger, 2003, pg. 1). A CoP defies traditional power-driven hierarchies as individuals network on a collegiate level versus defer decision making to the next level up in a chain of command. Communities can be composed of many interrelated sub-communities, but overall, they have a common tie which brings them together, be it work or pleasure related. CoP can be extremely useful when the groups are formed from knowledgeable teams of experts who have the desire to work together and learn from each other. CoP can leverage existing group members by formalizing what they know, strengthening "weak ties that provide exposure to new ideas" (Voss and Schafer et al, 2003),and turning tacit knowledge into explicit knowledge.

Community Response Grid

There are a number of professional, civilian and volunteer emergency response groups, including CERT, volunteer fire departments, FEMA civilian corps, military, government and civilians. When a disaster occurs, the first to know what happened are those who survive to tell about it. If civilians would use present-day technology, such as cell phones, Blackberries and laptops as reporting and recording devices, it would be the first step which would revolutionize how emergency situations are managed. There needs to be a single identifiable place which acts as a Knowledge Exchange Center, a site online which is as nationally identifiable as 911. This would overcome the bottlenecking effect such as would normally occur during high call periods in which assistance would not be accessible, where many people would be left with a busy signal. Since a phone system could not handle the load and could be down, a 911.gov grid could be used to report information similar to what is already accomplished on such a grand scale by social sites, such as MySpace, Facebook and UTube (Schneiderman and Preece, 2007). A Community Response Grid (CRG) could be set up by the government "where residents could report incidents in seconds, receive emergency information, and request resident-to-resident assistance." Anyone with a web browser could use this system, as could anybody with an internet-enabled cell phone or other telecommunications device.

CERT Community Members

CERT is a community based group of civilians who are trained to take part and aid in the event of an emergency, hence, Community Emergency Response Team (CERT). This group of people can be classified as 'local experts' who have been professionally trained in basic disaster response skills with focus given to community events which are most probable to occur given their geographic location. CERTs practice the philosophies of a CoP, where all members participate voluntarily, with a common goal where each member is there to learn and work together. This could be managed building a critical infrastructure and history amongst members, serving both as a KEC as well as a social network from which to further benefit during times of crisis.

An example showing the diversity and the strength a CERT can provide comes from Florida, during severe wildfires. "The Edgewater CERT helped emergency management and the fire department personnel by assisting with evacuation; handling donations; preparing food for firefighters; and answering the phone while the professionals were fighting the fire. This is a great example of CERT members and response personnel working together for the benefit of the community." (cert.org)

BACKGROUND

Collaboration

Typically a group might cooperate on writing a book by assigning each chapter to a different person who works on the topic from an outline of chapter topics for the book. However, such a collection of individual chapters is not true collaboration. What one may hope for in a collaborative effort is to produce "collective intelligence" i.e. where the ideas of many are better than the view of any single person in the group (Hiltz and Turoff, 1978). To accomplish this, the whole group must participate on all the concepts and views that go into the book. Clearly obtaining such an objective for a group of any size leads to information overload (Hiltz and Turoff, 1985). The introduction of the computer into human communications allows three specific technical approaches to increase true collaboration to minimize and hopefully overcome the limitations of information overload (Turoff, et al, 1991). They are:

- **Roles**: human roles designed into the communication process and allowing special privileges built into the software (e.g. author, editor, reviewer, modifier, indexer, briefer (Turoff, et al, 1991, (Turoff, et al, 2004)
- **Protocols**: Processes for establishing results such as who can approve or incorporate a suggested change to what item, voting to reach agreement or expose disagreements, etc.
- **Structure**: knowledge structures such as in Delphi exercises (Linstone and Turoff, 1975) to organize and provide modeled relationships, sometimes non linear, to provide visualizations of information that promote understanding. This may include scaling methods to help reach a group understanding and perception of a group view or voice.

Aspects of these are appearing in the efforts to develop social systems such as CoPs and examples of social networking sites such as Facebook® and Myspace®. However, they have been a key component of Computer Mediated Communications (CMC) systems for many years (Hiltz and Turoff, 1978).

A Dynamic Delphi System

The Delphi method originated from the RAND Corporation, and was extended to non "forecasting" applications by Linstone and Turoff (1975). Later a social decision support system was created, further changing Delphi to give it more flexibility in its decision making process (Turoff, et al, 2002). Prior research on this system demonstrated that this was conducive for groups interacting online and prompted groups to give not only more decisions, but better overall quality (Li, et al, 2001, White, et al 2007b). This method was studied for its potential in helping groups manage and reduce information overload given complex collaborative problem solving.

Based on this prior research, a truly dynamic version of Delphi was created and has been tested in a few pilot studies demonstrating its strength and potential for larger groups to utilize. This system includes the following features:

- Member identity is anonymous; pen names or handles are used.
- Anyone can vote or have their say on any topic
- Anyone can change their vote anytime or choose not to vote
- Anyone can participate on any part of the decision process anytime
- Interaction is asynchronous
- There is a visual feedback system that is real time.

One way a Dynamic Delphi system decreases information overload is by breaking decisions down into their atomic parts, creating sets of unidimensional data which are compared in a strategic manner which best reflects the view of the experts. This is accomplished by using Thurstone's Law of Comparative Judgment where each decision is broken down into a unidimensional set of items then, each item is compared with one other until all comparisons in a set are made (Thurstone 1927). Although this can be cumbersome given larger sets of data, many methods are available to reduce the number of comparisons (White, et al, 2007a). This simplifies the process, with the added benefit of producing a more accurate reflection of the expert's opinions (Miranda, 2001). This system also takes into account the reflection of changes that occur given the changes in merit of a decision option over time. This is most beneficial as the environmental events may occur in an unfolding situation and the decisions need to reflect that change in real time

Thurstone's Law of Comparative Judgment

Along with aforementioned Delphi characteristics, Thurstone's Law of Comparative Judgment is utilized for its ability to take in numerous individual opinions and formulate one group opinion (Thurstone, 1927). Each item an individual offers to the community for consideration is paired with every other item. Next, a vote selecting one item over another based on some criteria is conducted by the community members concerned with that issue. Thus, voting can be accomplished expeditiously while maintaining an accurate reflection of each member's opinion, especially when given a complex task. Visual presentation is an important feature for clarifying the overall group voice: easy to understand feedback on where the group stands at any given moment in time. This scale is unique in that it is only defined after these calculations have been made. Hence, there is no predetermined scale as all items are judged relative to one another; this is what determines the length as well as the numeric intervals.

This is a real time means of accomplishing a number of things:

- letting individual group members know what they think relative to the other members in the community;
- informing members where the group stands on every item being considered;
- telling where each item stands in relation to the next item; and
- creating a scale that shows exactly the collective group opinion on a set of items.

The visual interpretation can show consensus or expose disagreements and the level of each. It's the disagreements that stimulate further discussion on an issue, which increases understanding and lessens ambiguity related to the issue at hand, creating as an end result, a cohesive and unambiguous group voice.

The contribution of this work is to promote success in the initial stages of building a CoP which further aids in its overall cultivation. Providing a method to aid in clarifying members' views will help develop a better group perspective that will hopefully satisfy the users in that they will feel as though their input matters and their voice is heard. Later, this methodology will also maintain the group's view as the opinions change as a direct reflection on changes in merit of the information. Also, the system will provide a forum where new ideas can be presented and the community can self-actualize and reach its potential.

METHODOLOGY

In order to build and maintain a CoP especially given the challenges in a virtual environment, hence VCoP, we implemented a Dynamic Delphi system to actually work with users to facilitate the process. Using one of Delphi's most notable characteristics, anonymity in voting is a crucial component. This allows the users to each have an equal 'voice' in the overall creation of the information being discussed, lessening a users inhibitions to promote more interaction and add more voices to the overall opinion.

Decision Making Model and Discussion Facilitation

We use a decision-model where all steps are connected in such a way that anyone can participate in any stage at any time, allowing for flexibility in decision making and catering to specific task types (See *Figure 1 borrowed from Turoff, et al, 2008*). Voting occurs during a few stages in this model where a group consensus or opinion is needed to either lessen ambiguity or to aid in the creation, then selection of some choice available (White, et al 2007b).

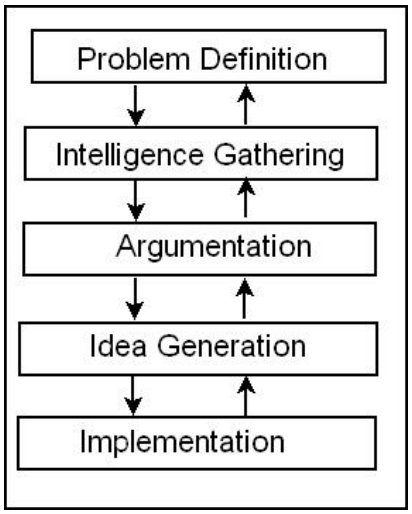

Figure 1 Dynamic Decision Making

Another crucial part of the methodology is the list generation of ideas, solutions, opinions or whatever the problem is that the group may be working on. Anyone can facilitate the discussion simply by posing a question and then allowing all members to offer solutions and give feedback. Since there is no leader or formal organization in the creation of discussions, the individual members must formulate and pose problems to the group so the facilitation can be initialized. The group can debate their points in a forum, offer arguments, or upload documents to support their efforts and all the while, members can vote, not vote or change their vote to reflect their views on the issue. Once a votable item is posted, all members give their input individually so the group eventually is represented as one voice.

The process is as follows:

- Any idea can be submitted by any group member anytime on a list
- There is an initial and continuous vote on the proposed item
- Anyone can vote, change their vote, choose not to vote, or can choose to hold their vote until more information comes in.
- If the suggested idea gets a predetermined percentage of votes, then the idea is placed on a primary list of alternatives for the group to consider for implementation.
- This cycle can be repeated until a solution is implemented.

Even after a decision has been implemented, the problem may be revisited. A solution may not have worked out or the problem environment may have changed so that the solutions may change. Or, it could simply be an evolving situation in which all of the problems remain, but the solutions change over time. (Note that Figure 1 shows the flow between the phases of the stages in the decision process being utilized). Next, we give an example of such a situation.

During an emergency situation, time is of the essence and the best decisions must be made with the given information at hand. Groups of experts can utilize a system such as this to reflect their collective intelligence and conduct decision making based on their collaborative expertise. For example, during Hurricane Katrina, a VCoP could have been utilized. Given the complexity of the situation and the changes in the requirements due to the changes in the environment, a system such as the one proposed can break down the complex components into their atomic parts. Also, decision making can be as expeditious as needed for the system, reflecting ongoing interactions amongst community members.

Complexity and Information Overload

Decisions and their selections can be nested, complementing the complexity of the decisions that are engaged by the group. For example, in *Figure 2*, we show where a group of first responders may be collaborating in order to prioritize where to put their efforts and resources responding to an emergency during the aftermath of an event such as Hurricane Katrina.

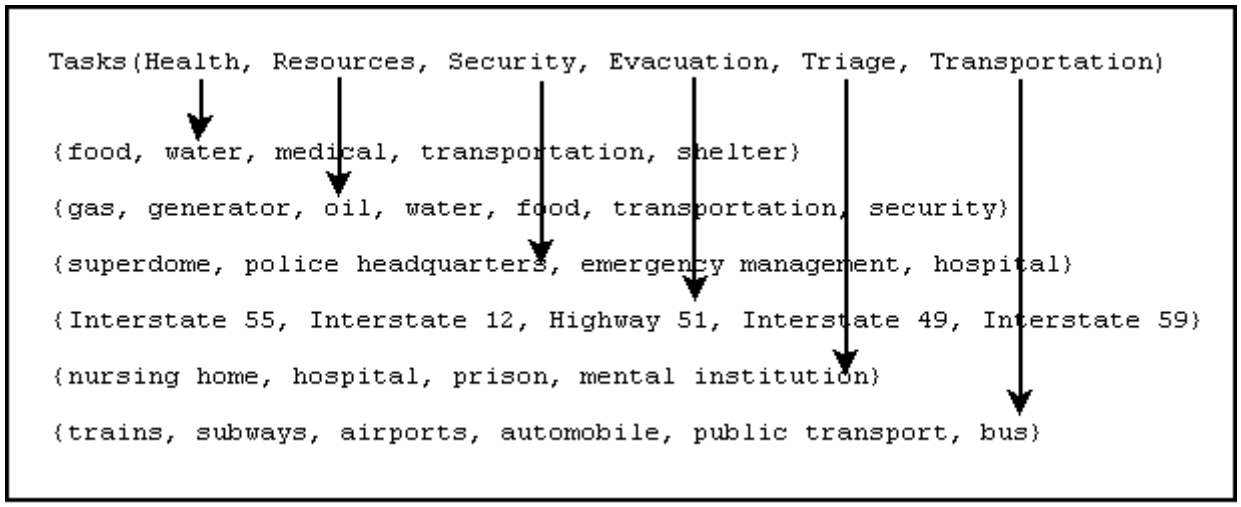

Figure 2 Atomic Break Down of Unidimensional Data

On the top level, the group must decide which tasks are given priority. Then, within each task, there is a unidimensional set upon which to further 'vote' and speak as a group. Multiple collaborators can give individual perspectives, producing a group decision where all are held accountable versus having one top official, or a small group of top officials, who normally are not part of the scene sometimes being far removed from the turn of events unfolding, making the decisions. It's the first responders who are in the midst of the event, and have the best significant information from which to make the most accurate decisions.

Visual Feedback

There is a real time visual interpretation of the group's outcome at all times. This offers the stimulus that may prompt discussions or negotiations in the forum. This method for argumentation helps to sway individual views, based on the merit of the case/situation being experienced. Thurstone's scaling technique is non-specific with respect to a prior starting and finishing position, there is no fixed predetermined distance. This is because the data being compared are a direct reflection of each choice to be made or weighted, one against the other, where all of the set is what defines the scale and where each item is rated in relation to the next, from one extreme to the other. This visual feedback can tell the group many things such as:

1. it can indicate strong areas of agreement or disagreement
2. it can show clusters of items indicating perceived equivalences based on some dimension
3. it can give a rank order of selected items on any semantic differential.

One example of how Thurstone's visual feedback works is demonstrated next in Figure 3. A first pilot study was conducted asking subjects to rank dimensions according to their perceived importance when effects from a catastrophic event may occur. This was an attempt to create a unified alert system for public and professional response.

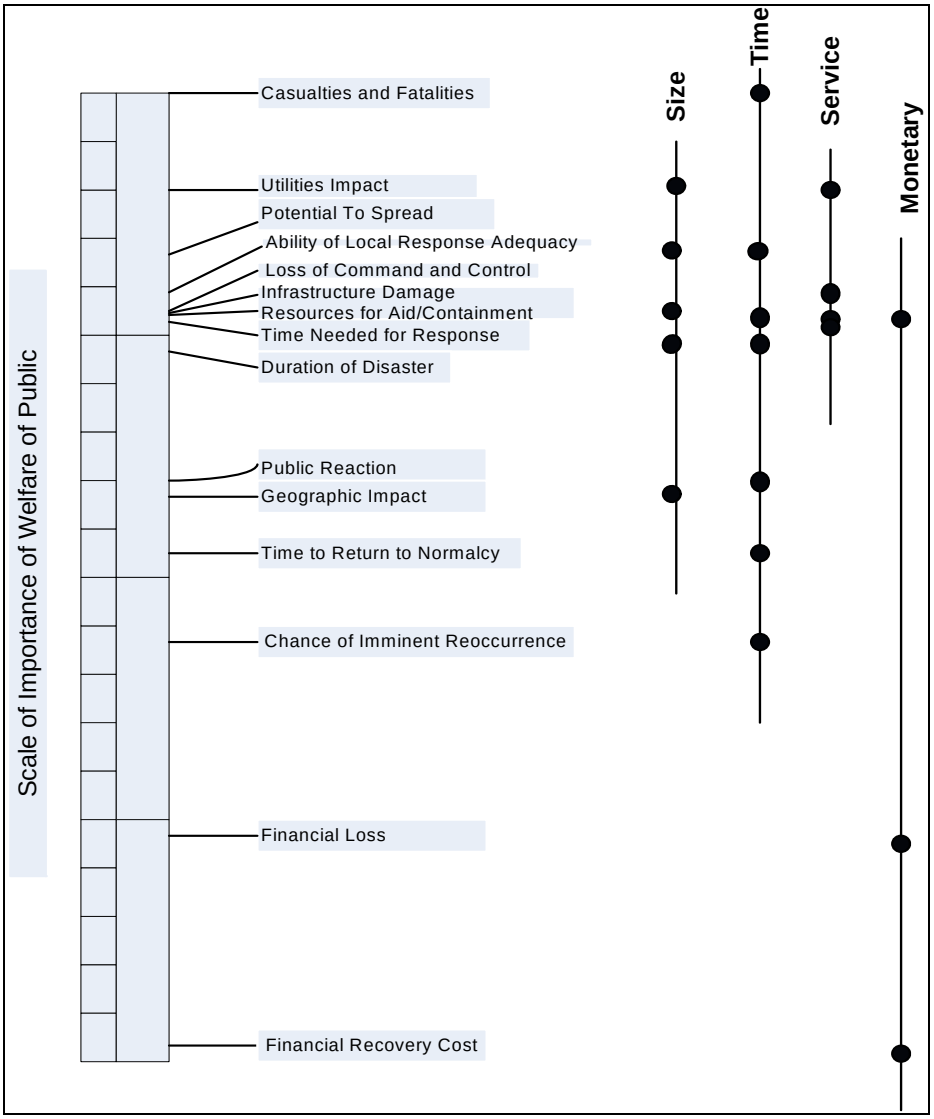

Figure 3 Values of Unified Emergency Scale

Figure 3 demonstrates how the dimensions were perceived and clusters were identified showing equivalences in perceptions. (*Figure 3* is adapted from Plotnick, et al, 2007) The information can then be further analyzed for any underlying factors that may be playing a larger role. Particular characteristics were found to be in common with many of the dimensions identified. For example, *Time* was shown to be an underlying element to many of the dimensions solicited as were the *Size* of the event, the elements that require human *Services* immediately as well as the dimensions that were *Monetarily* driven. There could be further associations between these categories, providing insight into the 'whys' behind the decision-making.

DISCUSSION

Various needs of the CoP in emergency management can be satisfied with applications derived from this methodology, ranging from local resource sharing to estimating potential damage from approaching storms or threats, given a set of local knowledgeable experts. The placement of critical response resources such as portable generators, medical resources, construction resources, and firefighting equipment are problems that might be addressed. The system could handle a wide variety of types of decisions reflecting the diversity of goals given a CoP supporting both the civilian and professional needs: preparedness or response actions, evaluating resource allocation, community emergency response efforts (CERT), volunteer and donation coordination, alert notifications or any other sort of problem solving.

In terms of our own efforts our system is one that concentrates on a group being able to suggest, discuss, and evaluate the atomic elements that make up a single list of items which could be goals, decisions, actions, criteria, problems, solutions, future events, etc. This is the foundation for many complex problems in different areas and is the first step in dealing with a specific complex problem. The next step might be building a structural modeling tool to allow a group to pool all their contributions into a viewable and understandable model. Examples of this are interpretive structural modeling, cross impact, relationship models, etc. The potential use of a Dynamic Delphi system such as we have described is increasing as community members are increasingly likely to be sophisticated users of technology at home and on the job (Wenger, 2005). As the web changes, emerging technologies are supporting the likelihood of VCoP and enabling them in a more pervasive manner. We have demonstrated that a Dynamic Delphi model can be implemented to help build a voice for a VCoP.

One might question, why use a CoP instead of depending on the government? We have local, state and federal officials, what could a CoP do that the government can't? Considering that elections are held every two, four or six years, depending on the position's term limits, the chances that all, if any, electoral candidates have the proper education, experience or expertise to handle a disaster on any scale are not high. One only has to recall the disorganized response efforts to Hurricane Katrina in the New Orleans area, to know that all of the interacting levels of government will not necessarily have the skills and expertise needed to constructively manage a disaster of this magnitude. Therefore, having a community of experts on standby is a much more realistic approach to successfully managing a large scale extreme event such as the one experienced with Hurricane Katrina.

In sum, this system is particularly useful for emergency management due to the real-time information system supporting large groups of experts making decisions, not only at a fast pace, but also under duress. In addition, this system can be used by a virtual group anytime, anywhere increasing accessibility and usability.

FUTURE RESEARCH

Presently, we are developing an open source Dynamic Delphi system. The focus of a dissertation is dedicated to building and testing this system with a team of emergency responders. However, this could be used in a number of domains as it is non-specific and can work for any given organization, interest group, or other group forming a VCoP. For example, we have created a large, open membership wiki (www.emergenciWiki.org) for academics and practitioners of the emergency domain as well as a smaller, private wiki (www.gischutzhundclub.org) for Schutzhund protection dog training and are using both as CoP test sites.

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