Designing a Group Support System to Review and Practice Emergency Plans in Virtual Teams

Xiang Yao
New Jersey Institute of Technology
xy3@njit.edu

Murray Turoff
New Jersey Institute of Technology
murray.turoff@njit.edu

Michael J. Chumer
New Jersey Institute of Technology
michael.j.chumer@njit.edu

ABSTRACT

In the 21st century, rapid changes of our society necessitate continuous review and practice of emergency plans. Traditional face-to-face (FtF) interactions to make emergency plans and train responders seem insufficient. The virtual team (VT), a new team form allowing dynamic recruitment of experts from global extent and conduction of teamwork whenever it is needed, provides a more agile solution. This paper introduces a group support system called Collario (Collaborative Scenario) aiming to facilitate effective collaboration in creating and discussing scenarios in VTs and to utilize scenarios as the vehicle to review and practice emergency plans on a continuous basis. This research is still in progress. Three professionals have been involved in system demonstrations and interviews. Although it is still too early to make any conclusions, it is encouraging to know that all the three experts thought Collario easy to use and might be useful for various emergency preparedness purposes.

Keywords

Emergency Preparedness, Group Support System, Scenario

INTRODUCTION

Background

After entering the 21st century, the world has been experiencing fast and dramatic changes. The 9-11 terrorist attack marked the first time after WWII that the soil of the United States had been attacked by external forces. Financial crisis caused by subprime mortgage in 2008 drew the United States and the world into the worst recession after the Great Depression. Climate change led to more frequent extreme weather conditions. Change is the top word of 2008, according to Global Language Monitor's (www.languagemonitor.com) annual global survey of the English Language. For many, change might mean opportunities. However, in the arena of Emergency Management, change first means challenges. It means uncharted water, new problems, uncertainties, that the assumptions underneath old plans might not hold true, and that there might be new threats that have not been addressed. How to effectively prepare for rapid changes will become an important research topic for Emergency Preparedness.

Traditionally, FtF meetings have been the most popular medium for emergency preparedness activities such as making plans and training responders. Prior research finds FtF meetings have incomparable advantages over other communication media. For example, Daft and Lengel (1986) found that FtF meetings provide the richest information cues and channels, allow instant feedback, and are less likely to be distracted. Based on these findings, Daft and Lengel (1986) conceptualized the Media Richness Theory (MRT) which posited FtF meetings might be the best choice to deal with complex (highly ambiguous and highly uncertain) problems. Over the past decades, various experiments and field studies have been conducted to compare performance between Face-to-Face (FtF) teams and Virtual Teams (VTs), which found that except for some special types of group tasks, FtF teams consistently outperformed VTs (Warkentin et al., 1997; de Pillis & Furumo, 2006). Also, FtF team members showed higher level of cohesion and satisfaction, and less time spent on the task (Warkentin et al.,

1997; de Pillis & Furumo, 2006). All these have made FtF meetings a preferable choice for emergency preparedness activities.

However, when dealing with rapid changes, it might be a different story. There is no doubt that prior experiments and field studies demonstrated FtF meetings' advantages. The problem is: Can necessary FtF meetings be organized in time? Rapid changes imply more frequently such meetings are needed to review, test, and practice emergency plans. However, experts might be scattered in different departments, organizations, even countries, and might have different schedules and priorities. The inflexibility in organizing FtF meetings can compromise its productivity in preparing for rapid changes.

Thus, it is worthwhile to reexamine the strengths and weaknesses of VTs in preparing for rapid changes. The unique strengths of VTs over FtF meetings include dynamic configuration, flexibility in joining team work, and universal accessibility (Mowshowitz, 1997). However, without physical presence, VTs can suffer from more process losses (Nunamaker et al., 1991). To improve VT productivity necessitates right group support systems (GSS) (Nunamaker et al., 1991), effective leadership (Yoo & Alavi, 2003), and positive attitude (Jarvenpaa & Leidner, 1999). Emergency professionals have shown great leadership and attitude in fighting emergencies. It is reasonable to believe that if they are powered with effective GSSs, they might be working more productively in VTs, which in turn might provide a feasible solution to prepare for rapid changes.

Our Contributions

This paper introduces an innovative GSS, Collario (standing for Collaborative Scenario), to facilitate collaborative scenario creation in VTs. It utilizes a knowledge structure to allow collaborators to build up scenarios, as well as reusable knowledge base. It also supplies mechanisms to promote deep collaboration. Small-scale system demonstrations and interviews show that Collario might be easy to use and might be useful for several Emergency Management applications, such as creating MSELs (pronounced as mE-sl, standing for Master Scenario Event List), conducting virtual TTXs (Table Top eXercise), and reflecting and sharing personal experiences.

CONTINUOUS REVIEW AND ADJUSTMENT

Three Approaches

To ensure complex system safety, literature and practice suggest three feasible approaches: the engineering approach, the organizational approach, and the system approach. The engineering approach is to ensure system safety through system designs (Perrow, 1986). Redundancies and buffers are two such solutions. However, this approach might have several deficiencies. First, there might be conditions that had not been considered in the designs. Second, when the system complexity explodes, probability of committing design errors rises (Perrow, 1986).

The second approach, the organizational approach, is to improve system safety by creating and enforcing organizational cultures and processes to prevent system dysfunctions from happening, to mitigate their consequences, and to reduce damages to the system in case of their occurrences (Roberts, 1990). Research about High Reliability Organization (HRO) is in line with this approach. HRO research has identified many organizational characteristics that contribute to increased system safety, such as continuous training, culture of reliability, and high degrees of responsibility and accountability (Roberts, 1990; Weick, 1999). However, one problem with HROs is that HRO's stringent requirements might prevent its applicability to normal organizations (Marais et al., 2004).

However, we believe the true challenge of these two approaches lies in change. There have been many disasters resulting from changed conditions. Without Hurricane Katrina, levees of New Orleans might not have collapsed. In 2007 winter, large-area blackout in southern China might have been avoided, if there had no unprecedented ice storms. Both system designs and organizational processes make some assumptions. However, changes might nullify these assumptions.

To deal with changes, Marais et al. (2004) suggested the system approach. The essence of the system approach is a monitoring system and a feedback loop to adjust system designs and organizational processes. For example, if the population of a city doubles or triples, evacuation plans must be adjusted accordingly, otherwise, problems can be expected. Under an era of change, one-time-for-all system designs and organizational processes would never be sufficient. A mechanism for continuous review and adjustment is mandatory.

Virtual Teams

Although the system approach seems necessary, a practical question is: How to execute? FtF meetings have been a matured method to discuss changes and their implications upon system designs and organizational processes and they have been extremely effective for this purpose. However, FtF meetings, especially those engaging large number of participants, need to accommodate attendees' schedules, require time and logistical efforts to organize, and incur travel and accommodation costs. Theoretically, FtF meetings can be called upon whenever they are needed. However, because of the above restraints, it is not unusual to see delays of FtF meetings to address changes, especially when the threats have not become so obvious. In addition, researchers have found several potential process losses related with FtF meetings (Nunamaker et al., 1991), such as conformance pressure, attention block, domination, evaluation apprehension, and etc. Our motivation is to design a program that allows organizations to review and adjust designs and processes at any time and with experts from any place, with nominal costs.

With recent development of information and communication technologies, the Virtual Team (VT), a new team form primarily interacting through technological interfaces, has become more and more popular. Unlike FtF meetings, anyone can join VTs no matter where they are and work on team tasks whenever it is best for them (Mowshowitz, 1997). This flexibility provides an incomparable advantage over FtF meetings, and a great opportunity for continuous review and adjustment of designs and processes. Still, we understand that there are challenges for its success, as previous research has found quite a few process losses related with VTs (Nunamaker et al., 1991). However, the potential benefits are so intriguing that we cannot help but moving forward to pursue solutions. The encouraging news is that research about technology acceptance suggests that perceived usefulness and perceive ease of use would lead to acceptance of a technology by end users (Davis, 1989; Venkatesh et al., 2003). Our endeavor at this stage is to design systems that would be useful and easy to use for this vision.

Scenario

Scenario has multiple meanings. Out of the three definitions from the on-line Merriam-Webster dictionary, Coates (2000) chose the following one to describe scenario as a planning tool:

> *"An imagined sequence of events, esp. any of several details or possibilities"*
>
> - On-line Merriam-Webster dictionary

Early application of scenarios can be traced back to as early as several thousand years ago in Ancient China. In modern times, there was a surge of use of scenarios during WWII. In 1950s, Herman Kahn created scenarios to raise awareness of potential complexity of nuclear war. Thanks to Kahn, military has had great experience in using scenarios (Coates, 2000).

Scenarios are a useful planning tool, especially for complex situations (Godet, 2000; Coates, 2000; Turoff et al., 2006). Human brain is capable of dealing with complexity, but that is laborious (Coates, 2000). The unique strength of a scenario is that it embeds real life complexity and uncertainty into coherent, plausible, and systematic stories, so that planners can make plans and/or test existing ones.

Scenarios are also a useful training tool (Turoff et al., 2006). Scenarios can be used for a full spectrum of scenario-based training programs ranging from small-scale low-fidelity Table-Top eXercises (TTXs) to large-scale high-fidelity simulations. Emergency scenarios emulate real-world emergencies and give trainees an opportunity to practice their situation assessment and decision making skills in dealing with the real hazards without being physically involved in the hazardous environments.

Collaborative Scenario Creation and Potential Applications

Allowing a group of people to create and discuss scenarios collaboratively would lead to many potential applications, including, but not limited to making and reviewing policies and plans, identifying potential problems, training students or employees, and even writing screenplays.

In the field of Emergency Management, since scenarios are generic planning and training tools, they can be used for nearly every type of emergencies. For example, a coastal state like New Jersey or New York might be interested in creating Hurricane scenarios, while California might be more willing to explore fire or earthquake scenarios. Public and private organizations can take advantage of collaborative scenario creation too. Museums can utilize burglary scenarios, while food industry can utilize flood scenarios. The possibilities are unlimited.

DESIGN OF COLLARIO

Alternatives

It is possible to adopt many open-source or commercially available general-purpose group support systems (GSS) like Wiki and Audio/Video Conference Systems to create and discuss scenarios in virtual teams. However, since these systems are not designed specifically for these purposes, there are no specialized supports to optimize collaborative scenario creation processes. Therefore, these general tools might not be optimal.

Design Objectives

As mentioned in the previous section, the two outmost design considerations for Collario are usefulness and ease of use. Davis (1989) created questionnaires to measure perceived usefulness and perceived ease of use. Referring to these questionnaires helped us to detail the design objectives for the two aspects of system design. The design objectives are summarized in the following table:

Usefulness	Ease of Use
1. Collario should help users to create/discuss scenarios in VTs more quickly.	1. Collario should be easy to operate.
2. Collario should help users to improve performance in creating/discussing scenarios.	2. Collario should be clear and understandable.
3. Collario should help users to improve productivity in creating/discussing scenarios.	3. Collario should be flexible to interact with.
4. Collario should make it easier to create/discuss scenarios.	4. Collario should be easy for users to be skillful.

Table 1: Designing Objectives of Collario

Design Methods

For the usefulness dimension of Collario design, we referred to Nunamaker et al. (1991) for the four types of supports a GSS can provide: task structure, task support, process structure, and process support. To us, task structure is the foundation, as task structure constrains the types of task support permitted, as well as communication and processes allowed. Task structure is a distinguishing feature of Collario out of any other generic GSS.

Above task structure, communication is the core of collaborative scenario creation. However, prior research reveals that there can be as many as five different communication levels: competing, informing, coordinating, cooperating, and collaborating (Neale, 2004; Denise, 2004). Characteristics of the five levels of communication are summarized below:

- **Competing**: No trust or committed exchange of information exists in the team.
- **Informing**: The team agrees to keep everyone informed of what every member does.
- **Coordination**: The team agrees to undertake actions in some sort of agreed order and schedule.
- **Cooperation**: The team has agreement on the actions be to taken.
- **Collaboration**: The team exerts holistic work and efforts on the actions being taken, and welcomes and synergizes disagreements.

Because scenarios are used to describe future uncertainties and variety of options, allowing different opinions and trying to take the most out of the differences would give us the most benefits. For this reason, we believe that collaboration, the highest level of communication, would be the best choice. And the design of Collario should promote deep collaboration. We use deep collaboration to refer to the special type of communication in this spectrum.

For the dimension of ease of use of Collario design, we referred to the literature of usability (Norman, 1989; Levi & Conrad, 1996) for suggestion. In terms of user interaction design, simple is virtue (Norman, 1989), as a simple system makes it much easier for users to learn and use. Affordance is also a preferable system feature, and using metaphors familiar to users is an effective way to achieve affordance (Norman, 1989). In addition, we referred to Levi & Conrad (2003) for the nine principles (heuristics) for WWW prototypes.

- Speak the users' language.

- Be consistent.
- Minimize the users' memory load.
- Build flexible and efficient systems.
- Design aesthetic and minimalist systems.
- Use chunking.
- Provide progressive level of details.
- Give navigational feedback.
- Don't lie to the user.

Design Details

This section explains the design of Collario. The introduction of the system is organized in the following four sub-sections: task structure, event log metaphor, templates, and deep collaboration support.

Task Structure:

As discussed in previous sections, task structure is the foundation for Collario. Because of this reason, we start the introduction of Collario from task structure. To design Collario's task structure, we did comprehensive literature review (Gordon, 1994; Quarantelli, 1997; Coates, 2000; McConnell & Davies 2006) and identified as many as 18 entities related with scenario creation: Scenario, Theme, Constraint, Event, Notification, Situation, Potential Outcome, Parameter, Prerequisite, Response, Resource, Resources Type, Alternatives Resource, Trigger, Assumption, Objective, Time, and Location.

However, because we follow the Design Science paradigm (Hevener et al., 2004) in the development of Collario, we will need multiple iterations to evolve the system. In each iteration, several design concepts will be implemented and evaluated. Evaluation results and user feedback from a previous iteration will become new design inputs for the next iteration. Because we used this iterative process, there is no need to implement all of the entities in a single iteration. We chose to implement a simplified task structure with fewer entities (Scenario, Response, Event, Situation, Resource, and Parameter) in the current iteration. This approach would help us to create prototypes quicker and get user feedback faster. In addition, since we have designed the system in a way that entities can be added to the task structure in a standard way, it would be pretty easy to include more entities in the future. Using Entity-Relationship (ER) diagram, the task structure used in the current iteration is shown in Figure 2:

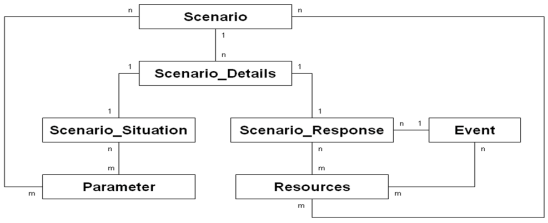

Figure 2: ER Diagram for Scenario Data Modeling

As this diagram illustrates, a Scenario can consist of many Scenario_Details, which in turn can be either a Scenario_Situation or a Scenario_Response. A Scenario_Situation can be defined by many Parameters (e.g. number of casualties). A Parameter can be used to define many Scenario_Situations. Similarly, a Scenario_Response can use many Resources, while a Resource can be used in many Scenario_Responses. In addition, a Scenario_Response can be a special case of a standard Event (e.g. dispatch an ambulance), and an Event can be used for many Scenario_Responses.

Event Log Metaphor:

Collario implements an Event Log metaphor to display the summary of a scenario and its related discussions. The Event Log metaphor was chosen because event logs are familiar to emergency management workers. The following screenshot shows the event log metaphor implemented in Collario:

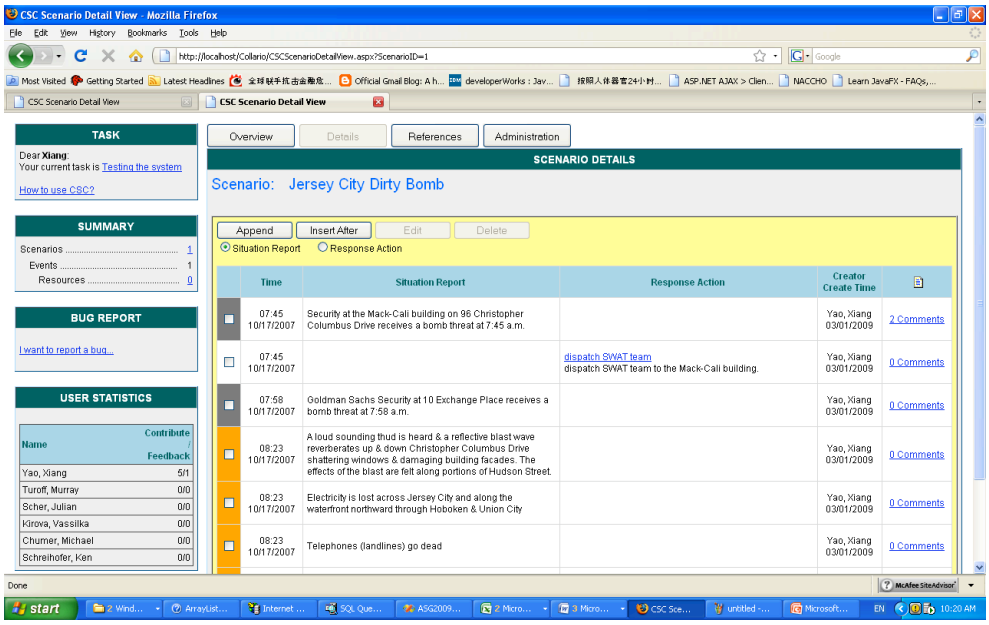

Figure 3: Screen of Collario 1#, Event Log Metaphor

In this screen, the main part is a table showing the summary of a scenario. The leftmost column of this table uses different colors to represent differentiate statuses of the scenario situations and scenario responses. Orange means the situation or the response is under current discussion focus. Gray means the situation or the response is out of discussion focus. White means the situation or the response is not create by an administrator as a part of MSEL (Master Scenario Event List), but inserted by a regular user. Collario allows administrators to change the statuses of discussion focus. The next four columns contain the time, scenario situation, scenario response, and creating user of a particular situation or response. The last column shows the numbers of comments given to each scenario element. By clicking on the link buttons under this column, one can view the comments given to the corresponding situation or response.

Templates:

Collario provides a set of templates for users to define and review contents of various scenario elements. For example, if the "Overview" button in Figure 3 is clicked, a template for scenario overview will be displayed, as shown in Figure 4.

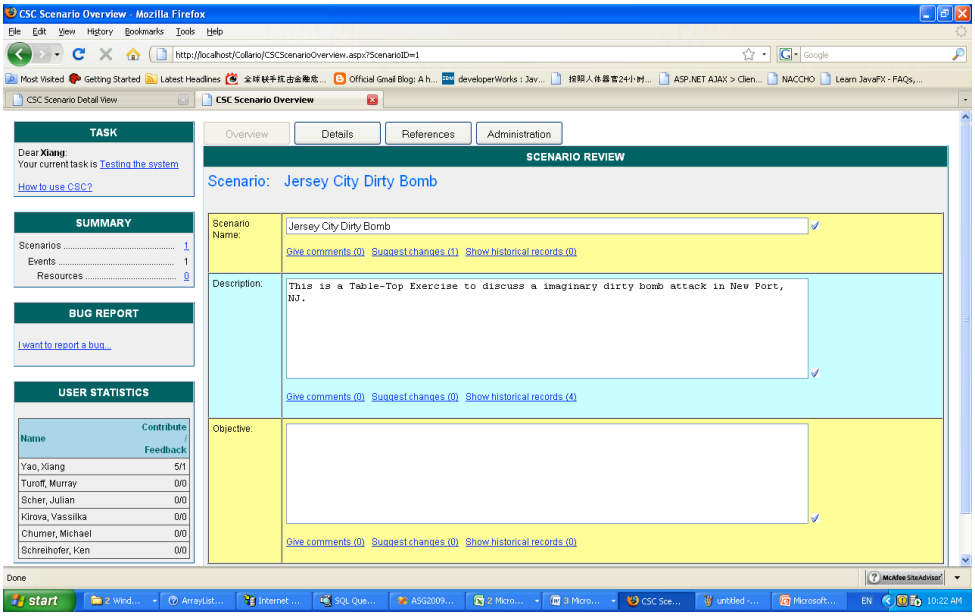

Figure 4: Screen of Collario 2#, Scenario Overview Template

In Collario, each element in the task structure has its own template.

Deep Collaboration Support:

Collario provides special mechanisms to foster deep collaboration. Multiple ways are provided for users to collaborate on every field of every element. The following lists the types of collaboration supported by Collario:

- **Fill in Empty Fields**: If a field is empty (like the Objective field in Figure 4), any user can fill in it.
- **Give/View Comments**: Any user can give/View comments to any field.
- **Update a Field**: A creator of an element or administrators can update a field of that element. Others cannot.
- **Suggest Changes**: However, any user can suggest changes to any field,
- **Accept Changes**: And the creator of the element or administrators can update a field using a suggested change.
- **View Historical Records**: Any user can view historical changes of any field,
- **Restore Historical Values**: But only the creator or administrators can restore a historical value.

Figure 4 actually shows how these deep collaboration supports are provided. Beside each field, there is an image button with a check sign. This button is only visible to the creator and administrators. Below each field, there are three link buttons, comments, suggested changes, and historical records, to review and leave comments, suggest changes, and view historical records. If a creator or an administrator clicks on the "Suggested Changes" link button in the middle, a screen as shown in Figure 5 will be displayed:

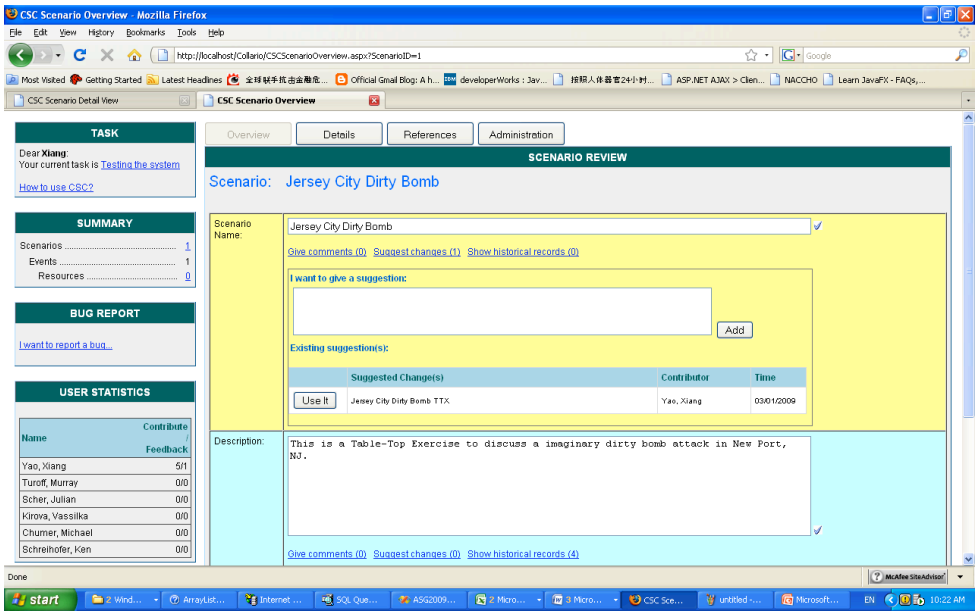

Figure 5: Screen of Collario 3#, Suggested Changes

A button named "Used it" is beside each suggested change. Only creators and administrators can see these buttons and use them to make the changes. Others can see and give suggested changes, but they cannot make the change. The working mechanism for historical records is very similar to suggested changes.

SYSTEM DEMONSTRATIONS AND INTERVIEWS

This study follows the Design Science paradigm (Hevner et al. 2004) to design, implement, and evaluate Collario. Unlike evaluation of Behavior Science research, whose purpose is to test hypotheses and models, evaluation of Design Science research is to test design effectiveness and get user feedbacks. Therefore, a wide range of evaluation methods can be used for Design Science research, such as system demonstrations, interviews, simulations, and formal experiments. This study used system demonstrations and interviews as evaluation methods.

Between August 2007 and February 2008, we invited a total of three emergency management experts from public sector, private sector, and federal agency for two rounds of system demonstrations and interviews. These experts and their background are listed below:

Expert 1#: Exercise Coordinator working for New Jersey State Department of Health and Senior Services.

Expert 2#: Corporate Safety Loss Prevention Manager working for the Wakefern Food Corporation.

Expert 3#: Voluntary Group Liaison working for FEMA region II.

In 2007, one author met experts 1# and 2# during two separate TTXs held in New Jersey to prepare for Hurricane threats. During the exercises, he introduced the system under construction to both experts and asked them if there would be interested for a system demonstration once the system would be ready. Both of them gave positive response. In August 2007, when an initial prototype was developed using mockups to illustrate the task structure, Event Log metaphor, and a few templates, invitations were sent to them and they accepted the invitations. During this round of demonstrations, the researcher showed the mockups to the experts and explained to them how they should work whenever it was necessary. The experts were encouraged to comment at any time. Some semi-structured questions to address ease of use and usefulness issues were given at the end of the demonstrations. The whole process was audio recorded for afterwards analysis. Both experts thought the Event Log metaphor and the task structure were easy to understand and both of them were enthusiastic about the potential convenience this system might bring to the practitioners. Finally, when asked if they would like to attend another round of demonstrations and interviews, both of them mentioned their pleasure and willingness.

Inspired by the positive responses from the experts, we then spent another 4 months to implement more functions. By that time, the system had become a working prototype, with not only those introduced in previous system design section, but also supports for administrators to prepare initial a set of scenario events and to direct the discussion focuses. In January 2008, invitations were sent to expert 1# and 2# again. Confirmations were replied soon. In addition, expert 3# was recruited through professional network.

For the second round of demonstrations, a researcher first gave a 25-30 minutes demonstration to show how to generate initial set of scenario events, how to organize an on-line TTX session, how to add new contents to a scenario, and how to use the deep collaboration features (comments, suggested changes, and historical records). Then, a research interviewed them with semi-structured questions. During demonstrations, the experts were encouraged to comment at any time. The whole process was video recorded for analysis. From these recordings, the following themes emerged.

Regarding perceived ease of use, all the three subjects unanimously agree that the system is easy to learn and easy to use. Subject 3# comments on the system as: "You know what? The most beautiful thing about this system is its simplicity… The design is elegant". None of them have trouble in understanding what the system is about and how to use the system after the demonstrations.

Regarding perceived usefulness, all the three subjects agree that the system has the potential to be useful for several Emergency Preparedness purposes. From different background, the three subjects envision different applications for Collario. Expert 1#, thinks that Collario can be useful to create MSEL (Master Scenario Event List), replacing their currently used inefficient email communication. Subject 2# thinks that Collario can be used to test and practice emergency planning on a regular basis. He comments: "We have had piles of emergency plans. What we need is a way to practice them." Subject 3# thinks in addition to these two applications, Collario can also be used to share personal experiences. He comments that there are a total of 12 Voluntary Group Liaison working for FEMA country wide. Such a collaborative system can be used by them to reflect and share personal experiences more effectively.

Also, all the three subjects welcome the flexibility provided by asynchronous participation. They feel that virtual participation can save them time, costs, and efforts in preparing and attending face-to-face TTXs. Subject 3# comments: "(in face-to-face TTXs), a lot of efforts were spent on things having nothing to do with the exercises". With Collario, not only such extra efforts can be saved, but users will have more freedom. Subject 2# comments: "With this system, I can ask my team to log on to the system 9 o'clock every morning and try out some scenarios. This is very helpful for us".

LIMITATIONS AND FUTURE WORK

The size of experts being interviewed so far has been too small to make any reliable conclusions. We are intended to increase the size of experts for evaluation. We are also plan to use more formal usability evaluation methods, such as protocol analysis to evaluate Collario usability.

More importantly, usefulness of a GSS has to be tested in group settings. Therefore, our major future work will be to use field studies to test Collario in real groups with meaningful emergency scenarios. In addition, we are

interested in how group dynamics factors such as trust and leadership would impact group performance in using Collario. We are also interested in studying different combinations (synchronous vs. asynchronous, group size, group composition, etc.) to use Collario and comparing group performance between VTs using Collario and FtF teams in creating and discussing scenarios. We hope that Collario would become not only a useful planning and training tool for emergency management practitioners, but also a valuable platform to study collaboration and collaborative work.

REFERENCES

1. Briggs, R. O. (1994). The focus theory of group productivity and its application to the development and testing of electronic group support technology. MIS Department. Tuscon, University of Arizona.
2. Coates, J. F. (2000). "Scenario planning." Technological Forecasting & Social Change 65: 115-123.
3. Daft, R. L., and Lengel, R. H. (1984). Information richness: a new approach to managerial behavior and organizational design. Research in Organizational Behavior. L. L. Cummings and B. M. Staw. (Eds.). Homewood, IL, JAI Press.
4. Davis, F. D. (1989). "Perceived usefulness, perceived ease of use, and use acceptance of information technology." MIS Quarterly 13(3): 318-340.
5. de Pillis, E., and Furumo, K. (2006). "Virtual vs. face-to-face teams: deadbeats, deserts, and other considerations", Proceedings of 2006 ACM SIGMIS CPR Conference, Claremont, CA.
6. Denise, L. (1999). "Collaboration vs. c-three (cooperation, coordination, and communication)." Innovating 7(3): 25-35.
7. Godet, M., and Roubelat, F. (1996). "Creating the future: the use and misuse of scenarios." Long Range Planning 29(2): 164-171.
8. Gordon, T. J. (1994). "Cross-impact method." In "Futures Research Methodology." Ed. J. C. Jerome and T. J. Gordon.
9. Hevner, A. R., March, S. T., Park, J., and Ram, S. (2004). "Design science in Information Systems research." MISQ Discovery 28(1): 75-105.
10. Hiltz, R. S., and Turoff, Murray (1985). "Structuring computer-mediated communication systems to avoid information overload." Communications of the ACM. 28(7): 680-689.
11. Jarvenpaa, S. L., and Leidner, D. E. (1999). "Communication and trust in global virtual teams." Organization Science 10(6): 791-815.
12. Levi, M., and Conrad, F. (1996). "A heuristics evaluation of a world wide web prototype." ACM Interactions, Jul-Aug. 1996.
13. Linstone, H., and Turoff, M. (1975). The Delphi Method: The Techniques and Applications, Addison-Wesley.
14. Marais, K., Dulac, N., and Leveson, M. (2004). "Beyond Normal Accidents and High Reliability Organziations: The need for an alternative approach to safety in complex systems." Paper presented at the Engineering Systems Division Symposium, MIT, Cambridge, MA. As of January 2009 available at http://sunnyday.mit.edu/papers/hro.pdf.
15. McConnell, P., and Davies, M. (2006). "Safety first – scenario analysis under Basel II." http://www.continuitycentral.com/SafetyFirstscenarioanalysis.pdf. Last accessed on Mar. 2nd, 2009.
16. Mowshowitz, A. (1997). "Virtual organization." Communication of the ACM. 40(9): 30-37.
17. Norman, D. A. (1989). "The Design of Everyday Things", Doubleday, NY, NY.
18. Nunamaker, J. F., Dennis, A. R., Valacich, J. S., Vogel, D. R., and George, J. F. (1991). "Electronic meeting systems to support group work." Communication of the ACM. 34(7): 40-61.
19. Quarantelli, E. L. (1997). "Ten criteria for evaluating the management of community disasters." Disaster 21(1): 39-56.
20. Roberts, K. H. (1990). "Some characteristics of one type of high reliability organizations." Organization Science, 1(2), pp. 160-176.
21. Turoff, M. (1991). "Computer-mediated communication requirements for group support." Journal of Organization 1: 85-113.

22. Turoff, M., Chumer, M., Hiltz, S. R., Hendela, A., Konopka, J., and Yao, X. (2006). "Gaming emergency preparedness". HICSS-39, Kauai, Hawaii.
23. Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. (2003). "User acceptance of information technology: toward a unified view." MIS Quarterly 27(3): pp. 425-478.
24. Warkentin, M. E., Sayeed, L., and Hightower, R. (1997). "Virtual teams versus face-to-face teams: An exploratory study of a web-based conference system", Decision Sciences, 28(4): 975-996.
25. Weick, K. E., Stucliffe, K., and Obstfeld, D. (1991). "Organizational culture as a source of high reliability." California Management Review, 29(2), Winter 1987: pp. 112-127.
26. Yoo, Y. A., Alavi, M. (2004). "Emergent leadership in virtual teams: What do emergent leaders do?" Information and Organization 14:27-58.