Using the Internet to Train Emergency Command Center Personnel

Audrey F. Glowacki, Richard L. Unger, Edward F. Fries, August J. Kwitowski
National Institute for Occupational Safety and Health
Pittsburgh Research Laboratory
P.O. Box 18070 Cochrans Mill Road
Pittsburgh PA 15236
afg5@cdc.gov

Keywords: emergency preparedness, simulation, training, internet

Abstract

Well-prepared personnel and an effective emergency response plan are essential components of any emergency command center. Unfortunately, evaluating emergency preparedness is often difficult until a disaster actually occurs. For example, unexpected events may develop during an emergency that were not considered during the planning phase. Also, the command center may need to cooperate with organizations that it has not worked with previously. Preparation can be especially difficult for smaller or remotely located command centers, or those with limited resources to conduct mock drills. This paper explores the potential of using the Internet to teach and evaluate command center skills. The National Institute for Occupational Safety and Health (NIOSH) is developing an Internet-based, computer simulation training package for the mining industry. Trainees will play the role of command center leaders at a mine, while the actions of other individuals and organizations are simulated. Trainees will be able to test their emergency response plans and learn valuable lessons from past mine emergencies. Nationally recognized experts will be able to create new training scenarios and make them available to mines throughout the U.S. This product should better prepare command center personnel for large-scale disasters such as fires and explosions.

Introduction

In any emergency situation, it is critical to have well-trained command center leaders and a comprehensive emergency response plan. Various methods are used to train command center personnel, ranging from classroom-based approaches (videos,

textbooks, lectures, etc.) to more heuristic methods (role-playing exercises, mock disasters, and pencil and paper simulations). However, there are deficiencies associated with all of these methods:

Complexity - Emergency management is a complex task, requiring the coordination of numerous individuals and activities. Quick judgments are required in an environment where critical information is often lacking and interruptions are common. It is difficult to teach these types of skills in a classroom setting. Heuristic training methods may be more useful. However, it is difficult to plan and execute a training exercise that considers all possible outcomes and can evolve based on the trainee's decisions. Many people may be needed to play roles such as victims, rescuers, medical staff, police, media, etc. It is often necessary to simplify the training scenario to make it more manageable, but this can result in a less authentic training experience that prevents trainees from dealing with issues that might occur during a real emergency.

Cost - Staging a mock disaster is expensive, both to the company running the exercise and to other organizations that should be involved. Large-scale mock disasters that use actual company facilities and involve personnel in their assigned roles can be costly in terms of salaries, lost productivity and other expenses. In many cases, it may not even be possible for all necessary persons to participate in the exercise. The company incurs these costs each time the training is given. Paper and pencil simulation exercises, while considerably less expensive, still have a cost associated with their development, printing, and administration. High costs means there will be less opportunity for both first time and critical refresher training of emergency responders.

Lack of flexibility - Traditional classroom training tools (videos, textbooks, etc.) are sometimes difficult to adapt to the unique conditions of a particular company. Mock drills can be better, but because most are prepared in advance, it may not be possible to alter the course of the emergency situation once it is underway. For example, trainees may make decisions that the planners did not anticipate or allow for in the scenario. Or, the trainees may find the exercise more or less challenging than expected. An ideal training experience would allow the scenario to be easily modified in response to the capabilities of the trainees. It would also allow trainees to test and evaluate their own emergency response plans.

Lack of training program development expertise or resources - Many organizations do not have the skills or resources to prepare effective training and measure its effectiveness. The complexity of emergency response makes creating this type of training program particularly difficult. At minimum, the company needs persons with expertise in content, training materials development, and media preparation. In the content area in particular, it may be difficult for

companies to find persons with the necessary knowledge or first-hand experience.

Proposed Solution: Internet-based Simulation

The Internet and computer simulation offer a potential solution to many of these problems. For instance, having a computer *simulate* the roles of other players and events in the emergency can reduce costs on a per training session basis - eliminating many salaries, lost productivity, and the need for company facilities and people that are not available. Delivering training over the Internet can reduce distribution costs. Trainees at various company sites could all access the same training, and even participate in joint training exercises with coworkers throughout the company. Training experts can develop exercises and make them available to numerous organizations. These exercises might be updated periodically to provide new and varied experiences.

Computer simulation is ideally suited to modeling complex scenarios with concurrent events. The computer can simulate nearly all of the events that can complicate the emergency manager's job. This can include interactions with individuals outside of the command center, such as media, medical services, labor, government officials, and unofficial visitors (victims' families, etc.). Other examples include weather (such as flooding that interferes with the flow of supplies), and traffic problems. Multiple complications can appear to be developing simultaneously, all vying for the trainee's attention. The degree to which events are simulated would be a decision of the training program designers. They need include only the level of detail necessary to provide an effective learning experience.

A simulation-based training program can also be designed to maximize flexibility. For example, the software might have various skill settings to accommodate novices or more experienced trainees. If the user is progressing rapidly, additional problems might be introduced on the fly to provide a greater challenge.

An Internet-based software solution can also assist companies with limited training program development expertise. A consortium of companies could pool their resources in content expertise, training materials development, and media preparation to develop a training simulation. Companies with no particular expertise to contribute could donate funds to help pay for development of the simulation code. Care in developing the software would allow it to be customizable at run time, so it could better mimic the situation of a particular company running the training session. An example of this would be a program that accepts a town's street map for an evacuation simulation. The simulation could run on a single host computer and each company could schedule, set up and execute training sessions via the Internet.

One issue that a computer-based training package does not easily deal with is the events that occur between individuals *within* the command center. For instance,

federal law requires that an official of the U.S. Mine Safety and Health Administration (MSHA) be in the command center during a mine emergency. This representative has the authority to make suggestions and enforce safety regulations. In extreme cases, he or she may even take control of the command center.

The simplest solution to this problem is to require that all command center representatives be physically present during the training session. They will work as a team, entering their joint decisions into the program in response to events. This approach has the benefit of teaching command center personnel to work together to solve problems.

A second alternative is to design the software so that each representative has his or her own PC and interface for communicating with the simulation and other command center personnel. From the perspective of the trainee, these other "live" representatives would appear to be part of the simulation.

A third option is to simulate some or all of the other command center members. This approach may be difficult, particularly if those members have complicated roles in the emergency. Also, it does not provide the benefit of teaching teamwork.

A summary of how an Internet-based training simulation solution could work is as follows:

- A training developer develops and installs the training simulation on a server with a connection to the Internet.
- A company trainer connects to the Internet, logs onto the server, and reserves time for a training session using a standard Windows PC and web browser. The trainer might customize the session to select a particular type of emergency (fire, flood, etc.), environment (such as customized map of the facility where the emergency occurs), environmental conditions (rain, snow, etc.), or other factors.
- Once the trainer configures the software, a trainee(s) connects to the Internet and logs onto the server to start a training session.
- If applicable, other trainees who will be participating in the exercise log onto the server via other PCs. When everyone is ready, a command is given to start the simulation.
- As the simulation progresses, the trainee(s) receives periodic information via the Internet link about what is happening concerning the emergency situation. These updates will only include information that the command center would be aware of in a real emergency. This might include reports submitted to the command center by rescue teams. It would not include information that has not yet been discovered. The trainee(s) can

communicate reactions and decisions to the host application via the Internet. These decisions may impact the progress of the simulated emergency.

- The host application tracks each stage of the resolution of the emergency. The software monitors the speed and appropriateness of the trainee's decisions, allowing for a thorough debriefing at the end of the exercise.

NIOSH is developing a prototype computer simulation based on this model for training mine emergency command center personnel. The Mine Emergency Response Interactive Training Simulation (MERITS) is an interactive multimedia computer simulation of an underground mine that can model many different mine emergency scenarios.

MERITS - A Prototype Emergency Management Simulation

In a mine emergency, the same managers who are responsible for the day-to-day operation of a mine become the command center leaders. When mine disasters were more common, it was not unusual to find mine managers and other individuals with command center experience. That is not the case today. Federal regulations do not require training for these individuals and, while emergency response plans are required, there are no official guidelines for preparing them. Although some formal training is available through various federal, state, and academic sources, many individuals don't take advantage of these opportunities. This is particularly true for managers of smaller or remotely located mines.

In response, NIOSH looked to the Internet as a means for delivering simulation-based training to the mining industry. A small group of experienced trainers and command center leaders could develop scenarios that could be made accessible to even the most remotely located mining operation.

MERITS runs on two personal computers (PCs) that communicate over a local area network (LAN) or Internet connection. The Host PC (or server) models events and behaviors of individuals outside of the command center. Trainees at the Local PC play the roles of command center personnel. As the host communicates relevant information about the simulation, trainees can respond to those events and issue commands to attempt to resolve the emergency. These actions affect the progress and outcome of the simulation. For the initial version of MERITS, all command center members are assumed to be physically present at the Local PC working as a team.

The Host PC simulates events that occur underground, at the mine's surface mine facilities, and off of mine property. Some examples include the spread of fire and smoke under the influence of the mine's ventilation system, miners attempting to escape the mine, rescue teams attempting to find the miners under the direction of the command center, weather and traffic problems, supply delivery, and communication systems. It also models the behaviors of media representatives,

medical personnel, labor and government officials, and unofficial visitors (such as victims' families).

Much of this content is based on NIOSH research studies concerning mine ventilation simulation, self-contained self-rescuer training and field audits, oxygen cost studies, miner demographics, and analyses of past mine emergencies. The simulation operates on a set of "rules" that define its possible behaviors. The rules cover classes of information needed to produce a realistic simulation including (but not limited to):

- Human factors - physiology, psychology, level of training, etc.
- Physical factors - mine location, ventilation systems, etc.
- Internal and external resources - fire fighting equipment, rescue team availability, roof control materials, available supplies, transportation, etc.
- Political considerations - relations with Federal, State, and local authorities, media impact, relations with victims' families, etc.

The Host PC communicates relevant information to the Local PC command center via computer-generated sound or video. For example, if a working mine phone is available (and assuming that the communications systems are operational), a simulated miner may telephone the command center to say he or she has encountered smoke in a particular mine passageway. A rescue team searching for missing miners might report its latest findings. Security personnel might call to say that media representatives have arrived on-site.

Via a Local PC interface program (figure 1), users can issue commands to simulated individuals by telephone (for offsite calls), mine phone (an open broadcast to all employees on site, including underground personnel), or a "runner" (a simulated messenger who can run errands). For example, the trainee might issue a mine evacuation order, call an outside company to order supplies, or delegate responsibility for a particular task to an available simulated person.

The interface provides access to resources that might be at the disposal of a command center during an actual emergency. These include mine maps (figure 2), emergency response plans, personnel rosters, reference publications (such as government regulations), and notebooks. For example, the response plan might document command center responsibilities and phone numbers of important emergency contacts. Because mines are diverse in size, location, resources, and mining approaches, these features need to be customizable. By supplying their own mine maps, personnel rosters, and/or emergency response plans, companies will be able to test their own emergency response preparedness. Companies with fewer resources will have the option of choosing from a database of sample mines.

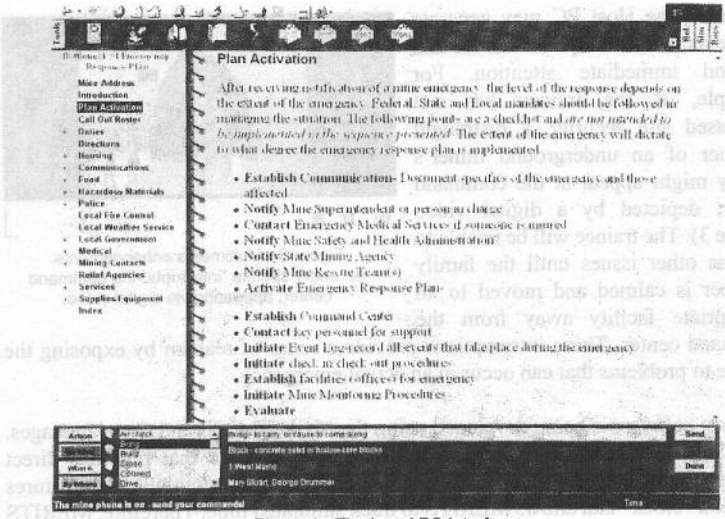

Figure 1 - The Local PC Interface.
Icons at the top of the screen access various tools and references, such as the mine's Emergency Response Plan. The lower left area of the screen is used to issue commands via telephone, mine phone, or a "runner".

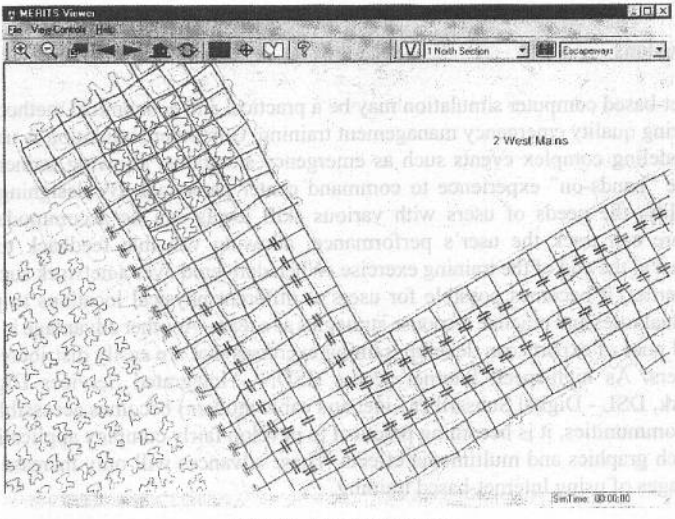

Figure 2 - Mine Map Viewer.
The Local PC interface includes a map viewing program that lets the trainee view the simulated mine.

At times, the Host PC may generate problems that interrupt the trainee and demand immediate attention. For example, if the trainee has not addressed site security, a distraught member of an underground miner's family might appear at the command center, depicted by a digital video (figure 3). The trainee will be unable to address other issues until the family member is calmed and moved to an appropriate facility away from the command center. These interruptions provide a sense of realism by exposing the trainee to problems that can occur in an actual emergency.

Figure 3 - Multimedia enhancements. An angry spouse "interrupts" the command center, appearing via digital video.

The host software is being developed using the MODSIM® III and C++ languages. MODSIM III is a general-purpose programming language that provides direct support for object-oriented programming and discrete-event simulation. Its features include a "clock" that allows MERITS to track simulated time. Therefore, MERITS can create time-stamped records of all events that occur during the simulation, including commands issued by the trainees. The software can monitor the speed and appropriateness of the trainee's decisions and skill at coordinating tasks, allowing for a thorough debriefing at the end of the exercise. The Local PC software is being written in C++, Visual Basic, Dynamic HTML, and Open Inventor (a general-purpose, three-dimensional graphics library used to generate and update the mine maps).

Conclusions

Internet-based computer simulation may be a practical and economical method for delivering quality emergency management training. Computer simulation is useful for modeling complex events such as emergency situations, allowing trainers to provide "hands-on" experience to command center personnel. By designing for flexibility, the needs of users with various skill levels can be accommodated. Software can track the user's performance, allowing valuable feedback to be provided at the end of the training exercise. When delivered over a network such as the Internet, it becomes possible for users at different physical locations to play individual roles and practice response strategies as a team. Another advantage is that a small pool of experts can develop training exercises that are easily distributed to end-users. As high-speed Internet access (ISDN - Integrated Services Digital Network, DSL - Digital Subscriber Line, and cable modem) becomes accessible to more communities, it is becoming practical to develop fairly complex applications with rich graphics and multimedia effects. These advances will only increase the advantages of using Internet-based training.