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Test Report
Virtual Trainer Simulation Program

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Executive Summary

The operational field assessment (OFA) of the Virtual Training (VT) Simulation Program, also known as the Enhanced Dynamic Geo-Social Environment (EDGE), was conducted from November 17 to 18, 2013, at the Sacramento Police Department headquarters in Sacramento, California. Thirty-six first responders from the Sacramento Police Department, Sacramento Fire Department, and Los Angeles Fire Department participated.

The Department of Homeland Security Science and Technology Directorate's First Responders Group (FRG) partnered with the U.S. Army Research, Development and Engineering Command's Simulation and Training Technology Center (STTC) to develop VT. FRG leveraged the U.S. Army Training and Doctrine Command and STTC EDGE program, building upon the Army's virtual framework to meet the needs of first responders across the nation. The need for a tool that allows first responders to train for high-impact events that require a multi-jurisdictional and multi-agency response served as the impetus behind its development. VT creates a virtual environment that can be accessed from disparate locations through the Internet or a local area network. It also allows for modification and customization at a minimum cost. The OFA featured an active shooter scenario that occurred in a virtual replica of a local Sacramento hotel.

The participating first responders noted an overall positive experience with EDGE. They believed that the simulation was realistic and accurate enough to help achieve their training needs for high-impact events. First responders also found the training—approximately one hour—to be straightforward and helpful, which is indicative of a mild to moderate learning curve and a well-designed graphical user interface.

The first responders, who represented areas of expertise such as fire services, law enforcement, dispatch, unified command, and emergency medical services, offered many recommendations. The majority of the recommendations sought to expand the capability of the simulation environment to become more realistic and interactive, which would allow for a more effective training experience. In sum, first responders were encouraged to see and use EDGE and look forward to training against additional VT scenarios.

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1 Introduction

First responders require realistic training to enable them to respond more effectively and efficiently to incidents of significance, such as an active shooter. Decisions made early in a major event often have a significant impact, either positively or negatively, in the successful management of a disaster or incident. First responders need the ability to conduct realistic training in a cost-effective and multi-disciplinary manner. This training must also support the challenges and complexities of the first responder's mission within the framework of multi-jurisdictional realities and complexities. The goal of the Virtual Trainer (VT) Simulation Program is to create that capability.

The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) First Responders Group and the U.S. Army Research, Development and Engineering Command's (RDECOM) Simulation and Training Technology Center (STTC) developed a virtual training "game" and conducted a pilot that leveraged existing government funding investments and technological advances made by the military, specifically the RDECOM/STTC prototype called Enhanced Dynamic Geo-Social Environment (EDGE). EDGE is not just a game, but a virtual environment that every jurisdiction within the country will be able to access, train within, and if desired, improve and modify. This pilot and subsequent expansion can provide first responders across the nation the ability to create local, geo-specific 3-D environments accurately depicting their own jurisdiction. It will also provide the option of using existing scenarios from an accessible repository at no cost.

1.1 Purpose

The purpose of the operational field assessment (OFA) was to gauge the suitability of VT in its current state.

1.2 Objective

The OFA sought to conduct realistic operational scenarios using trained first responders operating the VT to assess and evaluate its suitability for first responder operations.

1.3 Requirements

A formal Operational Requirements Document was not associated with this project. The informal guiding requirements for this project were derived from a Statement of Work. Table 1 is an excerpt from this document.

Table 1 – Statement of Work

Program Element/Project	Major Tasks
Provide a 3-D virtual environment capability based on Multiplayer Online Game technologies, utilize open development standards ("plug and play" interfaces), and support a multi-discipline	• Create a base set of applications that are open standard. • Ensure applications are adaptable and modifiable. • Ensure compatibility with commercial off the shelf (COTS) hardware and operating systems such as Windows and Mac

Program Element/Project	Major Tasks
training scenario. Develop a multi-discipline (i.e., fire, law enforcement, and emergency medical personnel) sandbox virtual environment with geo-specific terrain, ultra high-resolution buildings, accurate avatars, equipment (vehicles and tools), and representational behaviors for non-player characters (individual and crowd simulation). The sand box shall accommodate role player avatars for first responders and the opposing force. Also, the scenarios will be tailored to support the successful accomplishment of the first responders' training requirements.	operating systems (OS). • Implement 3-D rendering and visualization. • Produce accurate physics within real time. • Enable Internet access to the EDGE environment from any location. • Provide a Web-based capability to view and interact with the virtual scenario. Cloud architecture, assets, and modules will be archived and stored remotely but executed locally. • Provide a tutorial capability for rapid user familiarity and proficiency. • Develop a virtual environment based upon a first responder scenario and training objectives. • Develop the supporting terrain, models, physics, and effects to accomplish the scenario. • Edit TSPs developed by Sacramento, California, first responders for the integration of TSP into both Beta and Version 1.0.

1.4 System Description

VT is a computer-based, multiplayer simulation game designed to aid in multi-jurisdictional training in response to disasters and major incidents. Version 1.0 focuses on an active shooter scenario at a hotel; however, the capability and architecture of the system allows for the build-out of other scenarios and environments. The software uses COTS hardware and software such as Windows and Mac OS.

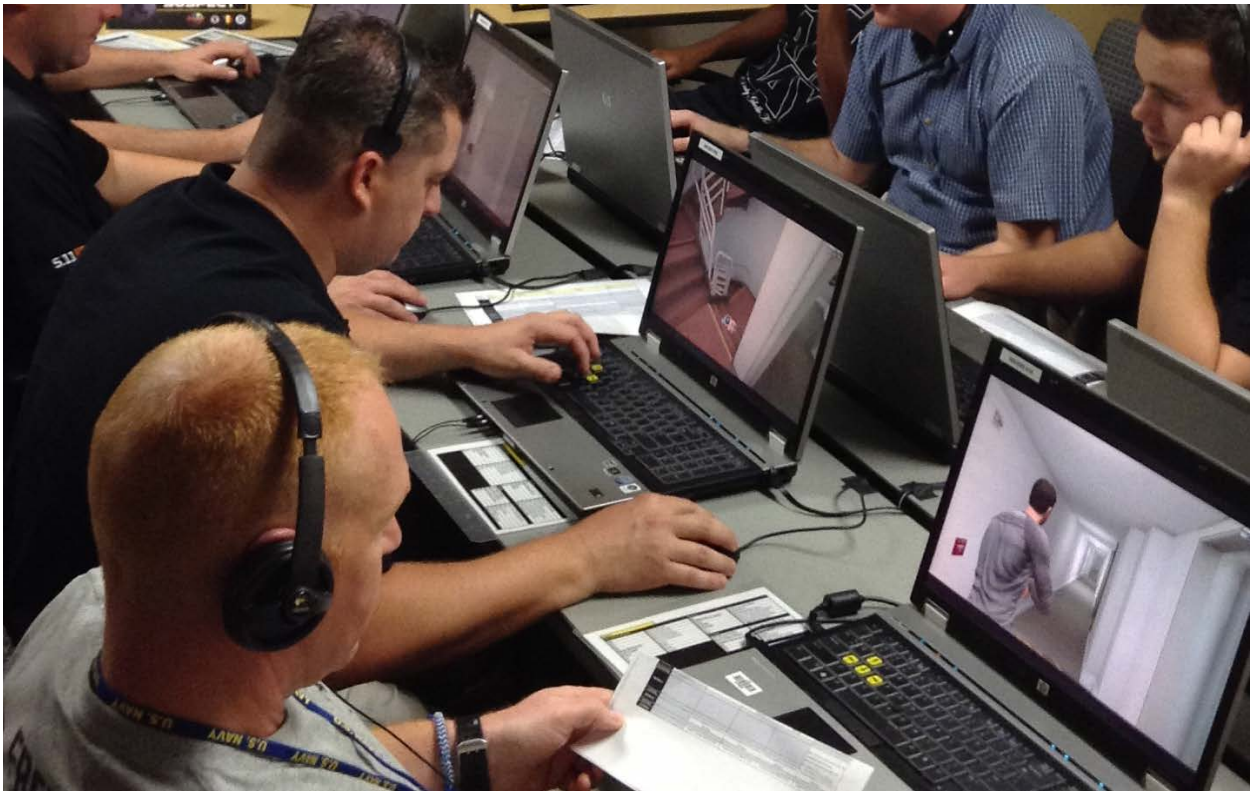

Figure 1 – First responders using Virtual Training

Multiple roles (dispatcher, civilian, firefighter, police officer, suspect, emergency medical technician [EMT], and unified commander) exist in the simulation and can be chosen in the character creation menu.

Figure 2 – Character creation menu

Interactive modules, including computers, weapons, vehicles, laptops, and other pieces of equipment, were also incorporated into VT. The character creation menu in Figure 2 displays some of the weapons and tactical equipment that might be carried by the police. Figure 3 depicts the back of a command car that contains a whiteboard (Figure 4) and laptop (Figure 5) that participants can interact with and share with other players.

Figure 3 – Command car with interactive modules

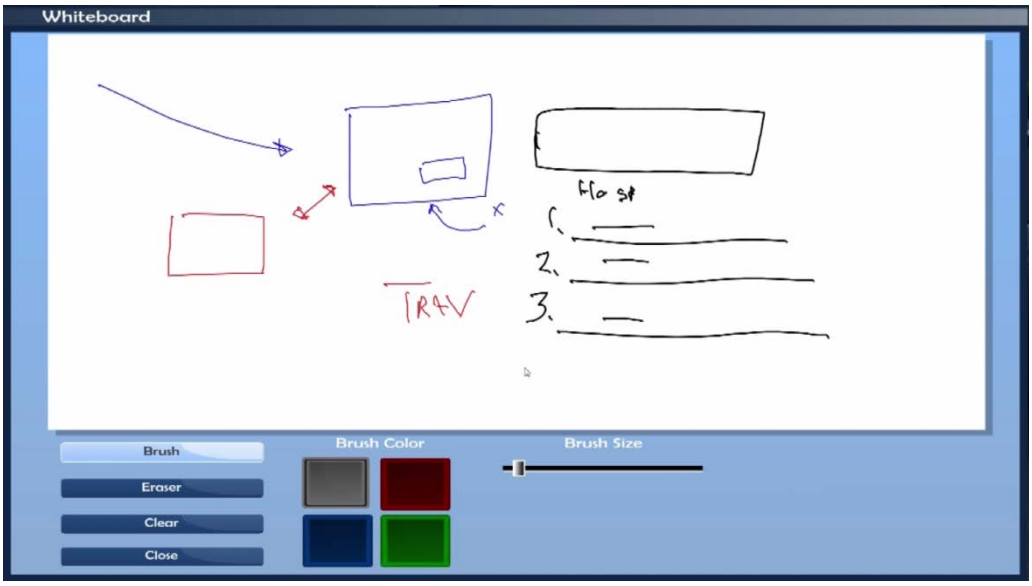

Figure 4 – Whiteboard that can be shared with other players

Figure 5 – Laptop browser that can be shared with other players

The simulation allows for multiple forms of communication among first responders; this includes audio channels that can be linked across jurisdictions to simulate radio channel communications (Figure 6), an audio chat capability that is based on an individual's location in the environment, and text-based communications similar to text messaging (see bottom right of Figure 7).

Figure 6 – Menu for selecting and linking communication channels

Figure 7 – Players can communicate with each other (view the text box in the bottom right)

Civilians in the simulation can either be controlled by players or simulated by artificial intelligence (AI) algorithms. The AI allows the civilians to respond to things such as the sound of gunfire, which causes them to cower (Figure 8).

Figure 8 – AI algorithms cause civilians to cower at the sound of gunfire

Administrators of the simulation (who may also be active players) have the ability view a mission results menu of the state of the players in the game as shown in Figure 9.

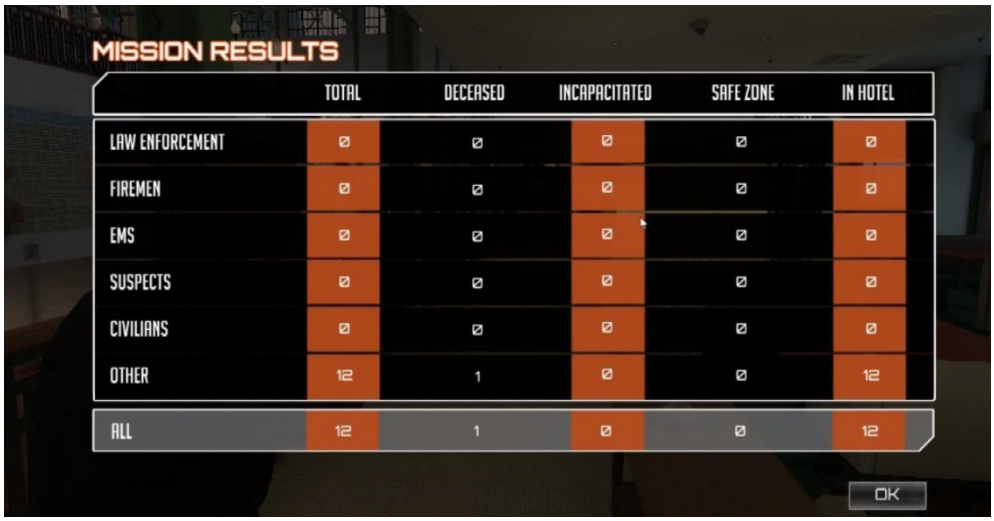

Figure 9 – Administrators can view a mission results menu

2 Operational Field Assessment Design

This section discusses the details of the OFA, including the scope, limitations, overall design, and specific requirements.

2.1 Event Design

The OFA included 36 participants from several jurisdictions in the Sacramento, California, area. Participants included police officers, firefighters, and emergency medical technicians, as well as those fulfilling the roles of suspects, dispatchers, incident or unified commanders, and civilians. The simulated disaster featured an active shooter scenario at a local Sacramento hotel. Each of these groups were

placed in separate rooms or sections of the office during the assessment. Table 2 lists the roles of active participants. A master scenario event list (MSEL) was created for this event with the help of the participating agencies. The MSEL served as a task list to flesh out the details of the simulated scenario. It also identified the role and responsibilities of each player. After reviewing the second iteration of the MSEL, participants agreed to adopt a more organic approach, which is discussed in the next section. Further details can be found in the *Operational Field Assessment Plan for Virtual Training (VT) Simulation Program* (contact Bhargav Patel at bhargav.patel@hq.dhs.gov or Christine Lee at christine.lee@hq.dhs.gov).

Table 2 – List of active roles and players in the simulation

Roles	# of people
Suspects	3
Police	
Dispatch	1
Officer Group	8
Fire Department	
Firefighters	8
Deputy Chief	1
Fire Dispatch	1
EMS	
Medic Strike Team	1
Civilian Victims	4
Unified Command	4

2.2 Deviations from the Test Plan

The goal of the MSEL was to provide a framework for first responders to test within; however, it failed to do so. Participants attempted to adhere to the timetable set forth in the MSEL. Monitoring players' locations and deciding when to initiate subsequent actions proved to be an issue as timing was off from the disparate groups sitting in different locations. After two iterations of running through the MSEL, participants agreed to adopt a more organic and realistic approach. As such, facilitators fed instructions directly to the participating "civilians" and "suspects" (e.g., test coordinator asks suspects to take civilians hostage; civilians report false information to arriving first responders). This allowed information to flow from civilians to dispatch and from first responders back to their dispatchers. The dispatchers then provided information back to unified command and to other dispatchers who diverted resources as needed (Figure 10).

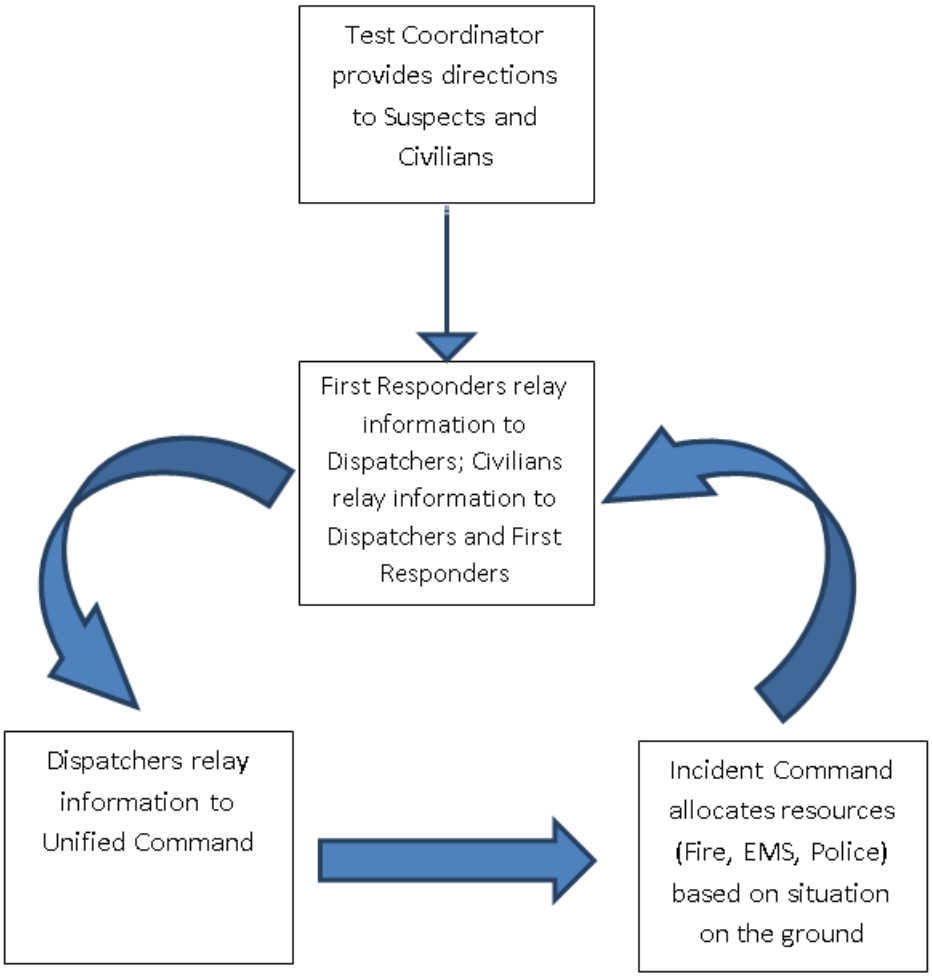

Figure 10 – Simulation game strategy

2.3 Summary of OFA

On Wednesday, November 20, 2013, representatives from the Sacramento Police Department, Sacramento Fire Department, Los Angeles Fire Department, DHS S&T, U.S. Army Training and Doctrine Command (TRADOC), U.S. Army RDECOM/STTC, and Cole Engineering Services Inc. convened at the Sacramento Police Department Central/East Command facility to participate in the OFA of the VT Simulation Program known as EDGE.

DHS S&T, TRADOC, and RDECOM/STTC led introductions, which provided participants with background information on the program, the long-term goals of the program, and the goals and purpose of the OFA. A brief training session led by the development team from Cole Engineering Services followed.

Many issues plagued the first attempted run-through of the MSEL. Technical issues involved malfunctioning microphones and virtual radios, and players were unable to spawn (i.e., re-enter game play as an active player) or access the gameplay mode. Facilitators rebooted the servers three times before solving all technical issues. Other issues included game play and user error. Initially treating the simulation as a video game, officers spawned themselves back into the game after they had been eliminated by a suspect or fire. Players communicated with each other based on their proximity to each other in the testing room and not by engaging through the radio channels via the game.

Problems with the initial MSEL's "scripted scenario" approach soon became apparent. The script was time based and required an unrealistic level of communication to ensure that every player was completing their actions at appropriate times. Many participants became unsure of when to execute certain actions or of their temporal location in the MSEL timeline.

Figure 11 – Members of the Sacramento Fire Department discussing VT

The test coordinators discussed devising a more organic means of participant engagement with the simulation that would take a more realistic approach and encourage better communication flow. The solution is illustrated in Figure 10. Test coordinators provided instructions directly to

the participating suspects and civilians. Civilians provided 911 messages to dispatch and on-the-ground information to the first responders on the scene. Suspects drove the action of the simulation. This allowed first responders to convey their observations of events on the ground to dispatchers. In response, dispatchers provided information back to unified command and to other dispatchers who would divert resources as needed.

The next simulation session went extremely well. All technical and user issues were remedied. The new approach to facilitating the simulation allowed participants to better conform to their roles and actively use the channels of communication that they would use in a real scenario. The test coordinators ended the scenario as a simulated fire that was caused by suspects early in the scenario grew out of control. Immediately after the scenario, an after action review (AAR) allowed participants to discuss issues and provide feedback. The comments from this discussion can be found in Section 4.2.

Figure 12 – Participants playing as suspects and civilians in VT

In the third simulation, members of the unified command group determined when the threat was terminated, dictating the end of the simulation. During this session, the efficiency and teamwork noticeably improved. Fires were ignited at different locations within the hotel and civilian victims were instructed to provide first responders with both accurate and inaccurate information about events occurring in the building as they evacuated. An AAR and debrief immediately followed this session of the simulation. The details of these discussions can be found in Section 4.2.

On Thursday, November 21, 2013, local media observed as first responders participated in the simulation. Again, participants provided feedback on both the simulation software and the events that transpired during the iterations of the simulation. Two iterations of the simulation were conducted prior to the media's arrival.

Figure 13 – Test organizers discussing VT with the media

Upon arrival of the media, members of DHS S&T, TRADOC, the Sacramento Police Department, and Sacramento Fire Department provided short speeches outlining the history of the project and the collaborative approach taken to conduct the OFA as well as to achieve each agency's overarching project goals. A final run through of the scenario was conducted with members of the media present to observe and ask questions. At the end of the day, participants provided feedback during a final AAR and completed a brief survey. Results can be found in Section 4.2.

3 Data Analysis

This section includes data collection methods, forms, and methods of analysis. Test coordinators collected data using the questionnaires from Table 3 below and the test director took notes. This information was then processed where necessary and reported in this OFA report.

3.1 Operational Scenario Survey

After the completion of all scenario simulations, users were asked to fill out a short survey.

Table 3 – Operational scenario survey

Questions/Response	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
I had a thorough understanding of Virtual Trainer before this exercise began					
The training associated with this software was accurate and helpful					
The movement and mechanics of the simulated players are realistic (endurance, mobility, speed)					
The realism of the simulated environment (texture, look, and fidelity) is adequate to achieve my training needs					
The controls (keyboard and mouse settings) were intuitive and easy to use					
The physics of the simulated environment (dynamics of weapons, fire, movement) were realistic and adequate for my training needs					
The artificial intelligence of the civilians was realistic and will aid in training					
The ability to communicate with other players (voice and text) is realistic and will aid in training for real incidents					
The settings in character creation provided me with enough flexibility to create realistic roles and players					
The ability to link audio communication channels was both realistic and useful					
The modules (cars, weapons, computers, equipment) were adequate enough to achieve my training needs					
The media sharing tool is useful and realistic					
The layout of the menu settings in the game is easy and intuitive to follow and find desired options					
The simulation is robust enough to mimic the changing environment of real disasters					
The user interface of the simulation software was intuitive and easy to use					

3.1.1 Data Analysis of Operational Scenario Survey

The Operational Scenario Survey is written in the form of a Likert Scale. The responses were assigned a value from 1 (strongly disagree) to 5 (strongly agree). All questions are written in the affirmative such that a higher score will correspond to a more positive experience with the software.

We used the following scale:

1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

3.2 Operational Scenario Debrief and After Action Reviews

Operational scenario debriefs were conducted at the end of each day. AARs were conducted after each simulation of the scenario. In total, two debriefs and six AARs were conducted.

4 Results

This section discusses the results of the OFA. It includes observations made by participants and the test team, feedback from participants about the system's operational suitability, and the results of the Operational Scenario Survey. This project does not have an Operational Requirements Document, so requirements compliance information does not exist. The results of this section are not an endorsement or rejection of the product or vendor. The goals are to: provide an objective understanding of how first responders interacted with the simulation software, determine ways to improve the simulation, and identify other means of filling the capability gap of having a multi-jurisdictional and multi-discipline approach to training first responders for high-impact events.

4.1 Operational Scenario Survey

Of the 36 first responders that participated in this OFA, 27 completed the Operational Scenario Survey. Table 4 displays the results of the survey in a color-coded format. The green squares represent the greatest areas of agreement among the first responders who participated and the red squares represent the least amount of agreement.

Table 4 – Summary of results of Operational Scenario Survey

Questions/Response	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I had a thorough understanding of Virtual Trainer before this exercise began	4	5	6	5	5
The training associated with this software was accurate and helpful	5	18	3	0	0
The movement and mechanics of the simulated player are realistic (endurance, mobility, speed)	4	12	4	4	2
The realism of the simulated environment (texture, look, and fidelity) is adequate to achieve my training needs	12	13	1	0	0
The controls (keyboard and mouse settings) were intuitive and easy to use	6	12	5	3	0
The physics of the simulated environment (dynamics of weapons, fire, movement) were realistic and adequate for my training needs	5	13	6	2	0
The artificial intelligence of the civilians was realistic and will aid in training	0	12	8	5	1
The ability to communicate with other players (voice and text) is realistic and will aid in training for real incidents	4	12	8	3	0
The settings in character creation provided me with enough flexibility to create realistic roles and players	3	17	6	0	0
The ability to link audio communication channels was both realistic and useful	2	10	12	2	1
The modules (cars, weapons, computers, equipment) were adequate enough to achieve my training needs	4	15	5	1	0
The media sharing tool is useful and realistic	1	9	14	1	0
The layout of the menu settings in the game is easy and intuitive to follow and find desired options	3	18	6	0	0
The simulation is robust enough to mimic the changing environment of real disasters	5	15	5	1	0
The user interface of the simulation software was intuitive and easy to use	6	15	5	1	0

Results were converted to a scale of 1 to 5 such that 1 indicates strongly disagreeing with a statement and 5 represents strongly agreeing with a statement. The averaged results can be seen in Table 5 which, once again, has been color coded to highlight values of interest.

Table 5 – Average rating for survey questions

Questions/Response	# of responses	Average Rating
I had a thorough understanding of Virtual Trainer before this exercise began	**25**	**2.92**
The training associated with this software was accurate and helpful	**26**	**4.08**
The movement and mechanics of the simulated player are realistic (endurance, mobility, speed)	**26**	**3.46**
The realism of the simulated environment (texture, look, and fidelity) is adequate to achieve my training needs	**26**	**4.42**
The controls (keyboard and mouse settings) were intuitive and easy to use	**26**	**3.81**
The physics of the simulated environment (dynamics of weapons, fire, movement) were realistic and adequate for my training needs	**26**	**3.81**
The artificial intelligence of the civilians was realistic and will aid in training	**26**	**3.19**
The ability to communicate with other players (voice and text) is realistic and will aid in training for real incidents	**27**	**3.63**
The settings in character creation provided me with enough flexibility to create realistic roles and players	**26**	**3.88**
The ability to link audio communication channels was both realistic and useful	**27**	**3.37**
The modules (cars, weapons, computers, equipment) were adequate enough to achieve my training needs	**25**	**3.88**
The media sharing tool is useful and realistic	**25**	**3.40**
The layout of the menu settings in the game is easy and intuitive to follow and find desired options	**27**	**3.89**
The simulation is robust enough to mimic the changing environment of real disasters	**26**	**3.92**
The user interface of the simulation software was intuitive and easy to use	**27**	**3.96**

The average result for the Operational Scenario Survey was **3.71 out of 5.** This value speaks to a neutral to positive response from first responders regarding the simulation. Participants found that the realism of the game adequately met their training needs. The first responder participants did not adequately understand the prototype before this assessment was conducted.

4.2 Operational Scenario Debrief and After Action Reviews

The first responder participants provided specific and constructive feedback during the AARs and debrief session, which can be used to refine the prototype even further. Some of this

feedback was of a technical nature while other comments were directed more at the strategy of implementation.

A resonating theme during these sessions was that the simulation tool's greatest benefits lie in practicing at a command and control level. Unified commanders who often become the focal point of both incoming frontline information and outgoing high-level orders benefit the greatest from a tool that emphasizes communication among independent agencies and first responders.

Members of the fire department made additional recommendations that support this claim. One consistent recommendation was scalability. According to members of the fire department, the benefit of this simulation lies in its ability to support realistic numbers such that a captain may control an entire company. Some of the suggestions sought to make the simulation operate more like other role player games (RPGs) by allowing for virtual "followers" or virtual first responders to shadow real first responders in the digital world or perform basic functions dictated by a captain. Another desired feature was that of a built-in task list that helps specify the mission, giving users more tasks and goals to achieve so as to provide a metric for measuring performance. Other suggestions were more specific, such as: allow the fire hoses to respond more realistically (e.g., allow entanglement); ensure the self-contained breathing apparatuses (SCBAs) contain accurate air levels; and include a more prominent health indicator meter and an on-screen compass for orientation.

Members of the unified command team and dispatchers offered similar comments and desired upgrades. Both of these roles lacked a certain degree of realism as far as visuals were concerned. Dispatchers provided several useful comments that could enhance the realism of their roles in the simulation. Unified commanders suggested including a map of the area. Unified commanders also noted a desire to incorporate a command and control sheet as a visual mechanism to engage with. Dispatchers noted a desire to transcribe audio for review, display a dispatch console that looks similar to the ones that they use, and visually indicate who is keying in on the radio. Members of unified command expressed a desire for visuals as well.

The EMS group desired greater functionality for their role, repeatedly noting concern about the limited nature of the EMTs in the simulation. They could only assess whether a simulated patient was alive or dead. A feature they would like to see incorporated into the simulation is the ability to assess injuries of patients and the ability to coordinate the transportation logistics of arriving and departing ambulances.

Law enforcement participants were the first to approach the active shooter scenario and engage both suspects and civilians. Their roles also required the greatest level of interaction with the simulated world and thus, the most operational awareness of the simulated environment. This resulted in a desire to have a proximity icon to keep them informed of other first responders around them. A more specific issue that they noticed was the inability to allow two players to enter a regulation single-door doorway at the same time, which in some cases inhibited them and is unrealistic. They also noticed a possible technical issue within the game—proximity talk

through the headsets was more difficult when talking to members of another role or team (e.g., EMS, fire). Issues of proximity chatter were also noted when law enforcement realized that the suspects could hear them and they could not communicate through normal hand signals. An interesting suggestion, later reiterated by the other participating agencies, was the desire to use their tactical radios for communication while maintaining the proximity chat feature. There were different ideas of how this might be implemented—integrating it with the game or keeping it completely separate—that need to be further explored. The participants playing the roles of suspects also thought that providing them with their own radio channel in the virtual environment might enhance the reality of a coordinated active shooter scenario.

The feedback did not focus exclusively on desired upgrades and expanded functionality. In fact, one of the more interesting conversations came during an AAR when a law enforcement member posed a question to the fire department chief. The individual wanted to understand the protocol for law enforcement to request time-sensitive support from on-scene members of the fire department. More specifically, the law enforcement member wanted to know if such a request needed to be routed up to unified command and back down to the individual making the request. The immediate answer was that the firefighter on the ground would relay the request up to his incident commander and await instructions. Much discussion focused on following protocol and under what circumstances protocol might be broken. A scenario that played out during the simulation sparked this conversation, which highlighted to participants the value of the simulation tool in exposing gaps in interagency communication or conflicts of protocol in highly time-sensitive scenarios.

At the debrief, participants noted general consensus that EDGE was a very useful tool that will have a positive impact on their ability to train against high-impact situations, such as active shooter events. A member of the fire department commented that real-life interagency training events usually occur once a year and first responders are relegated to only one of many possible roles that day. She acknowledged that this software allows for a single person to take on several roles and to train remotely more than once a year.

Table 6 – Summary of participant suggestions

Fire Services
Allow the game to operate more like an RPG: Include virtual first responders who can conduct certain tasks with minimal instruction and shadow real first responder players.
Develop a Mission/Tasks list to help firefighters identify more specific objectives during training and provide a means of collecting metrics and measuring performance.
Create more realistic fire hoses (allowing for entanglement).
Make SCBAs contain accurate amounts of air.
Include a more prominent health indicator meter.
Include an on-screen compass.
Unified Commanders and Dispatchers
Offer more visuals for interacting within the game.
Include a map of the area.
Provide the ability to transcribe audio for later review (dispatchers).
Create an interactive console similar to ones typically used by dispatchers.
Develop a command and control sheet as a visual mechanism to interact with unified command.
EMS
Provide the ability to assess varying levels of injuries of patients.
Offer the ability to coordinate transportation logistics of ambulances.
Law Enforcement
Include a proximity icon to allow players to stay informed about other first responders in their vicinity.
Add realism within the physical environment.
Integrate tactical radios with the simulation.

5 Definitions List

AI	-	Artificial Intelligence
AAR	-	After Action Review
COTS	-	Commercial Off The Shelf
DHS	-	Department of Homeland Security
EDGE	-	Enhanced Dynamic Geo-Social Environment
EMS	-	Emergency Medical Services
MSEL	-	Master Scenario Event List
NUSTL	-	National Urban Security Technology Laboratory
OFA	-	Operational Field Assessment
OS	-	Operating System
RDECOM	-	U.S. Army Research, Development and Engineering Command
RPG	-	Role Player Game
SCBA	-	Self-contained Breathing Apparatus
S&T	-	Science and Technology Directorate
STTC	-	Simulation and Training Technology Center
TSP	-	Training Support Package
TRADOC	-	U.S. Army Training and Doctrine Command
VT	-	Virtual Trainer Simulation Program