Virtual Dismounted Soldier Simulation: Human Performance and Training Effectiveness

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ABSTRACT

The U.S. Army requires a virtual dismounted soldier simulation capability for training, mission rehearsal, and concept development. To meet that need, the Army Research Institute, the Army Simulation, Training, and Instrumentation Command, and the Army Research Laboratory participated in a four-year research and development program to create a demonstration virtual training system for dismounted small-unit leaders. The concept was that repeated practice on realistic scenarios in the simulator, enhanced by training features and after action reviews, would build decision-making and coordination skills. Computer-controlled or semi-automated agents would represent friendly forces, enemy forces, and civilians. The goal was to produce a training system that was realistic and effective, yet required few support personnel to fill the positions of subordinates and role players. Progress was assessed during annual culminating events, series of exercises conducted with Infantry soldiers at the end of each year to obtain objective and subjective data about system capabilities and training effectiveness. This paper describes the results of the fourth and final culminating event, during which three groups of soldiers each participated in a series of eight tactical scenarios in virtual simulators over a two-day period. Ratings of unit performance and responses to questionnaires covering simulator capabilities and training effectiveness were obtained. The paper briefly reviews the key technological capabilities developed, but focuses primarily on the results of the human performance and training effectiveness assessments. Between 82% and 100% of leaders said that their performance improved as a result of the training, depending on the task. Similarly, observer ratings of squad performance on comparable scenarios were slightly higher at the end of training than at the beginning. Trends across the four years are described. Major accomplishments and remaining challenges are discussed.

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INTRODUCTION

The U.S. Army requires vastly improved simulation capabilities for dismounted soldiers. Dismounted leaders, soldiers, and units must be able to train effectively even when they cannot participate in high fidelity field training exercises. They also need effective mission rehearsal tools to prepare them for specific combat missions in all types of terrain. Army decision makers need inexpensive, high fidelity prototyping and testing systems that will allow them to explore and evaluate potential changes in doctrine, organization, equipment, and soldier characteristics. These needs are very important today, and are likely to become more important as the Army transformation continues.

Virtual Environment (VE) technologies have the potential to provide training, mission rehearsal, and experimentation capabilities for dismounted leaders, soldiers, and units. However, the potential of VE has not been realized because no one has yet overcome critical hardware and software limitations, documented effective training methods and strategies, or created the training support packages necessary to use it. In response to these needs, the U.S. Army Research Institute Simulator Systems (ARI-SSRU) and Infantry Forces Research Units (ARI-IFRU), the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM)[1], and the U.S. Army Research Laboratory Human Research and Engineering Directorate (ARL-HRED) and Computational and Information Sciences Directorate (ARL-CISD) participated in and recently completed a four-year Science and Technology Objective (STO) entitled "Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal." The objective of the STO was to produce a demonstration of an integrated dismounted soldier simulation system that would include the following components and capabilities:

- A locomotion platform that provides realistic perception of movement and accurate energy expenditure.
- A visual display system that could accurately simulate a variety of night vision sensors and equipment.
- "Intelligent" computer-controlled forces to represent enemy, friendly, and neutral forces.
- Dynamic Terrain (DT), including damage to structures, rubble and other obstacles.
- Features to enhance the effectiveness of training and mission rehearsal.
- Demonstrated effectiveness of the system.

The goal of the research was to develop a demonstration dismounted leader trainer at the fire team, squad, and platoon level. Leader trainees would be able to execute a series of realistic training scenarios (combat operations and support operations) in the simulator. Repeated practice, enhanced by training features, coaching, and After Action Reviews (AARs) would build decision-making and coordination skills. Computer-controlled or semi-automated agents would represent subordinates, other friendly forces, enemy forces, and civilians. The goal was to produce a training system that was realistic and effective, yet required few support personnel to fill the positions of subordinates and role players in the training scenarios. We focused on leader training because we initially believed that the use of networked individual simulators for collective training of all members or key members of units together would not be cost effective. Nevertheless, the developments made under the STO support collective training as well.

The purpose of this paper is to review selected accomplishments of the program with an emphasis on human performance and training effectiveness. Each year of the STO has consisted of a period of research and technology development, followed by the conduct of an assessment that came to be referred as a Culminating Event (CE). The purpose of the CEs was to assess the technologies developed in a realistic setting with soldier trainees. Did the technologies function as intended, both individually and collectively? Could trainees and support personnel perform their required tasks? Did the skills of the soldiers improve as a result of their experience? The results of each CE were important in setting goals and priorities for the development efforts for the next year. They helped to identify technology gaps and needs,

[1] Now the Research, Development, and Engineering Command Simulation Technology Center.

problems which needed to be corrected, and provided benchmarks we could use to gauge our progress from year to year. CEs were held at the end of the first, third, and fourth years at the Dismounted BattleSpace BattleLab, Fort Benning, Georgia. The CE at the end of the second year was held at the STRICOM Technology Development Center (TDC) and the Institute for Simulation and Training (IST) at Central Florida Research Park, Orlando, Florida. The detailed results of the final two CEs are documented in Knerr et al (2002) and Knerr et al (in preparation).

SELECTED TECHNOLOGIES

The specific technologies involved in the FY 2002 CE are described in the following paragraphs.

Soldier Visualization Station (SVS)

The SVS (Figure 1) is a realistic, immersive 3D virtual simulator developed by Advanced Interactive Systems, Inc. It uses a PC-based rear-screen projection system to present a 32-bit color image in 1024 X 768 resolution on a screen approximately 10 feet wide by 7.5 feet high. The soldier can move within this enclosure, and his movement is tracked and reflected in perspective changes in the VE, but typically remains centered in that space. The immersed soldier's head and weapon are tracked using an acoustic and inertial tracking system. The soldier navigates through the environment via a thumb switch located on the weapon. Recent software enhancements included: lighting improvements such as streetlights and interior building lights that can be shot out and extinguished; incorporation of electrical transformers into the database; tracer rounds; hand-launched flares; fragmentation, smoke, and flashbang grenades; entity wounding (visual and performance effects); satchel charge (model and effects); armed civilian entity; and incorporation of a binocular capability (hardware and software).

Dismounted Infantry Semi-Automated Forces (DISAF)

DISAF was developed by SAIC to provide a realistic representation of dismounted infantry and civilians on the virtual battlefield. The primary focus of DISAF has been the development of tactical behaviors for individual through squad level operations. DISAF is based on the Modular SAF/ OneSAF TestBed architecture. DISAF includes support for urban and rural terrain operations. Most of the DISAF behaviors are based on validated military Combat Instruction Sets. DISAF provides an enhanced 2D Plan View Display to support display of Multiple Elevation Structure buildings and new Individual Combatant icons, and can be networked to a stealth viewer to provide a 3D display. DISAF runs on a PC under Linux or Windows NT. In addition to establishing compatibility with the Dynamic Terrain Server (DTServer) and SVS, improvements were made to DISAF to model smoke/stun grenades, C4 explosives, higher-fidelity wounding, an armed civilian, various crowd units and corresponding behaviors, a hostage behavior, a sniper shooting behavior, formation keeping, and the addition of a joystick control mode. The DISAF joystick control mode and sniper shooting capabilities were not available for use during the CE and consequently were not evaluated.

Figure 1. Soldier in an SVS

Voice Recognition and Synthesis

Voice recognition to control DISAF was developed by the University of Central Florida Institute for Simulation and Training (IST). It is used by a Fire Team Leader to control DISAF subordinates. Speech synthesis (computer generated speech) was used by DISAF to acknowledge a command, indicate failure to understand a command, indicate completion of a task, or report that they have come under fire. Enhancements made during 2002 included efforts to improve recognition accuracy and natural language compatibility, and to incorporate DISAF spontaneous speech.

Dynamic Terrain Server (DTServer)

The DTServer was developed by ARL-CISD. It provides a means to blow holes in buildings and create rubble. The holes are sized appropriately for the munition and building material. The DTServer is Linux-based software that receives Detonation PDUs from the DIS network, processes the data, and distributes the results to other simulators on the network. Results can be either a “ding”, resulting from small arms fire on a hard surface, or a breach. In the 2002 CE, breaches could be created by either anti-tank rounds or C4 satchel charges. Thomas (2003) provides a more complete description of the DTServer.

Dismounted Infantry Virtual After Action Review System (DIVAARS)

DIVAARS is a PC-based AAR system developed by ARI and IST specifically to meet the AAR requirements for dismounted infantry in urban combat. See Figure 2. The key capabilities of DIVAARS are digital videodisc (DVD)-like replay with synchronized audio and video, including the capability to jump to pre-designated segments or views, and tabular data summaries. Enhancements made during the year included a "Windows-like" interface, addition of the capability to view building interiors, correction of problems with voice communication capture and replay, and new visual effects. DIVAARS is described in detail in Knerr, Lampton, Martin, Washburn, and Cope (2002).

COMMON CE APPROACH

Although the CEs varied from year to year, they had many common characteristics. All involved the conduct of a series of tactical scenarios by full or partial squads of Infantry soldiers in networked immersive simulators. DISAF served as enemy and civilians, and filled some friendly positions within the squads. The soldier trainees conducted multiple tactical scenarios in a simulated urban setting, either the Shughart-Gordon Military Operations in Urban Terrain (MOUT) site, Fort Polk, or the McKenna MOUT site, Fort Benning. The scenarios were generally about 10-30 minutes in duration. They focused specifically on creating the opportunity and need for the soldiers to use the various new devices and capabilities in the VE, and to actively involve as many players as possible. Support personnel included a DISAF operator, an exercise controller, and human role players.

Figure 2. Soldiers participating in an AAR with DIVAARS

The procedure was generally the same as well. Soldiers reported for either a one- or two-day period. Upon their arrival, they were given an introductory briefing which described: the overall purpose of the exercises; the nature of the performance and questionnaire data to be collected; the procedures that would be followed to ensure the privacy of information collected; safety procedures; and administrative information. They then completed background questionnaires, and were assigned duty positions for the exercises. Next, all soldiers received instruction and practice on the use of the simulator they would be using. Those who required it were then given special training, such as use of a special locomotion or voice recognition system. A series of tactical exercises followed. Each exercise session consisted of delivery of the mission order, squad leader development of the mission plan and brief to his squad, conduct of the mission, and an AAR. Finally, questionnaires were administered and interviews were conducted.

Because we were particularly interested in the how well the technology permitted the soldiers to perform their required tasks, how much they learned during their training, and in generally obtaining feedback from them about their perceptions of the technologies, we made extensive use of questionnaires and interviews. While there were variations in some of the questionnaire items from year to year, there was a substantial body of questions common to each of the four CEs. For this paper we will focus on two questionnaires. The *Simulator Capability Questionnaire* asked soldiers to

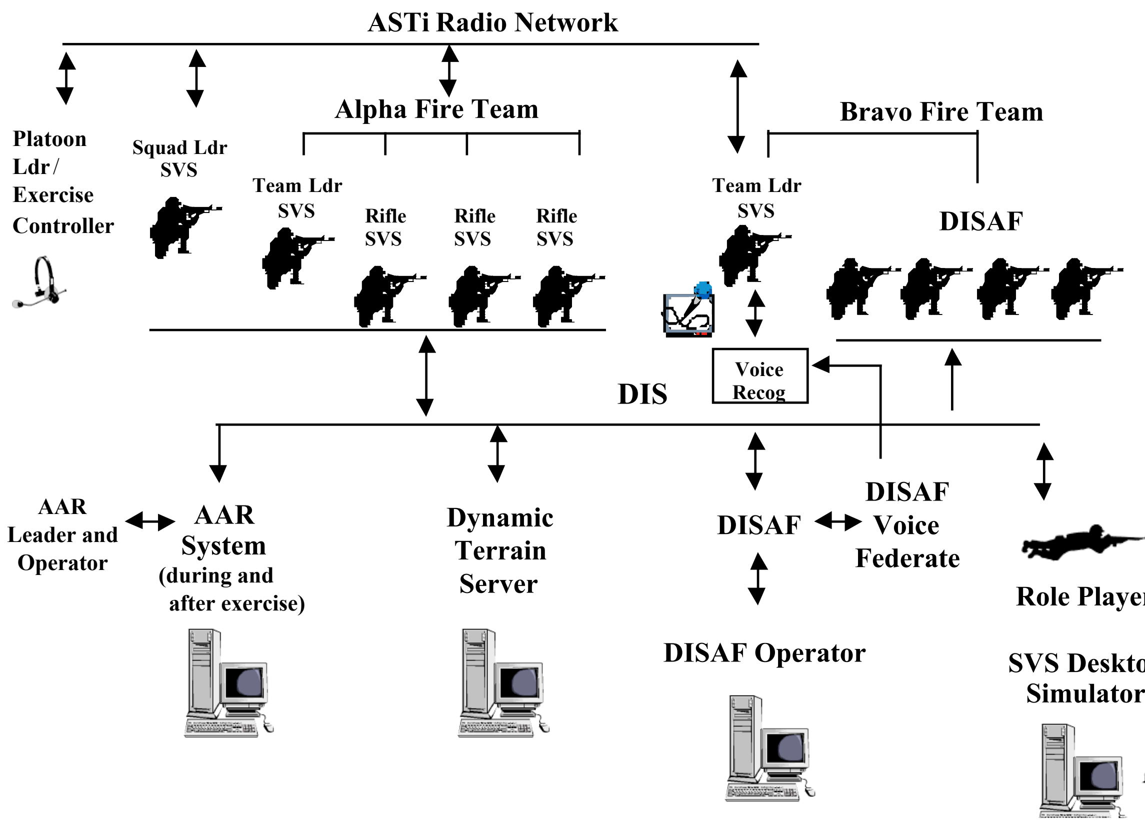

Figure 3. CE system configuration.

rate their ability to perform various tasks in the simulators (*Very Good, Good, Poor, or Very Poor).*

The *Training Effectiveness Questionnaire* asked leaders how much improvement in performance on each of 11 tasks resulted from the day's exercises (*No Improvement, Slight Improvement, Moderate Improvement,* or *Vast Improvement*). Squad performance was also assessed using a *Unit Evaluation Checklist*. Three evaluators (the Exercise Controller, the AAR Leader, and the live enemy role player) independently rated the unit on 14 items at the conclusion of each scenario. The items were primarily Squad Leader behaviors, including planning, command and control, acquiring and maintaining situation awareness, and tactical skills.

METHODOLOGY FOR THE FINAL CE

The approach for the final CE followed the same general procedure as the others. Three squads of six soldiers were each organized as a Squad Leader, Fire Team A Leader, Fire Team B Leader, and three Fire Team A members. DISAF filled the positions of the Fire Team B team members. Each squad participated for two days, during which they completed eight or nine scenarios. The equipment and personnel configuration is shown in Figure 3. The following items were connected to the network:

- Six SVS individual soldier simulators
- One Voice Recognition PC
- Two DIVAARS Systems (2 PCs each)
- One Dynamic Terrain Server
- One BattleMaster/DISAF Operator Station.
- One Desktop SVS used by a role player

The SVS simulators were used by the squad leader, the two fire team leaders, and the three Fire Team A members. The simulators were identical, except for additional equipment in the Fire Team B leader's area for the voice recognition system. All SVSs were equipped with radio headsets, which permitted verbal communication on up to two channels, depending on the duty position. The squad leader could talk to his fire team leaders and the platoon leader (a role player). Each fire team leader could talk to the squad leader and his subordinates. Fire team members could talk among themselves and with their fire team leader.

The scenarios covered a variety of wartime and Support and Sustainment Operations (SASO). They included:

- Roving Patrol
- Hostage Rescue (two scenarios)
- Deliberate Attack (two scenarios)
- Air Assault and Clear a Building

- Assault and Clear a Building
- Crowd Control
- Downed Helicopter

There were two versions of the Hostage Rescue and Deliberate Attack scenarios, designed to be equivalent in difficulty. These were used as the first two and last two scenarios for each squad.

RESULTS

Perhaps the most significant accomplishments of the VE STO are not reflected in the ratings or performance data that were collected, but in the level of sophistication and complexity of the scenarios that were run. In the 1999 CE, at the end of the first year of the STO, five different scenarios were used. All were basically the same: initiate movement to the building designated as the objective, react to enemy contact in route, resume movement and finally assault the building. It was always daylight. DISAF could not enter buildings. Few civilians were present, and their behaviors were limited to either standing still or moving on a preplanned route. Buildings could not be breached. Neither force could use smoke or grenades. A hit always equaled a kill. A fire team leader could control DISAF only by giving a verbal command to the DISAF operator, who then implemented that command at his console. Routes for DISAF had to largely be scripted in advance. AARs were limited to linear playback on a stealth viewer. In 2002, there were nine different scenarios. Scenarios could be conducted at any time of day or night. DISAF could go anywhere, and could autonomously carry out some highly sophisticated behaviors, such as room clearing. Civilians moved about freely, as individuals and in crowds, and could be armed. Holes could be blown at any location in any building. Flares, smoke, and grenades were available to all participants. Soldiers could be wounded as well as killed when hit. These factors greatly increased the variety and realism of the training situations that could be presented.

Simulator Capability

Soldiers rated their capability to perform 49 tasks in the simulators in both 1999 and 2002. The ratings were derived by assigning a value of 0 for Very Poor, 1 for Poor, 2 for Good, and 3 for Very Good. The mean rating for those 49 tasks increased from 1.90 in 1999 to 2.12 in 2002. Of those, 20 were rated significantly higher in 2002 ($p<.05$), and one was rated significantly lower. Table 1 shows the highest rated and lowest rated tasks, along with the 1999 means for the same tasks.

Thirty-six of 52 tasks were rated *Good* or higher (mean equal to or greater than 2.0) in 2002, as compared with 16 in 1999. Despite the overall change, there were consistencies across the years. The more highly rated tasks consisted of identification of types of people (such as civilians and non-combatants) and tactically significant areas, imprecise movement, and communication. The lower rated tasks consisted of precise or rapid movement (including aiming), distance estimation, and locating the source of enemy fire using either visual or auditory cues.

Perceived Training Effectiveness.

Generally, Squad and Fire Team Leaders said that their performance improved as a result of the training. The percentage who said that their performance improved at least slightly ranged from 82% for the task "Clear a building" to 100% for "Assess the tactical situation," "Control your squad or fire team," and "Plan a tactical operation." Ratings from the 2002 CE on all of the tasks were higher than those from the 1999 CE, and those on ten tasks were higher than those of the 2001 CE. Complete results are shown in Table 2. In general, ratings for coordination, communication, and control tasks were higher than those for specific unit tasks or battle drills, although this difference was not as pronounced in 2002 as it had been in previous years.

Ratings of Squad Performance

The most interesting question is whether performance improved with practice. This information was obtained from the scores on the Unit Performance Evaluation Checklist. They were examined in two ways: first, by looking at the overall performance trends over time, and second, by comparing performance on the pairs of comparable scenarios.

The overall trend is shown in Figure 4. It generally shows an overall increase followed by a sharp decline in performance on the final scenario of the second day. This occurs for every squad. Since each squad had different scenarios in both the seventh and eighth positions in their sequence, it is unlikely to result from a more difficult final scenario. Fatigue is the most likely cause.

Table 1. Simulator Capability Questionnaire Responses: Highest and Lowest Rated Tasks in 2002, with 1999 Means

Task	**Mean**	
	1999	**2002**
Best		
Execute planned route.	1.89*	2.67
Use hand-held illumination (flares).		2.59
Employ tactical hand-held smoke grenades.		2.56
Identify assigned sectors of observation.	2.06*	2.53
Move in single file.	2.00*	2.50
Look around corners.	1.47*	2.50
Communicate enemy location to team member.	2.06*	2.50
Move through open areas as a widely separated group.	2.38	2.47
Understand verbal commands.	1.94*	2.47
Fire weapon in short bursts.	2.00*	2.44
Move quickly to the point of attack.	1.94*	2.44
Communicate spot reports to squad leader.	1.94*	2.44
Scan from side to side.	1.72*	2.44
Use flash-bang grenades to help clear rooms.		2.44
Worst		
Take a tactical position within a room.	1.83	1.72
Determine the direction enemy rounds are coming from.		1.72
Move quickly through doorways.	1.61	1.67
Maneuver past other personnel within a room.	1.55	1.61
Visually locate the source of enemy fire.	1.44	1.59
Move past furniture in a room.	1.56	1.59
Determine the source of enemy fire by sound.	1.78	1.44
Distinguish between friendly and enemy fire.	1.61	1.44
Scan vertically.	1.11	1.39
Mean (common items)	1.90	2.12

Notes: 1999 N=18. 2002 N = 17 or 18. A blank in a cell indicates that that question was not included in that year.
* significantly different from the 2002 mean at $p<.05$.

Table 2. A Three Year Comparison of Squad and Fire Team Leader Training Effectiveness Ratings

Task	**% Indicating Improvement**		
	1999	**2001**	**2002**
N	9	15	18
Assess the tactical situation.	67%	93%	100%
Control your squad or fire team.	67%	80%	100%
Plan a tactical operation.	33%	73%	100%
Squad/fire team communication and coordination.	78%	80%	94%
Control squad or fire team movement during assault.	67%	80%	89%
React to Contact Battle Drill.	44%	80%	89%
Locate known or suspected enemy positions.	44%	67%	89%
Coordinate activities with your chain of command.	44%	100%	88%
Control squad or fire team movement while not in contact with the enemy.	67%	80%	83%
Clear a room.	44%	53%	83%
Clear a building.	56%	57%	82%[a]

Note. Squad and Fire Team Leaders who participated for two days completed the questionnaire at the end of each day.
[a] N = 17

Figure 5 shows the mean scores on the Unit Evaluation Checklist for the first and second occurrences of the comparable scenarios.

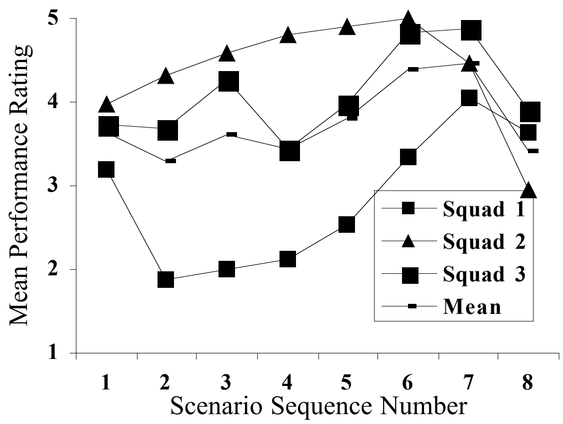

Figure 4. Performance ratings as a function of scenario number.

Overall, the squads received a mean score of 3.47 on the first occurrence of a scenario, and 3.72 on the later occurrence of a comparable scenario. Of the six possible comparisons (three squads times two pairs of scenarios), five showed better performance on the second occurrence.

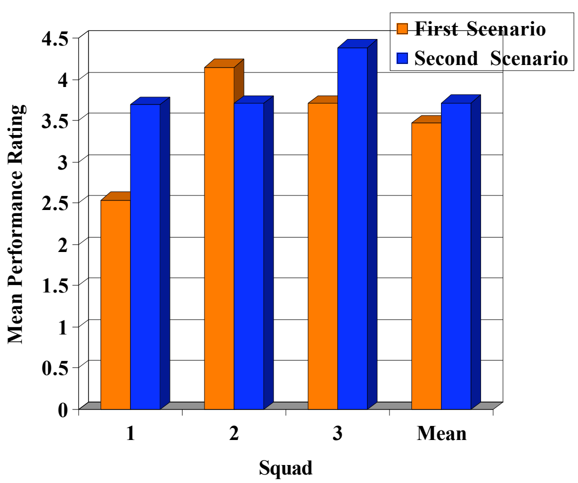

Figure 5. Comparison of squad performance on first and second comparable scenarios

DISCUSSION

Simulator Capabilities

While it was rewarding to find that soldier ratings of the simulator capabilities were generally higher than in previous years, it was difficult to relate the changes in rating on specific items to a likely cause. For example, why did soldiers give the task "move in single file" a higher rating in 2002 than in 2001? While capabilities have been added to the SVSs, the basic characteristics remain the same. The most likely explanation is that the soldiers responded to the individual items on the basis of both the specific item content and their perception of the overall quality of their experience in the simulators. The new capabilities, like smoke and grenades, which were rated highly (and the absence of which was a cause for complaint in prior years), may have increased the overall quality of this experience and, by extension, the ratings of individual tasks that were not directly affected. It should also be noted that the ratings of training effectiveness are dependent on both the contributions of the human components of the system and the technology components. The characteristics of the scenarios and the performance of the Exercise Controller, DISAF Operator, AAR Leader and role players, are all critical to effective training.

Other factors may have had less straightforward but nevertheless substantial effects on the ratings. The training scenarios have become increasingly challenging and complicated over the course of the STO. While this made the training more realistic, it required the soldiers to try to perform more complicated tasks in the simulators, and may also have made it more likely that the soldiers would encounter the limits of the simulators. The video gaming experience of the soldiers may also have been a factor in the ratings. It appeared from the interviews and informal interactions that the game-playing experience of the soldiers has increased over the years. On the one hand, their gaming experience has given them opportunity to acquire necessary "basic skills" that make it easier to learn to function in the SVSs. One group of soldiers reported in their interviews that they had no difficulty learning to use the SVSs because "We're the Nintendo generation." On the other hand, the impact of the increasing sophistication of computer and video games may have caused soldiers to have higher standards for simulator performance. The simulator capabilities are being compared with increasingly realistic and sophisticated commercial products. This has, in effect raised the standards by which automated entities and environments are judged.

Some soldier interface needs are recurring. Precise movement in the SVSs has been a consistent problem over the life of the STO. Probably this is inherent in the SVS design. A soldier centered under the tracker in the SVS is several feet from the visual display. Virtual entities and objects in the area between the soldier and the screen cannot be rendered clearly or accurately on the screen. This makes precise maneuver difficult. However, this approach has other advantages in that it is less likely to produce symptoms of simulator sickness or create safety issues than would a head-mounted display. It also provides a relatively high-resolution display at a reasonable cost.

Training Effectiveness

Leader ratings of training effectiveness constitute perhaps the biggest success story of the STO. Since 1999, we have seen a consistent increase in leader ratings of training effectiveness. Like the ratings of simulator capability, these ratings were likely influenced by the changes in the backgrounds and experience of the trainers and administrative changes (primarily the separation of the roles of the Exercise Controller and the AAR Leader).

In 2002 the self-ratings were supplemented with independent ratings of unit performance. Those data revealed a general upward trend in performance prior to the final one or two exercises, and generally better performance on the second of two comparable exercises than on the first. Our overall conclusion is that the soldiers were learning, but that other factors were affecting their performance as well. Clearly, some very powerful factor or factors had a negative effect on their performance on the final scenario. Fatigue is the most likely cause. Prior to the CE, we did not consider the effects of fatigue because the training was not physically demanding, was conducted in air-conditioned buildings, and the actual conduct of each scenario lasted only about 20 minutes. However, it appeared to be mentally demanding. The soldiers were highly involved and wanted to perform well. Observers noted the fatigue at the end of the second day. Fatigue was more likely to be a factor on the second day, which consisted of five tactical exercises, than the first, which consisted of train-up activities plus three exercises.

Implications

There is a broad range of tactical skills that could conceivably be trained in VE. At one end of the continuum are small unit leader decision-making skills. Pleban, Eakin, Salter, and Matthews (2001) found that these skills could be trained effectively in VE. Training these skills does not require a high fidelity, fast, or precise interface with the virtual world. Success is more likely to depend on the scenarios and the quality of the role-players. At the other end of the continuum are the specific squad drills and tasks, like building clearing, which involve less decision making, more communication and coordination among unit members, but above all require rapid and precise positioning, movement and use of weapons. A recent experiment by Pleban and Salvetti (2003) indicates that, although there are a number of interface and technology problems to be overcome, VE nevertheless shows promise for this type of training as well, although it appears not to be effective as real world training at present. The types of squad-level exercises conducted during the last two CEs fall somewhere in the middle, targeted at improving leader decision-making and command and control skills in a variety of mission types.

Given the current state of technology, it does not appear that VE is an effective complete replacement for real world tactical training. However, it could be used effectively for some types of training and some stages of training. VE training could provide the walk phase of the training, concentrating on improving decision-making, situation awareness, communication, and coordination skills. Companion real world training could place greater emphasis on the motor skills. VE training also has the advantage of being more flexible, in that terrain databases and environmental conditions can be changed more rapidly than a real world urban training center.

CONCLUSIONS AND FUTURE DIRECTIONS

Substantial improvements have been made during the last four years in the capability of virtual simulation to provide training for the leaders of small dismounted Infantry units. These developments in technology have greatly increased the level of realism that is possible through virtual simulation, and the breadth of tasks that can be trained. While the samples are small, both leader self-ratings and independently-obtained performance scores during this CE indicate that soldier skills improved with practice in VE. Moreover, leader self-ratings of skill improvement have increased regularly since the first year of the STO. The 2001 and 2002 CEs have focused on sustainment and support operations, and in that context, the leaders reported more improvement in command and control, coordination and communication, planning, and situational awareness skills than in skills conducting specific unit tasks or battle drills. Similarly, Pleban et al. (2001) found VE effective for training platoon leader decision-making skills.

It appears that VE could be used effectively for some types of training and some stages of training. VE could be used to improve decision making, situation awareness, communication, and coordination skills, while real world training could improve motor skills. Therefore, although there are still further improvements that can be made in the individual technologies, the next step should be an advanced development effort, taking a total systems approach, to produce a prototype VE training system for the leaders of small dismounted Infantry units.

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