DARWARS Ambush! – Authoring Lessons Learned in a Training Game

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ABSTRACT

As the conflict in Iraq has moved from open combat toward stability and support operations, both sides have reacted to the changing nature of the conflict. This has resulted in an increased need to quickly revise military tactics, techniques, and procedures (TTPs). This need, coupled with the largest rotation of U.S. troops since World War II, has resulted in an increased need and effort to capture and pass along lessons learned to troops rotating into the conflict area. This paper describes the design and implementation of a "lessons learning" game, DARWARS Ambush!, developed under the DARPA Training Superiority Program (DARWARS) and managed by the Office of Naval Research (ONR). DARWARS Ambush! is a computer-based training game that enables squads to experience and respond to ambush situations. Although initially focused on the most common types of ambushes observed in Iraq, those involving convoy operations and improvised explosive devices (IEDs), DARWARS Ambush! is designed to be useful in training for more general operations, such as military operations in urban terrain (MOUT). A primary feature of DARWARS Ambush! is that it allows troops in the field to construct and modify scenarios based on their experiences in order to pass along their hard-won knowledge to other military personnel. The system is being developed as a modification of an existing commercial game, which provides an immersive and compelling experience. This "leveraging" of commercial software is enabling the project to meet its ambitious schedule – development, testing, and deployment within six months.

ABOUT THE AUTHORS

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Bruce Roberts is a Division Scientist at BBN Technologies. He has a B.S.E. and M.S. from the University of Michigan, and has been on the research staff at the MIT Artificial Intelligence Laboratory. He has been responsible for the development of numerous intelligent systems that aid in the design, operation, and repair of complex devices. He is currently the principle investigator for the DARPA DARWARS project, where he leads the team developing the architecture for DARWARS, which allows multiple simulation-based training systems to interoperate and interact around learning objectives.

Stephen Blankenship is a founder and C.E.O. of Total Immersion Software, Inc. He is a 14-year veteran of the computer gaming industry, with experience in all aspects of product development. He managed the biggest selling flight simulation franchise, "Falcon", for most of the 1990's, and was a Senior Producer for Electronic Arts, Inc. He has shipped more than 20 top-tier titles that resulted in sales well in excess of 15,000,000 units at retail.

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INTRODUCTION

Current military conflicts require dynamic changes to military tactics, techniques, and procedures (TTPs). As the conflict in Iraq has moved from open combat toward stability and support operations, there has been an increased need to quickly revise TTPs, as both sides react to changing conditions.

> "As quickly as we come up with new tactics, the enemy is studying those tactics so they can counterattack. We've got to stay one step ahead of them." – SSgt John Lee[1]

This quickly changing environment, coupled with the largest rotation of U.S. troops since World War II (with almost 250,000 soldiers transitioning into or out of Iraq), has resulted in an increased need and effort to capture and pass along "lessons learned" to new troops rotating into the theater of operations. In response to this need, experienced troops are passing information back to units in the United States through a variety of channels, both formal and ad hoc.

One of the primary activities during which soldiers in Iraq are most threatened involves convoy operations. With almost daily attacks on convoys from small arms, rocket-propelled grenades (RPGs), mines or improvised explosive devices (IEDs); ambushes on convoys are a leading cause of casualties. The U.S. Military has recognized the need for increased training on convoy operations and is aggressively pursuing a variety of training solutions, including increased live-fire convoy operations training exercises, new installations of marksmanship trainers and driver training systems with improved capabilities that focus on convoy operations, as well as virtual desktop trainers such as DARWARS Ambush! (for examples of these training solutions, see Steele, 2004; Tiron, 2004).

This paper describes the design and implementation of DARWARS Ambush!, a "lessons learning," game-based, training environment that enables squads to experience situations involving ambushes. Although initially focused on common ambush situations involving convoy operations, DARWARS Ambush! is designed to be useful in training for more general operations, such as military operations in urban terrain (MOUT). A primary feature of DARWARS Ambush! is its ability to allow troops in the field to construct and modify scenarios based on their experiences, in order to pass along lessons learned to other military personnel.

OBJECTIVES & REQUIREMENTS

The short-term goal of the DARWARS Ambush! Project is to develop a lessons learning trainer designed to provide an environment in which individuals and teams of soldiers can learn, demonstrate, and develop TTPs and standard operating procedures (SOPs) for use against ambushes, especially those involving convoy operations. The system is designed primarily as a training aid for soldiers at the squad-level to experience and respond to ambush situations.

Equally important as the development of the simulation environment is the establishment of infrastructure and processes that will enable the collection, authoring, and distribution of lessons learned so that appropriate personnel can benefit from those lessons. The learning process should be experience-based, to the extent possible. Because TTPs and SOPs can change rapidly to accommodate new situations, DARWARS Ambush! must not remain static after deployment, nor should it require all new modifications to be made by the development team. Instead, we are developing DARWARS Ambush! and its surrounding infrastructure to allow troops in the field to rapidly construct and modify scenarios based on their own experiences. Once deployed, DARWARS Ambush! will facilitate field-level re-creation of actual tactical problems.

We are not alone in recognizing the increased need for the collection and dissemination of lessons learned. The Center for Army Lessons Learned[2] (CALL) was designed specifically for the purpose of collecting,

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[1] http://www.tradoc.army.mil/pao/TNSarchives/January04/012604.htm

[2] http://www.call.army.mil

analyzing, and disseminating lessons-learned materials. We desire to leverage and augment existing processes such as those developed by CALL in order to provide the most benefit to the soldier.

In order to provide maximum utility for the ongoing operations in Iraq and Afghanistan, it has been critical that we develop and deploy DARWARS Ambush! as quickly as possible – within a six-month timeframe. We took a number of steps to help ensure our ability to meet such an ambitious schedule. For example, we:

1. Assembled a diverse development team (BBN Technologies, Total Immersion Software, & Savage Entertainment) with expertise in game development, game production, individual and team training, and military operations.
2. Identified a group of willing and early adopters – the 1st Brigade, 25th Infantry Division, Stryker Brigade Combat Team – who are working with us to develop a set of initial lessons and their accompanying scenarios, conduct a formative evaluation of the system, and help navigate the hurdles of deploying the system with the troops.
3. Chosen to develop the system as a modification of a pre-existing game that features built-in authoring tools and an active "modding" (modifying) community.

Because the DARWARS Ambush! system is designed to be readily available to troops in theater as well as to those at their home base, the system must have minimal hardware requirements – it must run on personal computers, including laptops. It is also crucial that the system be useable by troops with little experience with computers. Despite our intentions to make the system as user-friendly as possible, we do not expect to be able to simply send a box of CDs to the field. We anticipate the need to deploy with hardware as well as software, and to provide ongoing support – personnel able to troubleshoot and improve the system while it is in the field.

Additional features of the DARWARS Ambush! system include:

- Game-playing from a first-person perspective, providing a compelling and immersive environment.
- Opponent forces and civilians controlled by human players or by the computer.
- Scalable in its ability to train a single individual or up to 64 personnel at one time.
- Ability to operate a variety of crew positions within vehicles.

- Voice communication to facilitate communications training and squad coordination.
- Large scale terrain maps to facilitate simulation of convoy operations.
- Observer/Controller station able to monitor, record, and interact with the training simulation.
- After action review (AAR) capabilities, including mission replay and summary statistics.

SYSTEM DESIGN

The typical DARWARS Ambush! system is comprised of a set of software modules distributed across a number of laptop-based workstations. Trainees interact with the system as part of a game-based, 3-D virtual environment, coupled with a voice communication system. Scenarios are presented within the 3-D simulation environment, while an optional observer/controller station displays and records data about the session for use as part of an instructor-led after action review. Figure 1 illustrates the primary software and hardware modules of DARWARS Ambush!. It is possible to implement the system on a single computer for individual instruction, but the preferred system configuration for team training utilizes a network of laptop computers to provide anytime, anywhere training for individuals and teams.

DARWARS Ambush! exploits a number of existing technologies:

- A mature game engine on which to develop the simulation environment and scenario-authoring tools.
- Voice conferencing technology to simulate military communication networks.
- Inexpensive, off-the-self video capture capabilities compatible with laptop computers for use in after action review.
- OpenMap, an Open Source geospatial mapping tool also used as part of the after action review (AAR) component.

We describe each of the main system components below.

Game-based Simulation Environment

A mature, commercial game engine, from which DARWARS Ambush! is developed, provides a flexible environment for training, and can accommodate training for both mounted and dismounted infantry operations. Figure 2 shows a screenshot from DARWARS Ambush! from a first-person perspective.
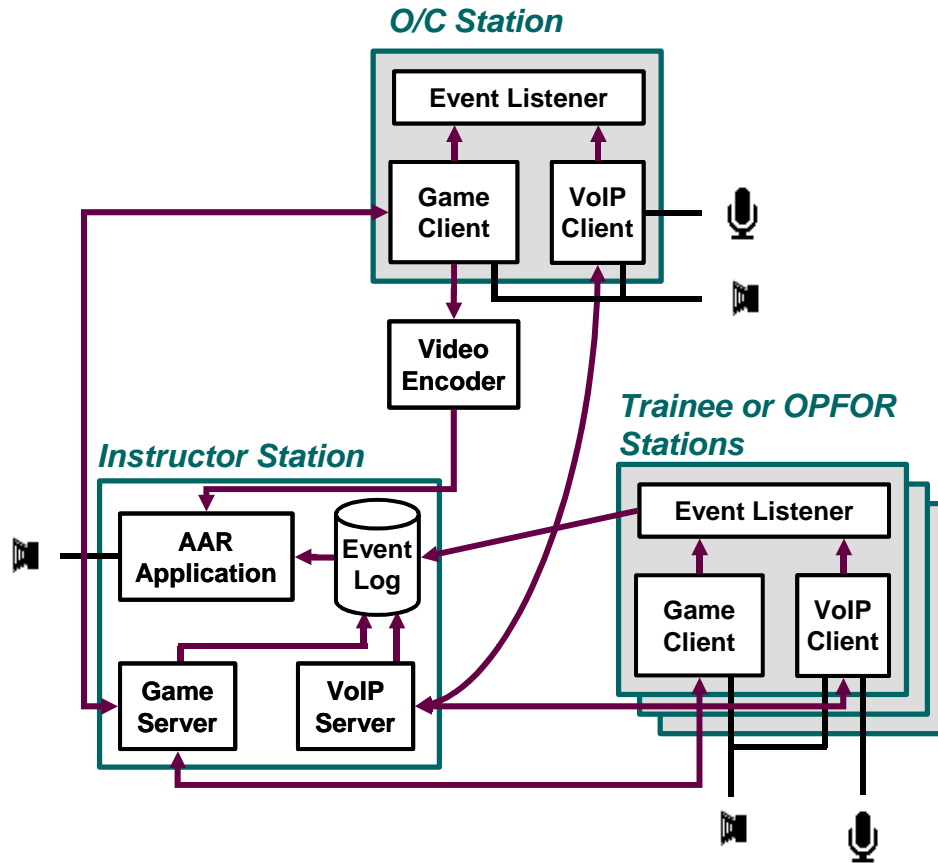
Figure 1. DARWARS Ambush! System Architecture

The game engine is mature, and is supported across a broad spectrum of personal computers, including laptops, with modest requirements (500 MHz CPU, 128 MB RAM, 550 MB disk space, and Windows 98 or later). By using an existing engine, we are able to focus development effort on content rather than technology and game play.

Although the single-player experience is the primary focus of the existing game engine, the game has fairly robust network support that allows multiple participants to operate as a team or to compete against each other. We heavily utilize this feature with our emphasis on team training. The engine allows individuals to play the roles of teammates, opposing forces, or civilian entities, but also provides the ability to have synthetic entities play these roles. While the artificial intelligence capabilities of these entities are sufficient for relatively simple behaviors, realistic teamwork behaviors are beyond the capabilities of these synthetic entities and we primarily use AI controlled characters for opposing forces and civilians. To enhance the capabilities and realism of these computer-controlled entities, we have developed our

own behavior scripts using the game engine's built-in scripting language.

This scripting language is reasonably full featured – providing support for a conditional trigger system with the ability to activate scripts when certain events occur, event handlers, waypoint navigation, as well as common constructs such as variables, conditionals, and a well-constructed function library. One feature not readily available in the game engine is the ability to write data out from within the game. However, clever utilization of functionality designed to save game status data provides a workable solution around this apparent limitation. These data are post-processed to provide detailed information about actions taken by trainees during missions and used as part of after action review.

For our purposes, the primary feature that differentiates the adopted game engine from other game engines is its mission-editing capabilities. It contains a mission editor tightly integrated with the game, making it easy to modify existing content or create new content. It uses a point-and-click interface and presents the game

world from a top-down perspective. The editor is moderately easy to use, and computer-literate users can gain proficiency without previous experience. In addition to providing tools for force composition and layout, the editor has facilities for defining force behaviors when entities are controlled by synthetic rather than human operators.

Figure 2. Screen-shot from DARWARS Ambush!

Using an existing game engine allowed the development effort to focus on creating content most relevant to the training focus of the program. A significant portion of the game-modification effort has been spent developing maps representing geo-typical terrain over a variety of regions in Iraq as well as the construction of art assets, including structures (e.g., buildings, bridges, overpasses), vehicles (e.g., Stryker family of combat vehicles), weapons systems (e.g., M249), characters (e.g., U.S. Military personnel, civilians, Iraqi police), and organics (e.g., palm trees, dead animals, garbage). The game engine has existing production pathways for transferring these assets from common asset generation tools such as 3D Studio Max into the game engine. Additional pathways exist for the construction of terrain assets and for level (scenario) design.

Another considerable portion of the development effort has been spent designing and developing a mission curriculum. Our mission design philosophy has had a layered approach, producing missions of varying complexity and duration. Missions build upon one another, beginning with short vignettes focused on specific battle drills and building to full convoy missions. Training materials have been developed, not only for the trainees, but also for instructors and optional personnel playing the role of opposing force or civilian units.

Voice Communication

Team communication skills are critical to success in today's battlefield environments, and effective team coordination is predicated on effective team communications training. Convoy operations are no exception. One of the primary functions of a convoy commander is to establish and maintain communications within the convoy and to maintain communication with superordinate and subordinate element commanders. Communications capabilities differ widely across differing units, ranging from units with multiple radios per vehicle to combat service support units that could have as few as two radios per convoy. In order to support training with a variety of communication network configurations we have developed a configurable communications subsystem capable of simulating voice communication on multiple communication subnets. Communications can be activated using either a push-to-talk switch or a voice-activated mode. Communication subnets are selectable within the simulation environment.

We have developed our voice communication capabilities using pre-existing voice-over-internet-protocol (VoIP) technology. One of the major difficulties with using of VoIP technology in training environments is its latency (delay in transmission) – often on the order of several hundred milliseconds. If this latency is not minimized, the result can be severely distracting and detrimental to training effectiveness. We have evaluated a number of systems and configurations in order to find a satisfactory solution.

All audio communications can be heard by instructors as well as recorded for later analysis or inclusion within an after action review. We are also working to enable the simulation of the selective breakdown of communications equipment as part of the training experience.

Observer/Controller Station

The observer/controller station (See Figure 1) operates several components not normally present on the trainee station. First, we have included an external video capture device to capture the on-screen display from the perspective of the observer/controller for later use as part of an after action review. Video is compressed (e.g., MPEG-2) on the external device and outputted to the instructor station via a USB 2.0 connection. Second, the observer/controller station can use a mode in the training system that allows views of simulation activity from multiple perspectives. With this view mode, the observer/controller station can see the

scenario from the perspective of any of the units in the simulation and from an invisible video camera able to 'fly' about in the environment. These features provide a large number of perspectives from which to observe game activity and generate video for later playback during AAR. Additionally, an observer/controller can manually mark times and events to facilitate their later review during an AAR.

After Action Review

Effective training using DARWARS Ambush! will benefit significantly from the ability to review and reflect on the executed mission in order to identify possible improvements. The U.S. Army has institutionalized this process in the form of After Action Reviews (Garvin, 2002). Originating with the National Training Centers as part of their process for learning from large simulated battlefield exercises, this process centers around four questions:

1. What did we set out to do?
2. What actually happened?
3. Why did it happen?
4. What are we going to do next time?

We have developed DARWARS Ambush! to help answer the first two questions and to provide some assistance in determining the answer to the third question. Although a number of efforts to automate the AAR process have been undertaken – including efforts by the authors (e.g., Diedrich, Roberts, Diller, MacMillan, & Deutsch, 2002; Roberts 2001), the short development cycle and the desire to develop a deployable system have led us to develop tools that aid an instructor leading an AAR, rather than automating the AAR process itself.

In this effort, we have taken a number of steps to assist in the AAR process. First, mission briefings were constructed to be extremely specific as to the purpose of the mission and the mission success criteria. Second, like the videotaping capabilities used extensively at the National Training Centers, we have developed a set of tools that capture the actions performed during the mission and facilitate mission replay from a variety of viewpoints and perspectives, which include including a top-down map view and a video replay of the activity from the observer/controller station. Third, we have constructed mechanisms for manually and automatically noting and indexing key events to allow an instructor to quickly find, review and share critical situations that challenged the participants. Key events automatically noted by the system include: engagements, casualties, vehicle mounts and dismounts, entrance into critical

geographical areas (such as kill zones), etc. Fourth, all audio communications can be recorded, identified by trainee, and replayed as part of the AAR.

These tools have been designed to function much like a video editing system but with three streams of data – the observer/controller station video, map-based activity replay, and audio communications. The instructor can replay the mission from any point in the data stream, and can choose to display the results from any or all three data streams. Also, a hierarchical list of key events helps focus the instructor on the most relevant parts of the mission.

SHARING LESSONS LEARNED

A major goal of DARWARS Ambush! is to rapidly capture knowledge of actual ambush incidents as scenarios within the game, and thereby enable experienced military personnel to rapidly transfer their knowledge to less experienced personnel. Although many modern computer games provide authoring tools that enable new game scenarios to be constructed, we chose the game engine largely because of its extensive mission authoring capabilities and map generation tools.

Capturing Lessons Learned

These authoring tools make it possible to capture lessons learned and incorporate them in the game, which then becomes a lesson transfer mechanism. For example, authoring tools can be used to (1) customize a map with respect to specific terrain features as well as visual and audio cues that seem relevant to communicate a specific learning instance; (2) capture relevant individual and group behavior patterns; (3) provide a means by which squad and platoon leaders can plan to avoid and respond to unexpected attacks; (4) provide a first person perspective for individuals and squads to visualize and interact with a tactical ambush environment; and (5) provide command-level interaction, such as directing squad and synthetic units. Overall, game scenario authoring provides knowledge capture at the level of understanding and analyzing of the important scenario features required for constructing lessons learned.

Supporting Infrastructure

Lessons learned have little value unless they can be disseminated to those in harm's way. The sustained support of deployed systems, their users, and the authors whose experiences are being captured and disseminated is necessary to insure the continued

effectiveness and relevance of DARWARS Ambush! This support includes the following activities:

- A secure Web site (ambush.darwars.net) to promote peer-to-peer interaction, as well as the development of frequently asked question (FAQ) lists for various aspects of DARWARS Ambush!. The Web site also supports subject matter experts and trainee interaction, and the distribution of system modifications, patches, and new content in the form of missions and supporting material. We elected to keep the contents of the Web site unclassified, while requiring secure authenticated access, to promote sharing of lessons learned. We treat the missions separately from the material that describes relevant TTPs and how they apply in a particular mission. When TTPs are classified they are distributed in parallel through a classified distribution mechanism. In addition, local installations may impose their own restrictions on locally developed material or missions.

- End user training in the form of tutorials, sample missions, and templates that describe the mission editing process in sufficient detail to allow soldiers to recreate their personal experiences within DARWARS Ambush!. "Train the Trainer" sessions are held to build expertise within units, and promote DARWARS Ambush! We dispatch instructors to major deployed units to assist with setting up and running the system.

- Continued development and a regular schedule of minor releases, which add tools and features based on user feedback obtained over the course of the development process and through ongoing use. Field authoring cannot address every need, although it can shorten the turnaround time for much new and modified content to reach its audience. We continue to respond to requests for new missions, new maps, new behaviors, and new assets by evaluating their utility to the user community at large.

- Layers of review and redistribution. Some material is created and retained by units themselves. Since some TTPs and SOPs are specialized by units, this local control gives them the ability to share freely within the units or with sister units. As soon as material is uploaded to the support website it becomes available to a larger audience. In this regard it is important that all material be attributed (to a known source) and that those responsible for the review and validation of TTPs be able to assess and comment on new

contributions. By supporting the active discussion of contributed content by multiple individuals, both the content and the commentators become better known and trusted.

PRELIMINARY EVALUATION

We conducted a preliminary evaluation of the DARWARS AMBUSH! System in order to demonstrate its utility to officers and enlisted personnel of the 1st Brigade, 25th Infantry Division Stryker Brigade Combat Team (SBCT), and to collect their feedback on the validity, utility, ease of use, and overall effectiveness of the system. The evaluation was conducted at Fort Lewis Army Base in Fort Lewis, WA, during May 2004.

A total of eighteen individuals participated in the evaluation, including two officers (O-2 & O-3) and 16 enlisted personnel, whose ranks ranged from E-3 to E-7. Three of the 18 individuals were women. Length of military service ranged widely – from as little as five months to over 14 years of service, with an average of 4.32 years (SD = 3.49). Experience with convoy operations also varied widely, with the number of convoy training exercises experienced ranging from none to 30 (M = 4.47; SD = 7.24). However, very few (N = 4) participants had any experience with computer-simulated convoy operations – one individual had two experiences, while the remaining three had only a single experience. Despite their lack of experience with computer-simulated convoy operations, many participants (N = 14) reported computer game experience of at least one hour per week and averaging 12.9 hours per week (SD = 15.44). Three participants had prior experience with the game on which DARWARS Ambush! is based.

Three groups (N = 5, 6, & 7) used the system separately, with sessions lasting about three hours. Participants received approximately an hour of familiarization training, including an instructional briefing and an in-game training mission. The training mission was designed to provide participants with practice controlling their character in the game, driving vehicles, operating weapons systems, and coordinating activities with other team members. This practice was accomplished by having participants execute structured activities utilizing in-game training aids such as an obstacle course, driving circuit, and a shooting range.

Upon completion of the training phase, each group executed three missions, each designed to provide opportunities to put into practice TTPs as well as execute battle drills associated with convoy operations.

The missions were given in the context of an Operation Order (OPORD) provided prior to the first mission. Each individual mission began with a Fragmentary Order (FRAGO), which highlighted the mission-specific situation and objectives. After presentation of the FRAGO, each group was given time to develop an execution plan, including the concept of operations, mission tasks, and any coordinating instructions. Missions commenced after each group felt comfortable with their execution plan. Each mission was followed with an after-action review.

At the conclusion of each group session, a debriefing was conducted to elicit feedback about the system and the suitability of elements such as the terrain and surroundings, vehicles, weapons systems, communication capabilities, mission and battle drills, instructional materials, game-play, etc. Additionally, participants completed an anonymous evaluation questionnaire – the results of which are described below.

RESULTS

Participant response to the system was extremely positive. When asked to rate overall satisfaction with the system as a convoy operations training tool on a scale of 1 (low) to 7 (high), all participants gave ratings at or above the midpoint of the scale (4) with the majority of the respondents reporting being Very Satisfied (7) with the system (mean = 5.88, mode = 7). Participants were even more positive about using the system as a tactics, techniques, and procedures training tool (mean = 6.36, mode = 7). Participants reported a high likelihood for using the system as a training tool if it were available (mean = 6.72, mode = 7) and that they would strongly recommend the system to others (mean = 6.77, mode = 7).

When asked to report what they most liked about the system, the graphics (visual realism) was clearly the feature most often cited. Most participants (12 of 18) indicated that this was one of the three things they liked most about the system. The variety of scenarios (8 reports) was also strongly agreed to be a good feature of the system. Also receiving repeated mention were the choices and realism of the vehicles and weapons (6 reports) and the ability to train communication skills (4 reports).

Aspects of the system most often reported as disliked by the participants included the difficulty in controlling vehicles (6 reports) and the general difficulty in learning the controls (5 reports). Difficulties operating game controls were also the most often cited response

to the question of what was most difficult to learn about the system. While approximately an hour of the session was devoted to training participants in how to use the system, there is clearly more time and effort required to make users comfortable with the controls. Of course with regular use of the system, the up-front learning time would be proportionately negligible over the long run. However, we are experimenting with the use of specialized game controllers (e.g., steering wheels and game pads) in order to decrease the difficulty in learning the controls.

Participant's suggestions for improving or expanding the capabilities of the system included the development of scenarios involving crowds, integration with the U.S. Army's Force XXI Battle Command, Brigade-and-Below (FBCB2), more vehicles, weapons systems, and terrain variations, and the ability to fire while driving.

General comments included:

> The capabilities demonstrated indicate that junior leaders would benefit greatly from executing a mission with this system. – Anonymous

> I now have questions for my chain of command regarding ROE [Rules of Engagement] and what exactly makes someone hostile. – Anonymous

> While a firm believer in "Real" world training and hands-on, I think the benefits of planning, analyzing and experiencing various scenarios is invaluable. – Anonymous

DISCUSSION

Preliminary evaluation of the DARWARS Ambush! system suggests that effective training of cognitive decision-making and communication skills needed to react to or avoid ambushes on convoy operations can be delivered cost effectively, with modest hardware requirements, little or no fixed infrastructure, and on a short development schedule. While virtual simulations such as DARWARS Ambush! will never take the place of live-fire exercises, the geographical requirements and constraints, high costs, and staffing requirements required by these training exercises limit their availability for ubiquitous training. Similarly, higher-fidelity virtual trainers, with their higher costs and staffing requirements, will also remain scarce resources. The DARWARS Ambush! system fills a critical void in the military training regimen by providing a low-cost, simulation-based training

environment able to provide anytime, anywhere training, allowing a high degree of repetition with missions based on current situations and TTPs. The system's focus on providing a mechanism for illustrating and distributing lessons learned make it relatively unique among desktop trainers.

FUTURE DIRECTIONS

Given the short development schedule for DARWARS Ambush!, we have purposely focused our efforts on a relatively few high-value scenarios representative of the most common ambush situations occurring in Iraq. After initial deployment, we anticipate increasing the breadth and depth of situations represented in the system. New scenarios will be created, both through ongoing development, and by the user community (with appropriate assistance) to promote user authoring and sharing of scenarios. Furthermore, we foresee the inclusion of a number of additional assets (such as artillery and air assets) in order to train inter-unit as well as to enable inter-Service ("joint") operational training.

In order to expedite development, we have worked primarily with a single user group, the Army's 1st Brigade, 25th Infantry Division, focusing on the model assets most representative of their capabilities and the terrain they anticipate experiencing in Iraq. We will be expanding our user base to include additional units and military services. This will require the development of additional asset models, as well as new terrain, possibly including terrain representative of Afghanistan.

Additionally, the ability to easily construct immersive situations makes the system a useful environment in which to build scenarios designed to teach and evaluate rules of engagement (ROE) – a fact alluded to in a previously noted comment regarding the system. With assistance from subject matter experts, we will be developing a set of scenarios designed as training aids for teaching ROE.

Finally, we hope to evolve DARWARS Ambush! into a modestly massive multi-player training system modeled on the large-scale training facilities at the national training centers – a Joint Virtual Training Center (JVTC) of sorts, able to simultaneously train multiple echelons across Services, with capabilities for observer/controllers and instructor-led AARs at multiple echelons.

ACKNOWLEDGEMENTS

REFERENCES

Diedrich, F., Roberts, B., Diller, D., MacMillan, J. and Deutsch, S. (2002). Hybrid team training for AWACS aircraft controllers, In *Proceedings of the 46th Annual Meeting of the Human Factors and Ergonomics Society*, Baltimore, MD.

Macedonia, M. (2002). Games Soldiers Play, *IEEE Spectrum* March 2002, 32-37.

Garvin, D.A. (2000). *Leaning in Action, A Guide to Putting the Learning Organization to Work*, Harvard Business School Press.

Roberts, B. (2001). COVE – A Shiphandling Trainer with an Attitude. In *Proceedings of the Interservice/Industry Training, Simulation and Education Conference*, Orlando, FL.

Steele, D. (2004). Last Stop Before Iraq. *Army Magazine*, *54 (5)*, 54-57.

Tiron, R. (2004). Army Bridging Training Gaps In Vehicle Convoy Operations. *National Defense Magazine*, April 2004.