FUTURE TRAINING WORKLOADS IN LIVE SIMULATIONS

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Abstract

At the request of the US Army Training and Command (TRADOC) Combat Training Support Directorate (CTSD), we examined the impacts of force modernization (new weapons, new sensor systems, and digitization of the battlespace) on the work trainers and analysts must do to support force-on-force exercises in live simulations. In 1997, we described tasks currently performed by trainers and analysts to support the simulation of system effects and provide post-exercise feedback to units at the Army's maneuver combat training centers. We estimated the effects of over 140 systems to be fielded over the next ten years on trainer workloads. In 1998 we interviewed personnel from the Army's National Training Center with hands-on experience supporting exercises involving a subset of the new systems during the Force XXI Advanced Warfighting Experiment (AWE). In the absence of interventions, force modernization will substantially increase the work required to support the simulation of weapon systems and provide formal post-exercise feedback. In addition, the same digitization capabilities that give units' information dominance over the enemy also have the side effect of making it more difficult for trainers to monitor exercises and track the flow of information within units.

About the Authors

Dr. Larry L. Meliza is a research psychologist with the U.S. Army Research Institute Simulator Systems Research Unit at Orlando, FL. His experience includes developing AAR systems for use in virtual simulations, assessing behavior of computer generated forces, measuring the effects of tactical engagement simulation systems on unit performance in live simulations, and developing guidebooks to support exercise control and feedback functions at the Army's National Training Center (NTC).

Bill R. Brown is a retired Army officer whose military experience includes serving as a fire support O/C and analyst at the NTC. He served as the project manager for the Training Analysis and Feedback Aids (TAAF Aids) Study. He was also the project manager for the Automated Training Analysis and Feedback System (ATAFS), which automates AAR preparations for tank platoon virtual simulation exercises. He also served as the project manager for a Phase I Small Business Innovation Research (SBIR) project to design a concept for a system to help trainers perform exercise control and feedback functions associated with battlespace digitization in the virtual environment.

Ira J. Begley II is a retired Army Officer with seventeen years of combined arms experience from platoon to brigade level. He has practical experience in the operation of artillery digital command and control systems. He served as the Systems Automation Officer for the Opposition Forces at the Army's NTC. Mr. Begley served as an analyst for the TAAF Aids Study. He determined the impact of existing and emerging lethal and non-lethal weapon systems on future exercise control and training feedback functions in live training simulations.

Louis Anderson is a former Army Officer whose military experience includes serving as Chief of the Analysis Branch at the Special Forces School. He performed analytical work on the Bradley Support Vehicle (BFIST) during Army Warfighting Experiment (AWE) 94-07 at the NTC. He was also project lead for research and writing of FM 100-13-1 which introduced Army Tactical Command and Control Systems (ATCCS) into Battlefield Coordination Detachments.

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Performance in live simulation exercises provides the most meaningful assessment of whether units are ready for combat (Department of the Army, 1990). A recent unit training strategy links live exercises to the “run” portion of the progressive “crawl, walk, run” approach to training, where "run" requires a high level of realism (Keesling, King and Mullen, 1997). It is in the live environment where
a unit is expected to face all of the variables that would be encountered in a real combat situation.
Lucha (1998) maintains that the only aspects of combat that are simulated in the live environment are concerned with weapons effects.

Live exercises are expensive, especially in terms of trainer costs. Trainers for live force-on-force (FOF) exercises are kept busy performing control functions and providing feedback to units. Control functions requiring the greatest time investment are those supporting the simulation of weapons effects.

The Army’s Training and Doctrine Command (TRADOC) Combat Training Support Directorate (CTSD) is responsible for defining instrumentation and other resources needed to support live training. CTSD is examining the impacts of force modernization under the Army’s Force XXI program (new weapons, new sensor systems, and digitization of the battlespace) on future support for live training. As part of a larger series of studies (Faber, 1996), CTSD asked us to describe the impact of force modernization on the workload of trainers and analysts in live FOF exercises.

BACKGROUND

Intrinsic and Extrinsic Feedback

Intrinsic and extrinsic feedback must be provided to units in any training environment. Intrinsic feedback is "downrange" feedback provided to soldiers during exercises as they interact with their tactical systems and other soldiers. It consists of real or simulated entities or activities that stimulate the senses of the players and provide information needed to cue and guide performance. For example, feedback regarding the location of artillery impacts defines the need for adjusting fires and provides information needed to adjust firing.

Extrinsic feedback is provided in the form of After Action Reviews (AARs), coaching, and mentoring.
It provides units with guidance for improving performance in future exercises.

Providing Feedback in Live Simulations

From the trainer’s perspective a crucial difference between training in live versus virtual or constructive simulations is the greater amount of work required to support intrinsic and extrinsic feedback in live exercises. In addition to supporting the simulation of weapons effects, live trainers must often collect and analyze data on weapons effects in preparing extrinsic feedback.

The workload of trainers in live exercises can be reduced by tactical engagement simulation (TES) and instrumentation systems. TES systems, and TES systems combined with instrumentation, can simulate selected aspects of the employment of a combat system during live FOF training. Figure 1 illustrates a case where much of the intrinsic feedback associated with the use of a weapon is provided by a TES system. Most line-of-sight (LOS) weapons are equipped with the Multiple Integrated Laser Engagement System (MILES) that emits an eye-safe laser when a weapon is fired. MILES sensors on soldiers and equipment detect engagement by the laser and produce an audio and/or visual signal for a kill, hit, or near miss.

TES and instrumentation systems can free trainers from certain weapon simulation tasks, and they can also be used to help trainers collect and analyze data for extrinsic feedback. The scope of this effort includes looking at current shortfalls in the ability of TES and instrumentation systems to support feedback, as well as examining the impacts of force modernization on future workloads.

Figure 1. Example of a case where tactical engagement simulation provides feedback to shooter and victim.

Differences between Combat Training Center (CTC) and Home-Station Training

The current effort is intended to apply to maneuver CTCs and to home-station training. Maneuver CTCs are the leaders in providing live FOF training for Army units. These CTCs are the National Training Center (NTC) at Fort Irwin, CA, the Joint Readiness Training Center (JRTC) at Fort Polk, LA, and the Combat Maneuver Training Center (CMTC) at Hohenfels, Germany. At CTCs, the trainers who coach and mentor units and conduct AARs are referred to as observer/controllers (OCs). OCs are supported by analysts in a training analysis and feedback (TAF) center that is collocated with an instrumentation system. The instrumentation system is an electronic data collector that monitors the status and activity of entities (vehicles, sensors, and dismounted soldiers). The system provides data that TAF workstations convert into computer-generated graphics providing a top-down view of player location, status (alive or dead), movement, firing activity, etc. The system records tactical voice communications, supports OC and TAF control communications, and displays video from mobile video crews in the exercise area.

In most cases, home-station live force-on-force exercises are conducted by trainers without the benefit of supporting TAF analysts or instrumentation systems. The Army envisions porting CTC-level training capabilities to home-stations. This will be accomplished by providing home-stations with instrumentation systems and using automation to mimic the TAF analyst function.

APPROACH

We used the Army Science and Technology Master Plan (ASTMP) prepared by the Department of the Army (1996) to identify new systems to be fielded over the next ten years. We used the ASTMP and Internet web sites to gain an understanding of the capabilities, operation, and employment of emerging systems. We identified the intrinsic and extrinsic feedback requirements for employment of these new systems in force-on-force training. To gain an understanding of control and feedback tasks OCs and TAF analysts currently perform, we visited the CMTC and JRTC, reviewed exercise rules of engagement, and reviewed an OC handbook. Through this procedure we determined control and feedback tasks OCs and TAF analysts will manually perform in the future, if TES and instrumentation systems are not modified. Based upon the capabilities of current TES and instrumentation systems, we estimated whether specific elements of feedback would be provided by a TES/instrumentation system, an OC/analyst, or through soldier interaction with an operational system. We also identified cases where feedback voids were expected. Figure 2 shows the process used to identify the impacts of new systems on trainer workloads. Figure 3 shows intrinsic feedback for the Apache Longbow firing in the non-line-of-sight (NLOS) mode.

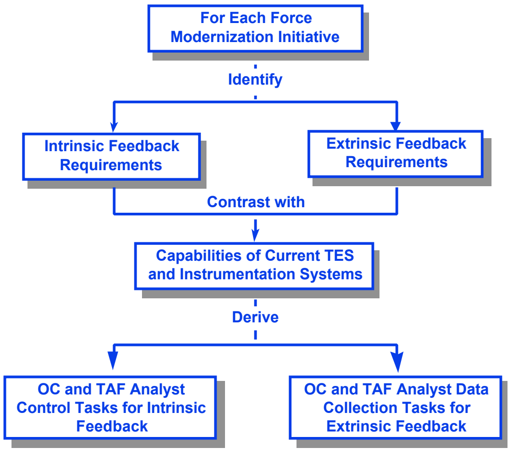

Figure 2. Process used to assess impacts of new systems on OC and analyst tasks.

As we analyzed the intrinsic and extrinsic feedback requirements imposed by force modernization initiatives, we identified 24 representative systems in which the analysis applied to 104 other systems (munitions, tactical systems, or technology demonstrations). The study also identifies 14 tactical systems which were special cases requiring a separate, unique analysis. The analysis supports a total of 142 systems/technology demonstrations.

A portion of the systems examined in the analytical effort were included in the Army's March 1997 Force XXI Army Warfighting Experiment (AWE), held at the NTC. We interviewed roughly sixty OCs and analysts that had participated in this effort to find out how the intrinsic and extrinsic feedback tasks associated with new systems had been performed.

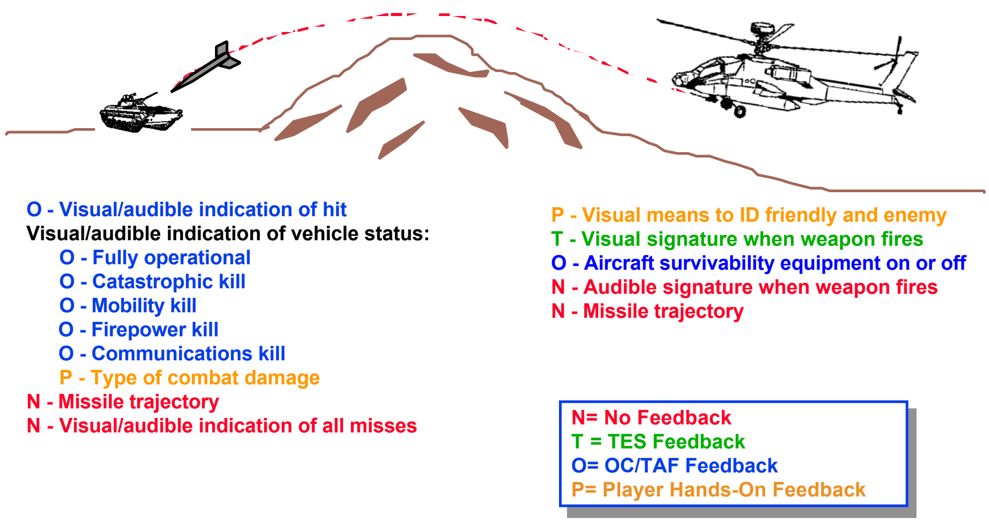

Figure 3. Intrinsic feedback requirements associated with the Apache AH-64D Longbow Hellfire firing a non-line-of-sight (NLOS) mission.

AVIATION ANALYST

1. Receive shooter ID and target location from AVN OC
2. Plot target location
3. Plot missile(s) footprint
4. If entities within footprint, assess battle damage according to PK
5. Administratively kill entity from TAF facility
6. Inform OPFOR that AH-64D Longbow Hellfire killed the vehicle

AVIATION OC

1. Coordinate and monitor shooter procedures to engage target
2. Record target description and location
3. If procedures valid, forward shooter and target information to AVN analyst

Figure 4. Intrinsic feedback tasks for aviation OCs and analysts supporting the simulation of Apache AH-64D Longbow Hellfire NLOS firing events.

EXISTING SHORTFALLS AND THEIR IMPACTS ON TRAINING

Apart from fielding of Force XXI systems, there are shortfalls in terms of the number of personnel available to support training, the capability to support the simulation of selected systems, and the capability for credible simulation of systems. Examples of each type of shortfall, and their impacts on training, are presented below.

The capability to support the training of air defense artillery (ADA) units at the NTC is reduced by personnel shortages. The number of OCs is enough to observe only half of the ADA units. ADA OCs have no dedicated TAF analysts to provide ground truth data or to help prepare extrinsic feedback. To address shortfalls in the number of OCs, CTCs may increase the number of OC augmentees used to support exercises. OC augmentees are soldiers that must be provided by the unit being trained and then trained by CTC personnel to perform OC functions. The augmentee approach is not used to address analyst shortfalls.

Personnel shortfalls and time constraints also influence the capability to support instrumented AARs at company and platoon level. Instrumented AARs are useful mainly because they provide the capability to demonstrate performance problems with ground truth data. The NTC now has the equipment to provide instrumented AARs down at company level, but TAF personnel do not have time to support both task force level and company level AARs. The need to start lower echelon AARs soon after the end of an exercises also makes it difficult to provide instrumented AARs.

There are already a number of weapon systems that cannot be simulated in live force-on-force exercise due to safety and/or cost considerations.
For infantry units, these systems include hand grenades, the MK19 40mm Grenade Machine Gun, the M203 Grenade Launcher, and the Claymore mine. When rotating to the JTRC units are told that these systems cannot be played in force-on-force exercises.

The manner in which certain systems are currently simulated creates credibility problems. For example, the methods used to assess ground casualties due to aviation engagements may result in cases where soldiers are told ten minutes after an engagement that they were killed by aircraft. In certain cases, OCs must move to the immediate location of enemy or friendly vehicles or soldiers to assess casualties, potentially giving away positions of the element being assessed.

IMPACTS OF FUTURE WEAPON SYSTEMS

Our analytical efforts in 1997 led us to conclude that, in the absence of interventions, force modernization will result in a significant increase in the workload of OCs and analysts. There will also be additional gaps in the capability to provide intrinsic and extrinsic feedback.

Subsequent interviews with OCs and analysts having Force XXI AWE experience led to modifications of the descriptions of OC and analyst tasks involved in supporting specific systems, but these interviews did not influence our general conclusions. In certain cases we found that we had underestimated the work involved in supporting new and existing systems. In other cases, we found that interventions had already helped to reduce workloads.

NLOS Engagements

The increase in workload will be due, in part, to the proliferation of systems capable of NLOS engagements, including individual helicopters, tanks and dismounted soldiers. Laser-based simulations do not support NLOS engagements, and the methods currently used to simulate this type of engagement are personnel intensive. To better appreciate the magnitude of the potential workload, look at Figures 3 and 4 and consider that the Apache may engage over ten targets at once.

During the AWE, OCs and analysts were able to employ a less personnel intensive method of simulating Longbow NLOS engagements than that illustrated in Figures 3 and 4; however, the maximum number of engagements conducted concurrently by a Longbow was only about one-quarter the number possible. The AWE employed instrumentation to support simulation of Longbow NLOS engagements. Radar would paint targets and send locations to the instrumentation system. The instrumentation system would then decide if a vehicle was at the location identified by radar. If so, the instrumentation system would kill the vehicle.

There were drawbacks to this approach. Ground position sensor (GPS) data used by the instrumentation system was not precise. Further, too much time was required to assess casualties, leading to situations where vehicles were killed forty-five seconds after an engagement. Finally, this worked for instrumented target vehicles only, and there are uninstrumented vehicles in exercises.

During our interviews with OCs and analysts we found that a new system for Longbow NLOS engagements is being tested, having the potential to remove both the latency and position accuracy problems. This system employs radio frequencies and detectors mounted on potential target vehicles to support casualty assessment. The system has the potential for application to other types of NLOS engagements.

Smart Weapons

The employment of “smart,” “intelligent,” and “brilliant” weapons will increase the degree of precision with which various weapon systems may be employed. Supporting the simulation of this increased degree of precision may be very personnel intensive.

Even before the AWE we were bumping up against the smart munitions problem when laser designators were employed. For a credible simulation, we had to make sure that targets were being painted by one element in the battlespace while another element engaged the target. Before and during the AWE, laser designation was played by having an OC look over the shoulder of the COLT team or forward observer using a laser designator to make sure proper lasing procedures were being employed, including keeping the target painted for the last 13 seconds of the projectile’s time of flight. An OC with the firing weapon (e.g., an artillery section firing a Copperhead) also had to make sure that the codes and ammunition required for a laser designated engagement were being employed.

The move to intelligent minefields creates an interesting situation where units have the capability to set the variables controlling the triggering of mines and to use different settings for various parts of the minefield. For example, a portion of the minefield may be set for self-activation (requiring a target to come within a certain distance to activate the mine) and another portion may make use of command detonation whereby mines may be activated by the unit when certain criteria are met (e.g., when at least three enemy vehicles have entered a particular part of the minefield). Under this situation two different control mechanisms are required to simulate a minefield. OCs need to monitor what the unit is doing to control the minefields, and they need to insure that casualties are assessed in accordance with whatever settings are in effect.

During the AWE, command activation and detonation capabilities of intelligent minefields were not simulated. Instead, the entire minefield was self-activated.

Non-Lethal Weapons

Another major contributor is the growth of non-lethal weapons. These weapons are capable of inflicting various degrees of incapacitation depending on factors such as weapon settings, the victim’s exposure time, and distance from the firing weapon. The degree of incapacitation may be so small as to incapacitate a soldier for just a few minutes. Some of these systems (e.g., the acoustic beam weapon) can be used through walls so that they combine non-lethal and NLOS feedback challenges. We envision a situation where OCs are forced to spend substantial amounts of time informing soldiers that they have been a victim of one of these weapons and insuring that soldiers restrict their behavior for the appropriate period of time in accordance with graded weapons effects. In addition, OCs may have to spend time collecting and reporting data regarding the employment and effectiveness of these systems.

Non-lethal weapons were not employed during the AWE, so our interviews provided no information about innovative ways to support the addition of non-lethal weapons to live simulation exercises. However, within a number of these interviews the point was made that OCs tend to be very busy addressing safety concerns when enemy and friendly troops are in close proximity. These are also the points in time when many of the non-lethal weapons are most likely to be used.

IMPACTS OF RECONNAISSANCE, SURVEILLANCE, AND TARGET ACQUISITION (RSTA) SYSTEMS

The growth of RSTA systems, such as the unmanned aerial vehicle (UAV), presents substantial extrinsic feedback challenges. OCs need to collect and analyze information about how a unit plans to use RSTA assets, how RSTA actions are executed, and what a unit does with the information obtained by the RSTA systems. The existence of UAVs, as well as other RSTA systems, raises a question as to how OCs will monitor the flow of information made available by these systems. For example, will an OC be fully occupied by the task of monitoring the information presented by a UAV?

During the AWE, OCs and analysts were able to develop useful information about how the unit employed the UAV and how it might be employed more effectively. For example, they found problems concerning the value of UAV pictures of the battlespace. Pictures might be focused to provide very detailed views of enemy vehicles without providing information about the terrain features surrounding the vehicles. That is, the pictures did not allow one to decide where the enemy vehicles were located. OCs and analysts also noted that decisions regarding where UAV data collection assets might be employed were made above the battalion task force level.

IMPACTS OF DIGITIZATION

The greatest impacts of force modernization on the jobs of OCs and analysts may involve the digitization of the battlespace. Digitization includes the capability for sending and receiving messages down at the individual vehicle level with the Applique system. It also includes the five Army Tactical Command and Control Systems (ATCCS); the Maneuver Control System (MCS), the All Source Analysis System (ASAS), the Advanced Field Artillery Tactical Data System (AFATDS), the Air and Missile Defense Workstation (AMDW/S), and the Combat Service Support Control System (CSSCS). Finally, battlefield digitization includes a number of other specialized digital systems, such as the Air Mission Planning System (AMPS), which automates aviation mission planning tasks from the aviation brigade to the aircrew.

Difficulties Tracking the Flow of Digital Information

It is more difficult for OCs to keep abreast of the tactical situation on the digital battlefield. Currently, OCs can monitor many voice nets at a time. For example, a platoon trainer might listen to a platoon net, a company team net, and a fire support net. With visually based digital communications, monitoring a net involves interacting with a computer to call up messages, read messages, or visually inspect graphical displays.

OCs equipped with digital systems may selectively monitor the digital messages received or transmitted by any exercise player, but only one node at a time. For example, the OC cannot visually eavesdrop on all digital stations that are subscribers to the Battalion (Bn) Task Force (TF) command net. However, the OC may monitor all incoming and outgoing traffic to a single node such as the Bn TF Commander. Another problem tracking the flow of information concerns deciding when a digital information has been received. In most cases, the receiver's Applique does not transmit an acknowledgement to the sender's Applique. By tracking the communications of a platoon leader (monitoring the platoon leader's node), one might know that a message had been sent to all of the vehicles in a platoon, but one would not know if each vehicle received the message.

Digitization makes it more difficult to provide extrinsic feedback. OCs do not know which messages are received by leaders, and they do not know if and when messages are read. Since an OC cannot monitor multiple digital nodes simultaneously, extensive OC cross-talk is necessary to discern disconnects in situational awareness or to assess the impact of player digital actions or inactions across the unit's chain of command. OCs will not know what decision aids are being employed by unit leaders inside tactical vehicles. To a large extent, OCs will be in the dark regarding digital operations.

We interviewed OCs and analysts with Force XXI experience to find out how they attempted to monitor the flow of digital information and what they learned about the unit's employment of digital communications.

The Applique screens of roughly 20 company commanders were directly monitored during the exercises through a "video tap" process. The vehicles monitored were fitted with a transmitter that allowed a receiver within one kilometer of the vehicle to see whatever was currently being displayed on the Applique screen. For example, if the Applique screen in a vehicle was showing a screen saver, the receiver would also show the screen saver. A subject matter expert (SME), sitting in the right front seat of a company team OC vehicle, monitored the receiver. SMEs were able to keep company team OCs informed of messages being received and sent by the company commanders whose systems were being observed.

An Applique was also available in each TAF center that mirrored the Applique for the Battalion S-3. For example, the TAF supporting the OCs for maneuver elements had an Applique, and the TAF supporting fire support functions had an Applique. Each TAF also had an MCS workstation.

OCs monitored use of the individual ATCCS in the Battalion Tactical Operations Center (TOC). When looking over the shoulder of operators, OCs could see what messages were coming in and going out. OCs generally had other observation duties that prevented them from continually monitoring the flow of digital information, such as observing face to face meetings among members of the battalion staff.

For the most part, Applique message flow below platoon level was tracked after the fact. OCs would go up to commanders during slack periods and ask leading questions about the messages they had sent and received. In some cases, the information was drawn out of exercise participants during AARs.

OCs were able to do a good job of developing information about how and when digital systems were used. OCs were able to decide when information was getting out to the field late or was not being received. They concluded that graphics were slowing down communications, and reported cases where it was taking as long as an hour for an echelon to transmit graphics and overlays to the next lower echelon. They also determined that voice traffic was overriding digital communications disrupting the transmission of operations orders. They were also able to find out what units were doing to hasten the distribution of graphics and overlays in a digitized format.

OCs were also able to identify interoperability problems among the various ATCCS systems (including Applique) and automated decision aids.

For example, flight plans developed using the Air Mission Planning System (AMPS) could not be directly loaded into the ATCCS. This was especially unfortunate in terms of the AMDWS, which requires information about friendly flight plans to develop and implement an air defense plan.

OCs said they would like to have the capability to display critical Applique screens during AARs, and they also noted the need to be automatically informed of critical digital messages. Most OCs reported that they did not want an Applique. OCs pointed out that it would be impractical, distracting, and unsafe for them to attempt to monitor an Applique on top of their other responsibilities. Instead, they preferred that their supporting TAF analyst monitor Applique traffic and alert them when a critical message was passed. This would be an extension of one of an analyst's current duties (i.e., filtering ground truth and other data to identify information that warrants being brought to the attention of OCs) to a new data source. TAF analysts, on the other hand, pointed out that monitoring Applique traffic would require additional staffing. TAAF analysts would be stretched too thin if they had to monitor digital messages on top of their other responsibilities.

There were two groups of OCs that indicated an interest in having an Applique to help monitor digital communications. In one case it was a group that is not directly supported by TAF analysts. In the other case, it was the platoon level OCs that crawled up on tactical vehicles to question vehicle commanders regarding what messages they had received and what they were doing with the information in the messages.

There were also bottom line conclusions from these interoperability problems that relate to exercise control and feedback functions. There is a set of information that must be passed within and across units to support combined arms performance, and OCs care about whether the information is passed and when it is passed. While Applique and ATCCS systems are evolving over the next several years, OCs and analysts will need to track digital, voice radio, face to face, and other methods of communications to follow the overall flow of information.

OCs and analysts need a system that can support exercise control and feedback functions by tracking this complex flow of communications.

Intrinsic Feedback Functions Associated with Digital Communications

Quite often, TAF personnel play the role of higher, adjacent, and supporting units during exercises by receiving and responding to radio messages. Performing these functions will be difficult on the digital battlefield, because it involves interacting with multiple player nodes.

The problems associated with playing the roles of other units may be greater at home-station. Trainers conducting exercises at home-station for platoon and company level exercises would be more likely to have to play a variety of roles. For example, a trainer for a company team level exercise might play the role of the battalion commander, scout platoon leader, and fire direction center.

STRATEGIES FOR REDUCING WORKLOADS AND/OR IMPROVING FEEDBACK

Automating the Preparation and Delivery of Post-Exercise Feedback

As in the case of the other CTCs, NTC platoon and company OCs tend to have libraries of canned AAR aids that they can draw upon. These aids are based upon what the OCs have found to be frequently encountered performance problems. These aids tend to be based upon tactical doctrine and provide information about how to improve performance (e.g., a checklist of items that need to be coordinated between units when responsibility for observing a minefield is transferred from one unit to another).

Given a trainer's judgement regarding the performance strengths and weaknesses of a unit, the trainer can select appropriate aids from the library. In many cases the OCs would like to further tailor specific aids to fit a given AAR., such as displaying ground truth data to document a performance problem.

One of the strategies for improving AARs without adding greatly to the workload is to provide for automatic generation of appropriate "how to fight" and ground truth AAR aids that would be guided by the trainer's judgments. For example, a trainer may decide that a unit "did not manage their time well during the planing phase of a mission causing orders to be distributed late." Automatically generated AAR aids appropriate to this diagnosis may include a timeline showing when orders were received by various subunits, a table indicating which mission preparation activities were completed by subunits, and "how to plan" guidance.

Using Automated Tools to Monitor the Flow of Digital Communications

New tools and procedures are needed for monitoring the flow of communications in the digitized battlespace. One possible strategy involves collecting digital communications across nets and using artificial intelligence to analyze the data flow during exercises. To provide extrinsic digital feedback to a Battalion Task Force, for example, the instrumentation system must capture all digital traffic transmitted and received by every player node from Battalion to platoon level. OCs and analysts need an automated capability that alerts them to significant digital actions or inactions. They also need to be alerted when messages come in for one of their exercise control roles.

Developing Future Instrumentation and TES Systems

A number of efforts are underway to develop instrumentation or TES systems that can more effectively simulate one weapon system or another. An example of this approach is the use of radio waves in simulating NLOS engagements for the Apache Longbow. Ideally, we would like to have a single system that can support the simulation of weapons effects for all types of engagements (direct, indirect, non-lethal, smart, intelligent, etc.) to avoid the pitfalls of stovepipe systems (Faber, 1996).

Implementing Embedded Simulations

We may be able to conduct exercises in what is essentially a live simulation while using virtual simulations to simulate the effects of selected weapon systems. Perhaps the key example of this approach is the development of embedded training and embedded simulation capabilities (Bahr, 1997). In this case soldiers may move across real terrain in their tactical vehicles while engaging virtual targets with virtual fires or they may engage real targets with virtual fires.

SUMMARY

OCs and TAF analysts in the CTC environment are already overextended in terms of exercise control and feedback functions. The situation is much worse in the home-station live force-on-force environment where trainers do not have the support of TAF analysts.

In the absence of interventions, force modernization will substantially increase the workload of OCs and analysts in live force-on-force exercises. Alternatively, certain weapon systems or selected capabilities of weapon systems may simply not be simulated due to personnel constraints, or the use of these systems and capabilities may be addressed inadequately by post-exercise feedback.

A variety of ongoing efforts may combine to reduce trainers' workloads and improve the quality of feedback given to units in live force-on-force exercises. Innovative instrumentation and TES systems are continually being devised and tested.

REFERENCES

Bahr, H. (1997). "Embedded Simulation for Ground Vehicles. " CD-ROM Conference Papers for 1997 Spring Simulation Interoperability Workshop. Orlando, FL: Simulation Interoperability Standards Organization.

Brown, B. R., Nordyke, J. W., Gerlock, D. L., Begley II, I.J., & Meliza, L.L. (1998). Training Analysis and Feedback Aids (TAAF Aids) Study for Live Training Support. (ARI Study Report 98-04)

Department of the Army (1990). FM 25-101: Battle Focused Training. Command and General Staff College; Fort Leavenworth, KS

Department of the Army (1996). Army Science and Technology Master Plan. Washington, DC: Author.

Faber, T.D. (1996) Report on Live Domain Research Requirements. Fort Eustis, VA: U.S. Army Training and Doctrine Command Combat Training Support Directorate.

Keesling, J. W., King, J. & Mullen III , W.J. (1997).
Report on Methods to Select Appropriate Training Environment.

Lucha, G.V. (1998). The Role of Instrumentation in Simulating Weapons Interactions on Live Training Ranges. Spring 1998 Systems Interoperability Workshop. Orlando, FL