**U.S. Army Research Institute
for the Behavioral and Social Sciences**

Research Report 1840

After Action Reviews With the Ground Soldier System

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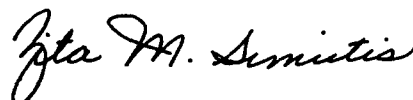
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14. ABSTRACT *(Maximum 200 words)*: The research examined how operational capabilities in the future Ground Soldier System (GSS) could serve as after action review (AAR) aids for trainers during force-on-force field exercises. It also examined what specific additional embedded training features could generate enhanced AAR aids and displays. The GSS is a dismounted Soldier system with a wearable computer. The AAR aids examined were based on automated aids used to support simulation training exercises, principles of graphic displays, and input from observer/controllers (OCs) at the Joint Readiness Training Center. Findings showed that the operational capabilities of the GSS could be used to provide aids that support the trainer's discussion of mission planning and preparation, plus some aspects of mission execution. Yet additional embedded AAR capabilities could expand the pool of potential aids, and more closely appropriate those used with simulations. It was also determined that existing automated aids typically do not address mission planning and execution. The OC interviews reinforced the tenet that the trainer is key to a successful AAR dialogue to help the unit understand what happened, why it happened, and what to sustain and improve.

15. SUBJECT TERMS   After action review   Ground Soldier System   Land Warrior   Observer/Controller   AAR Aids   Training   Graphic Displays   Training assessment

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Army Project Number	Personnel Performance
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AFTER ACTION REVIEWS WITH THE GROUND SOLDIER SYSTEM

EXECUTIVE SUMMARY

Research Requirement:

The After Action Review (AAR) is critical to the Army's training process. Much work conducted by the U.S. Army Research Institute (ARI) has been devoted to developing automated aids to support AARs given in conjunction with training simulations. These AAR aids are generated by the computer systems underlying the simulations themselves. With the introduction of advanced combat systems that incorporate computers, there is a need to examine how these computer capabilities can be applied to generating AAR aids for live training environments. The ARI's Infantry Forces Research Unit has focused extensively on training research with future dismounted Soldier systems which incorporate a wearable computer and a helmet-mounted display, specifically the Ground Soldier System (GSS), and a version of the GSS known as the Land Warrior. The research reported here represents an extension of that research thrust by examining how the operational capabilities of the Soldier system could be used as AAR aids to enhance the trainer's AAR dialogue with the unit, as well as what additional training capabilities could be embedded in the system's design to generate other AAR aids.

Procedure:

The military training and doctrine literature on AARs was reviewed, as well as research on automated AAR tools used in constructive and virtual simulations. These concepts were examined for their potential application to live training and operational environments. Literature on creating effective graphical displays was reviewed to identify principles for effective graphic and tabular AAR displays. Most critical to the research were interviews with the observer/controllers (OCs) at the Joint Readiness Training Center (JRTC) who observed the Land Warrior (LW) equipped platoon as part of the Joint Contingency Force Army Warfighting Experiment in 2000. These ten OCs were asked to identify what they stressed in AARs, how they would use the features of a system such as the LW to assist them in the conduct of an AAR, and their reactions to two-dimensional graphics that illustrated what aids might be possible if specific AAR features were embedded in the LW system. These data sources were used to generate specific examples of aids that could be used during AARs with GSS-equipped units.

Findings:

The JRTC OCs did not treat all areas equally in their AARs. The most common area was communications, which included mission planning. The next most frequent areas were movement and preparation for operations, followed by shooting/target engagement. Force protection and fratricide were the least frequent. Many of the automated AAR aids developed for simulations (e.g., battle flow, plan views, stealth views, fire fights, replay, battle scorecard)

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were found to focus on movement, shooting/target engagement, and some aspects of force protection and communications during mission execution. The fact that most of the automated AAR aids developed for simulations typically did not cover mission preparation and mission planning, important topics in live training and operational environments, was an unexpected finding.

The JRTC OCs identified ways they would use the actual LW system to help them in their AARs. For example, they would use the system's helmet-mounted display to track individuals from the unit on the map, monitor information exchanges via radio nets and digital messages, and examine digital messages regarding orders and overlays. They wanted the flexibility to change whom and what they monitored as the need arose.

Additional embedded capabilities that would allow automated AAR aids similar to those used in training simulations were examined. The OCs stressed that these aids should be event-centered, and through application of graphic design principles some data-rich display prototypes were generated. An "automated AAR" capability was viewed by the OCs as an augmentation to the traditional means of obtaining data. They stressed that for some critical areas there was no substitute for on-site observation.

The most experienced OCs wanted everything possible through an automated system, preformatted in various ways so they could pick and choose what to present in an AAR. On the other hand, the less experienced OCs were concerned about having too much information with such AAR capabilities.

Utilization and Dissemination of Findings:

The findings will help guide training developers in designing Training Support Packages for AARs that rely on the GSS system itself. In addition, the report provides multiple alternatives for training developers and engineers to more fully address the embedded training requirements regarding AARs cited in the GSS Capability Development Document.

Simply because technology allows the creation of an AAR aid, does not mean that the aid should be used in every AAR. There is a danger of letting the technology-generated tools become the AAR, as opposed to being aids to trainers, that allow them to apply their expertise and wisdom to the AAR process. Consequently, the aids suggested here should be viewed as providing a large collection of tools for trainers to select from and use as desired, in order to enhance the AAR dialogue with units.

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AFTER ACTION REVIEWS WITH THE GROUND SOLDIER SYSTEM

Introduction and Scope of Report

The morning after the night attack, the trainer for Company A sat in front of the company and platoon leaders in a semi-shaded spot near the objective at Ft. AAR. To his right were two training aids: a military map of the area with the battalion's overlays, and a list of key events with their associated times. Both training aids were on poster boards covered with plastic to protect them from the early morning dew.

The after action review (AAR) began with the trainer summarizing the battalion's mission, the orders given by the battalion commander, and the topics to be covered in the AAR. . . .

Then the dialogue started with the unit.

"Was your company mission stated in the battalion WARNO? . . ."
"What were the stated (if any) tasks and implied tasks? "Based on the battalion mission, what were your expectations? What rehearsals did you anticipate you should conduct? . . ."
"What did you know about the enemy? When did you learn about the enemy? . . ."
"When you received the battalion OPORD, what additional information did it have regarding your company's mission? Did it have all the information you needed? When did you get things clarified? How did it change your plans?" . . ."
"What would you have done differently? . . ."

The *OPFOR leader* summarized his mission, force strength and equipment, disposition of his force, time to prepare, intelligence the OPFOR gathered on the company, how they reacted to the company's actions, perceived strengths and weaknesses. Company leaders asked questions of the OPFOR leader.

The trainer continued the dialogue.
"What did you want to accomplish between receipt of the battalion OPORD and crossing the LD/LC?"
"Time was critical. Were you getting briefbacks? What did they do for you? . . ."
"What was the most essential task for this mission? . . . "What did you rehearse? . . ."
"When did you identify critical equipment needed for the mission? When should you have told battalion when you didn't have it? . . ."
The trainer points to the map with a stick. "Tell me about the passages of lines. Did the linkup happen as the battalion planned? What went right at the linkup? What went wrong? . . ."
The trainer pointed to his hand-drawn snail trail of the unit's route on the map. "During the movement, did you know where you were at? What slowed you down? How would you rate your movement? What should you have done differently? . . ."
"When you made first contact with the enemy, what formation were you in? What impact did that have?"
The trainer showed the OPFOR's drawing of the objective. "Where were you going to breach? What fields of fire did the OPFOR have? What types of casualties occurred at the breach? Why did these casualties occur? What signals and marking techniques did you use? Were they effective? . . ."

The trainer concluded the dialogue by discussing what to sustain and to improve with the company and platoon leaders.

Assume the time is now 2012 - 2015. The unit participating in the AAR is equipped with the Ground Soldier System (*Capability Development Document*, 2005). At the time of this report, the GSS had not been fielded; prototypes existed as did the requirements document. For purposes of this report, it was assumed the GGS has a wearable computer, global positioning system, and networks all individuals within the unit. Other capabilities assumed are cited below.

- The system has built-in voice communications for all Soldiers. For example, squad leaders have networked communications to their fire teams, the platoon leader, and other leaders and elements when required, to include engineers, mortarmen, artillery, attack helicopters and Joint fires.
- Helmet-mounted displays, wrist, and/or handheld display devices provide individuals with a variety of information through the computer, global positioning system, and the wireless network. Information on enemy and friendly locations is displayed on maps and photographs. Soldiers take digital photos from reconnaissance positions and send them to their leaders. Digital messages, similar to e-mail messages, are created and transmitted, and can be modified by the receiver as required. Text messages and preformatted messages are sent as well as graphics: orders, overlays, spot reports, call for fire, medical evacuation (MEDEVAC) reports, situational reports, etc. Soldiers receive visual information from reconnaissance and surveillance robotic systems and unmanned aerial vehicles, and sensory input from unmanned sensors.
- Leaders use a leader tablet/device for mission planning and course of action analyses via constructive simulations; this tablet also interfaces with the Soldier system.
- Built-in sensors monitor health status, expenditure of ammunition and water, and remaining battery power.
- The wearable computer records and saves information on individual and unit status, communications, digital messages, etc.

If the company had been equipped with this Ground Soldier System (GSS), how might AARs change? What additional training aids would trainers have to facilitate the AAR? What additional information might they have about the mission that would provide insights into what happened and why it happened?

The purpose of this report is to examine and recommend ways that the GSS can be used to enhance and facilitate an AAR at the company level and below in field exercises. It is assumed the trainer wears the system during the training exercise or military operation. Specifically, the report examines two ways the GSS could be used to support the AAR process.

- How the operational capabilities specified for the extant GSS can be used as AAR aids for operational missions and/or live-training exercises in a local training area without special training instrumentation or support capabilities. These capabilities could assist small-unit leaders conducting informal AARs.
- What embedded or automated aids could be added to the GSS or generated from the system's digital and networked capabilities to enhance the AAR process. An instrumented training environment and/or a training analysis support facility might be needed to generate some of these AAR aids for the trainer. No technical solutions are proposed, only AAR concepts are presented.

Military training and doctrine literature on AARs is summarized as well as research efforts on "automated AAR tools" that have been created and used for constructive and virtual training simulations. These concepts are examined for their potential application to the live training and operational environments. This report does not address GSS AAR applications in the virtual and constructive training environments.

Literature on graphic displays is reviewed in order to identify principles for generating effective computer-generated graphical and tabular display AAR aids. In addition, and perhaps of most importance, results from interviews with observer/controllers (OCs) at the Joint Readiness Training Center (JRTC) are presented. In 2000, these OCs worked with a platoon equipped with a prototype of the GSS. This was version 0.6 of the Land Warrior (LW) system, a predecessor to the GSS. The LW-equipped platoon participated in a culminating exercise at JRTC. The intent of the OC interviews was to determine what the OCs typically stressed in their AARs, and how the OCs would use a system such as the LW to assist them in their AARs.

Soldier System Capabilities and AARs

To provide feedback in an AAR that will help improve unit performance, any trainer must be aware of what happened on the battlefield and understand why it happened. Such information and knowledge can come from many sources: personal observation by the leader, observation by others, radio communications, information from unit members and members of the opposing force during the AAR process itself, physical records (ammunition expended, damage to equipment/property), etc. With digital systems as major components of tactical equipment, a new source of AAR information enters the picture --- information from the system itself.

The report examines how leaders, trainers, instructors, external evaluators, and OCs can enhance AARs when working with dismounted units and Soldiers who are equipped with digital systems such as the LW system or the GSS.[1] The generic word "trainer" is used in this report to refer to the individuals who lead the AAR discussion with the unit, whether it is the squad leader who is training his squad or an external evaluator for a battalion level exercise. A more specific phrase will be used where appropriate, as when results from the OCs at the Joint Readiness Training Center (JRTC) are presented, or when prior research is discussed.

Some mechanized and armor brigades and battalions have digital systems that comprise the Army Battle Command System (ABCS). These automated systems include, among others, the Maneuver Control System (MCS), the All Source Analysis System (ASAS), and the Force XXI Battle Command Brigade and Below (FBCB2). A special Center for Army Lessons Learned (CALL) Newsletter (2001) shared lessons learned by COL Lynch, the commander of the 1st Brigade Combat Team, 4th Infantry Division, during his command of the Digital Brigade

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[1] In this report, digital systems for dismounted Soldiers are referred to as both Land Warrior (LW) and the Ground Soldier System (GSS). Until 2004, the name Land Warrior was used. In 2004 the Ground Soldier System label was introduced and used to designate the final version of the Land Warrior system. However, a Stryker Combat Team will be equipped with a version of the Land Warrior system in 2006. Whenever the reference is to the system that existed prior to 2004, only the Land Warrior name is used.

Combat Team and participation in the Joint Advanced Warfighting Program (JAWP). The observations made by COL Lynch covered a two-year period from 1997 to 1999. Although the CALL Newsletter typically referred to battle staff operations, generic points made regarding digital systems apply to digital systems for the dismounted Soldier. However, only the statements made regarding AARs are referenced in this report. One thrust was the need to access quickly what individuals were seeing at critical points in time.

> The major difficulty with battle staff training is the overhead required to plan, conduct, and provide an after-action review (AAR) of the training event. We must develop a low overhead driver for digital battle staff training. ... In line with the low overhead driver, we must have a digital AAR capability. After the battle staff training session, we must be able to "go back in time" and see what information was available when (and where) as part of the AAR. Snapshots of all the boxes must be available (what was the operator on screen "X" looking at time "Y") for the AAR. (p. 10)

COL Lynch also stressed the need for OCs to be experts with the digital systems used by the unit they are training/evaluating.

> All training must be evaluated. We must develop a core of "digital O/Cs" (observers/controllers) who have had personal experience in developing, training, and fighting with digital systems. These digital O/Cs must be present to help commanders develop their training programs, and to evaluate training as it is conducted. They must be there to facilitate AARs, and to capture lessons learned and feed them back into the next training cycle. (p. 10)

The GSS provides new opportunities for a trainer to obtain relevant battlefield information as well as challenges to obtaining that information. The system itself, when worn by the trainer, can be used as a means of monitoring battlefield actions, in real-time; actions that are not directly observable. The trainer can track certain types of information with his own GSS during a mission and use information stored on his computer, as desired, in the AAR. In this mode, the trainer's actual GSS system can be an invaluable AAR aid, providing capabilities that do not exist with current Soldier equipment.

Even with the enhanced operational capabilities provided by the GSS in conjunction with the traditional modes of direct observation of performance and listening to communications, trainers may not have the complete picture of what happened on the battlefield and why. Direct observation does not always tell the trainer what Soldiers are doing with the system interface and whether they are using the system to the best advantage. Consider the variety of ways Soldiers could be using their system: they could be looking at an overlay on the map; they could be preparing to send a message; they could be monitoring their squad leader's movements; they could be reading a message or a fragmentary order; they could be observing the environment with their thermal weapon sight; they could be checking the status of their battery; they could be using the multi-function laser to determine distance to a potential target; etc. In each of these examples, the Soldier is looking at his helmet-mounted or perhaps a wrist display, but an external observer has no means of distinguishing among these different activities. This raises the

question of what information might be desirable to store on a Soldier's computer for later access and transformation into AAR aids.

Because GSS Soldiers are on a wireless local area network (WLAN), there is potential for embedding additional capabilities within the GSS computer that will, in turn, enable the trainer to better track Soldier and leader use of the system. Such digital information could then be converted into appropriate AAR aids, much like what is done with AAR aids that support simulation exercises (Morrison & Meliza, 1999).

The GSS is both a weapon system and a command, control, communications, computers, and intelligence (C4I) system. The training community in the Army has recognized that new system capabilities will have an impact on how performance feedback can be provided. In response to a request from the Training and Doctrine Command (TRADOC), Brown, Nordyke, Gerlock, Begley, and Meliza (1998) studied the impact of force modernization on the jobs of OCs and analysts at the Combat Training Centers (CTCs) and for trainers at home station. They concluded that without upgrades to the tactical engagement systems (TES) and instrumentation systems (IS) at the CTCs, the control and feedback requirements imposed by force modernization will "overwhelm OCs and TAF [Training Analysis Facility] analysts" (p. viii). New workload and control tasks could divert trainers from their primary responsibilities of observing and coaching units and leaders. Thirteen strategies were recommended as ways to reduce the workload on the OCs and the TAF analysts. Neither the GSS nor the LW system was specifically included in the detailed analyses. However, most relevant to these systems were recommendations to automate C4I information, data collection and control, tracking of player activities and equipment resources, TES system monitoring, and AAR preparations.

It is clearly acknowledged that not everything critical to an AAR can be automated. The human element, the expertise of the trainer plus the input from and dialogue with unit members, is essential no matter how much information or data can be automatically compiled. Input from the trainer and the unit is requisite to determining "ground truth," why things happened, and how to improve. AAR aids are not requirements; they are simply tools that may be used during an AAR. The trainer must determine what information and displays support the central training points to be made. He should select what will enhance the AAR and will benefit the unit being trained; not use an AAR aid because it exists.

Four sources of information were used for this report: the training and doctrine literature on AARs, work on automated AAR aids for training simulators such as the Close Combat Tactical Trainer (CCTT) and the Simulation Networking (SIMNET) plus other research regarding field AARs, professional literature on creating effective information and data displays, and interviews with the JRTC OCs who observed the LW platoon in 2000 during the Joint Contingency Force Advanced Warfighting Experiment (JCF AWE). The relationship between the source materials and the suggested AAR enhancements is shown in Figure 1.

These topics are presented in the report in the sequence given in the top row of Figure 1. The Army training and doctrine literature is examined first, followed by automated AAR aids, and then literature on displaying graphical and tabular information. The results from the JRTC OC interviews are presented last.

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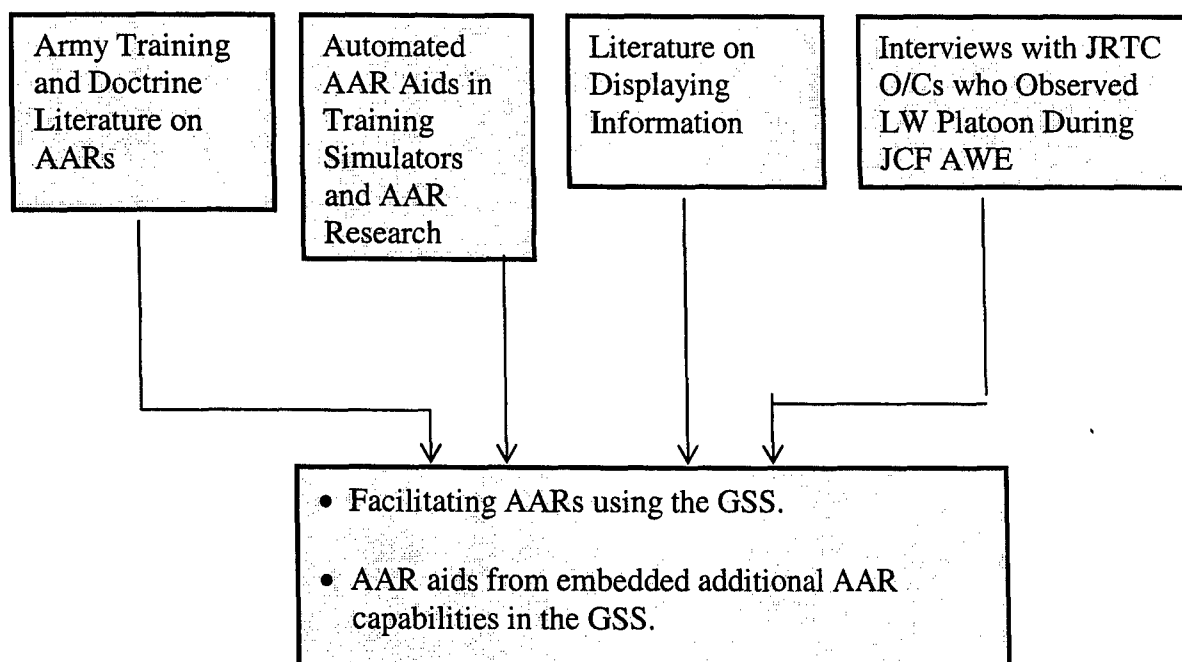
Figure 1. Source materials.

The After Action Review (AAR)

Purpose of the AAR

The AAR is the primary means of providing feedback after unit training (Department of the Army [DA], 1988, 1990, & 1993, i.e., Field Manual (FM) 25-100, FM 25-101 and Training Circular (TC) 25-20, respectively). "An after action review (AAR) is a professional discussion of an event, focused on performance standards, that enables Soldiers to discover for themselves what happened, why it happened, and how to sustain strengths and improve on weaknesses" (DA, 1993, Chapter 1, p. 1). These three areas – what happened, why it happened, and how to sustain strengths and improve weaknesses – constitute the foundation of the AAR. Establishing what happened, "ground truth," includes the viewpoint of the opposing force. The trainer is encouraged to relate tactical events to subsequent actions (DA, 1990). Identifying what went right and what went wrong is part of determining which strengths should be sustained, the weaknesses to eliminate, and how training could be executed differently to improve performance. The trainer is encouraged to explore alternative courses of action with the unit to determine what might have been more effective and how the unit could have executed aspects of the mission better.

The ability to conduct an effective AAR takes time to develop, as it is not easy for the trainer to "shift" from a critique mode to a Socratic dialogue. The trainer's challenge is to develop techniques that elicit the full participation of the unit to think through alternative courses of action. These points are stressed in this report as it is recognized that the proposed aids

support the trainer during the AAR process, and that the trainer is central to effective selection and use of these means. AAR aids can be used effectively, not at all, or ineffectively.

Much of the Army training and doctrine literature on AARs focuses on how to make the AAR a professional discussion, how to plan and prepare for the AAR, the length of the AAR, and the logistics of executing the AAR. Some general guidelines are presented on developing AAR aids, with the statement in TC 25-20 that "The bottom line is to only use a training aid if it makes the AAR better" (DA, 1993, Chapter 2, p. 4).

It is of interest to note that AARs have not been around forever. Meliza and Morrison (1999) indicated that AARs emerged in the mid 1970s. Meliza and Morrison described several phases of AAR development. First, there were training programs developed for optically based tactical engagement systems (TES). These were followed by modifications in the AAR process to support the Multiple Integrated Laser Engagement System (MILES) and training at the Army's National Training Center. More recently are efforts to capture and synthesize electronic data for AARs that support training simulations, specifically the mechanized/armor simulations of the SIMNET, the CCTT, and dismounted virtual simulations. In addition, there have been efforts to standardize AAR products to insure a minimum set of AAR aids can be made available easily and quickly.

AAR Content

General guidelines regarding AAR content are in the military training and doctrine literature (DA, 1993, 1990). The AAR should be based on the mission conducted by the unit, specifically the training and evaluation outline (TEO) as reflected in the Army Training and Evaluation Program (ARTEP) mission training plan (MTP). The specific training objectives should be reviewed and discussed, along with the commander's mission and his intent. When appropriate, the opposing force (OPFOR) commander's mission and intent are covered. Other topics specifically mentioned as key points for the AAR are the relevant tactics, techniques and procedures (TTP), a summary of what happened, why it happened, how to improve, what to sustain, force protection issues, and any fratricide incidents.

Other examples of activities the trainer should address include the issuance of orders, troop leading procedures, communications, contacts with the opposing force, resupply, and intelligence preparation of the battlefield. The trainer should record events and the date and time when they occurred. This date-time record helps to coordinate observations with other trainers.

Typically an AAR will begin with the key tasks or training objectives and the mission, followed by the trainer focusing on the key issues and training points. This second phase of the AAR is the longest phase and is where the trainer's ability to facilitate a dialogue with the unit is critical. This phase is also where AAR tools and aids can assist the trainer and unit to better understand what happened and why it happened. The AAR typically ends with what tasks to sustain and what tasks to improve.

AAR Training Aids

This report deals with AAR aids that can assist the trainer during the AAR with a GSS-equipped unit. Obviously, a particular aid does not guarantee an effective AAR. A particular display or chart could be used to critique unit performance, rather than to elicit from unit members a better understanding of what happened and how it happened, and of alternative courses of action. Factors to consider regarding training aids (DA, 1993) are: what points to make and what aids will help make the points, the number of points a given aid illustrates, if there are special requirements, whether unit members can hear and/or see the aid, whether the actual terrain or equipment can be used instead, and lastly if the aid is really necessary.

Basically, the trainer is given considerable freedom in developing training aids for the AAR. A common theme in the literature is to use some form of representation of the terrain during the AAR: the actual terrain, a drawing, sand table, terrain model, map, map overlay, etc. (DA, 1990). Other suggestions are to use recordings of radio communications (e.g., fragmentary orders, violations of communication security). Charts can be used for important data such as artillery missions fired and the effectiveness of artillery during the mission, and kill ratios. AAR aids can be designed to focus on different aspects of the mission, so the trainer can select from a pool of resources during the AAR. For example, kill ratios may be important to show in some missions and not in others.

Automated AAR Aids in Training Simulations

As cited by Meliza and Morrison (1999), there has been considerable effort in developing automated AAR aids to complement training simulations. It is acknowledged that training simulations represent a "closed" environment, as compared to field training environments. Complete ground truth is known through digital and audio records. Exact locations of the enemy (typically computer-generated) and friendly forces can be determined. The times of events are recorded. Voice recordings are made. The exercise, or exercise segments, can be replayed for review if desired. Stealth views are possible. Everything can be tracked and documented, if necessary. This closed environment provides considerable flexibility for generating AAR aids. However, there are technical and time factors that must be considered when an overwhelming amount of information is available. Thus some of the critical issues with automated AARs that support simulations have been how to select what to display and how best to display this information.

Common Automated AAR Aids

An exhaustive review of the "automated AAR" literature is not presented here. Some of that literature focuses on the technical aspects of how to generate aids from simulations and the interfaces that have been developed to help the trainer prepare the AAR. This report describes the variety of AAR aids that have been developed and used to support simulations, primarily SIMNET and CCTT, and more recently the dismounted virtual simulations conducted in the Soldier Battle Laboratory at Ft. Benning, GA. The concepts underlying many of the AAR aids developed for these simulations continue to evolve as technical progress in generating aids is

made[2]. Technical progress has typically resulted in greater flexibility in the aids. It is useful to note that some of the aids for the mechanized/armor simulations would not necessarily be as appropriate for dismounted simulations.

Much of the research and developmental work on AAR aids for mechanized and armor simulations was initiated by the Army Research Institute (Brown, et al., 1997; Brown, et al., 1996; Meliza, Bessemer, Burnside, & Shlechter, 1992a; Meliza, Tan, White, Gross, & McMeel, 1992b; Schlecter, Bessemer, Rowatt, & Nesselroade, 1994). Recently, attention has been given to AAR aids for virtual dismounted training simulations in the Soldier Battle Laboratory at Ft. Benning, GA (Gately, Watts, & Pleban, 2002; Gately, Watts, Jaxtheimer, & Pleban, 2005; Knerr, Lampton, Martin, Washburn, & Cope, 2002; Campbell, Knerr, & Lampton, 2004) as well as aids appropriate for digitized units (Leibrecht, Lockaby, & Meliza, 2003; Leibrecht, Lockaby, Perrault, & Meliza, 2004).

The early work on automated AARs for Army simulation systems was called the Unit Performance Assessment System or UPAS (Meliza, Bessemer, et al, 1992; Meliza & Tan, 1996; Meliza, Tan, et al, 1992). UPAS was periodically updated in response to user feedback. A follow-on to UPAS was the Automated Training Analysis and Feedback System or ATAFS (Brown, et al, 1997). The tool developed by Gately et al. (2002, 2005) is known as ViSSA (Virtual Soldier Skills Assessment). The tool cited by Knerr et al. (2002) and Campbell et al. (2004) is DIVAARS (Dismounted Infantry Virtual After Action Review System). Although the early displays have been refined, the basic concepts remain, as do the names associated with various AAR displays. Listed below are the displays and display capabilities used in the research cited here. Practically all aids present the time or duration of the events depicted. In addition, AAR software is designed so the trainer can select specific segments of the mission for the AAR discussion.

- **Exercise Timeline**: Multiple timelines on a single display that show the times when critical events relating to movement, direct and indirect fire engagements, and communications that occurred over the period of the exercise/mission. The intent of the timeline is to illustrate how well a unit coordinated movement and employment of weapons in conjunction with other tactical events.
  - Movement examples are: time last vehicle crossed the line of departure or time when first vehicle was at the objective.
  - Engagement examples are: first friendly fire delivered; first enemy fire delivered, artillery impact, enemy vehicle destroyed.
  - Communication examples are: call for fire, orders, reports.

- **Snapshot**: A freeze-frame of the unit's (each vehicle or individual) position, friendly or enemy, on the simulation terrain map at a specific (critical) point in time. Snapshot can also display unit control measures. With vehicle icons shown on this display, the orientation of the chassis and gun tube are portrayed. With individuals there is also an attempt to show

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[2] Early versions of AAR simulation aids did not have multitasking capability and aids could not be generated quickly. Later versions have multi-tasking capability and a knowledge database that automatically generates aids during exercises, thereby providing a pool of possible AAR aids.

orientation. If there is sufficient detail in the terrain, the snapshot can also be used to show line-of-sight vectors (typically used with vehicles).

- **Battle Flow**: Provides a line trace of the unit's (vehicle, Soldier) movements at specified time intervals on the simulation terrain map. Trace lines on the map allow discussion of route/navigation to the objective, unit formations, use of terrain, unit movement with respect to control measures, etc. Sometimes this is called a "snail trail." It can be animated.

- **Plan View Display**: Traditionally, this is a top-down two-dimensional view and playback of either the entire exercise or segments of the exercise on the simulation map. **Playbacks** can synchronize audio of communications between vehicles/units/individuals with key events. Typically, playbacks can be at different speeds, can stop, pause, and go in reverse. Trainers can mark events during the exercise so the trainer can go directly to them in the AAR. For vehicles, playback can include animated replay of vehicle movement, gun tube orientation, and firing. Control measures can be displayed.

- **Viewing Modes**: Included in this category is the traditional two-dimensional plan view display. Three-dimensional (virtual) views are also possible, with the trainer selecting the desired perspective or viewpoint for the scene. For example, the playback can be from the vantage point of a friendly or enemy position, so everyone sees what that position (individual, vehicle) saw. The playback view can also provide a broad or general perspective, zooming in or out as desired. For dismounted virtual simulations, there is the capability to show/replay the movement of entities (Soldiers) in the various floors of a building without other floors or the external structure of the building blocking the view. DIVAARS has this capability. All these different viewing modes allow each participant in the AAR to view the exercise from perspectives not possible during actual mission execution.

- **Stealth View**: The stealth view allows the trainer to move freely throughout the simulation environment (on the ground, in the air, pass through objects, etc.) to observe activities from various perspectives, some not available in real life, while not being seen by the exercise participants.

- **Fire Fight**: Fire fight is a two-dimensional depiction on top of the map or grid coordinate system that shows the direct and indirect fires on the battlefield during a specified time period. The trainer and AAR participants can determine who shot who, the origin and destination of the weapon firing. They can also determine if fires were massed, whether a unit fired in its assigned sector, etc. Various colors and graphic techniques are used to illustrate the type of fires and outcomes. For example, in ATAFS, dotted lines between vehicles indicated a miss; solid lines indicated a hit. Circles indicated indirect fire. Blue was used for friendly fires, red for enemy fires. Solid colored vehicles (red or blue) were operational; vehicles with only a colored outline were disabled.

- **Tables and Graphs**: Tables and graphs could be tabular summaries of data or statistical type graphs. The most common example is data on target engagements such as ammunition expended, number of shots and number of kills by time, friendly vs enemy, and/or by unit/vehicle/weapon system. This particular type of information has sometimes been labeled

the **Battle Scorecard**. Other examples are the **Master Event** list with associated times, rates of movement, distance of kills, various types of killer-victim scoreboards, percentage of time friendly units were stationary, etc. The exercise timeline cited earlier could be considered a type of statistical AAR aid.

- **Socratic Questions or Key Points for AAR Discussion:** Sometimes AAR aids have suggestions for Socratic-type questions that the trainer could ask. However, in theory, it would appear that key points for discussion could be displayed on practically any aid. The questions that appear are based on rule sets within the automated AAR software and are keyed to the different types of aids. Typically the software allows the trainer to alter the text to adapt to the particular exercise. Examples of questions in the Brown et al. (1996) report are:
  - *Fire fight display*: "How well did the tank commander initiating the action return or initiate fires?" "Did he seek cover and concealment?" "How well did his perception of the threat compare to the actual threat?"
  - *Kills vs rounds expended graph*: "How well did the platoon conform to the battle drill order?" What does this chart reveal about platoon fire control?"

More recently, researchers have developed AAR questions that relate to the extent the unit or individuals exploited digital system capabilities, such as FBCB2, during training exercises (Leibrecht et al., 2003). Examples of these questions are "How did your use of FBCB2 impact your mission execution?" "Did you use any FBCB2 capabilities in your mission rehearsal?" and "Did anyone lose SA during the operation? What troubleshooting techniques did you apply?"

Several of the AAR aids used in conjunction with training simulations have animated, dynamic (versus static or summary) capabilities. The plan view display or replay (either a two-dimensional top-down view or a virtual presentation) as well as the stealth view are examples of this capability. The ability to show where Soldiers move and fire during an urban operations exercise is another example. On the other hand, battle statistics tables are static presentations.

With ViSSA, the intent is to generate AAR aids that monitor and infer Soldier and small-unit leader decision-making skills within virtual simulation environments (Gately et al., 2002, 2005). The procedure is accomplished by linking unit or Soldier behavior to decisions regarding route selection, use of cover and concealment, and timelines. Typically this is done prior to the exercise, where the trainer identifies the conditions and resulting actions that are associated with decisions. In this particular system, the trainer can also mark or tag significant events as they occur, allowing the trainer to link, when desired during the AAR, to the displays and audio related to these events during the conduct of the AAR.

Leibrecht, Lockaby, Perrault, and Meliza (2004) described AAR systems that can record digital data streams from digital systems, and save the output in a relational data base. They also indicated that some of these systems have the capability to capture the screens viewed by the system operators.

Relationship between AAR Aids and Army Training Standards

Melisa et al. (1992a) analyzed the relationship between MTP standards for armor platoons and the five types of AAR aids in UPAS. This information is displayed in Table 1. Common to many of the performance categories listed are movement (including spatial relationships), firing, and control measures. Locations, communications, and cover/concealment are also cited. These MTP topics are obviously of concern to trainers working with armor platoons, and as shown in Table 1 are displayed in some manner with the AAR aids.

Table 1

Relationship Between MTP Standards and Five AAR Aids in UPAS

Performance Measure Categories in MTP Standards	AAR Aid in UPAS				
	Plan View	Snapshot	Battleflow	Exercise Timeline	Tables/ Graphs
Movement & Firing Events	X			X	
Movement & Control Measures	X	X	X	X	
Movement Techniques & METT-T	X	X	X	X	
Movement & Cover/Concealment	X	X	X		
Weapon Orientation	X	X			
Halts & Cover/Concealment	X	X	X	X	
Spatial Relationships among Moving Vehicles	X	X	X		
Rate of Movement	X		X	X	
Friendly & Enemy Fires	X				X
Location, Control Measures and Communications				X	
Firing Events and Communications				X	
Locations of Friendly Indirect Fire and Enemy Positions					X

Note. Based on Table 5, page 30 of Melisa et al., 1992a.

Table 1 also shows overlap in the information displayed with the different aids. Consequently a trainer will probably select those which best fit the training event at hand. Melisa et al. (1992a) made some critical distinctions among these different AAR aids, which should be considered by a trainer when planning the AAR. For example, only the plan view shows movement of vehicles and firing engagements with continuous updates. Information on movement techniques is also displayed with the snapshot and battleflow. The exercise timeline provides information about the temporal relationship between movement and engagements, but no terrain features are displayed, as is the case with the plan view. Neither the battleflow nor the snapshot provides information on firing engagements. Tables and charts can provide precise information on time, volume, and effectiveness of fires. With the plan view, the user can "see" firing information in a dynamic, but not a summary, mode. Meliza et al. state that any aid could be used to estimate the distance between control measures and vehicles.

Effectiveness of AAR Aids

Shlechter et al. (1994) had Armor School instructors, in the basic and advanced officer courses who used SIMNET in tactics training, evaluate the training value of different UPAS displays (battleflow, exercise timeline, snapshot, plan view, and table/graphs). The results of this evaluation showed how feedback from military personnel influenced the features of automated AARs during the research and development phase. In this assessment, two formats of the plan view display were compared, a slide show format and an animated replay. The AAR displays were prepared to represent each of four missions: platoon tactical road march, platoon force-on-force exercise, company attack and company defense.

Although instructors liked having both the animated replay and the slide show formats of the plan view display, the slide show format was preferred. The slide show format was preferred because of its instructional value and the fact that it took less time than the replay. (At that time, there was no fast replay in UPAS nor could an instructor select sections of the animated replay.) The slide show format was also preferred because the instructors could select what they wanted to show vice showing all in the animated replay. Both methods were liked because of the system control features associated with these two display formats.

With regard to the other formats, some instructors preferred the battle snapshot (with and without a line-of-sight feature) and the graphics to the battleflow and the exercise timeline. However, others did not feel that the exercise timeline and battleflow displays provided as much instructional value.

One improvement recommended by the majority of instructors was the need for a fast forward mechanism – a feature incorporated in later automated AAR aids. Another was the need for replay of communications. Communications replays are now available as well. Training considerations also influenced instructor preferences, e.g., ease of use and good use of AAR time. Thus instructors preferred features that allowed them to identify vehicles and critical incidents easily, and allowed them to progress quickly through the mission.

A particularly valuable phase of the Shlechter et al. (1994) research was the validity check. In this phase, they recorded requests that Army Officer Advanced Course instructors made for different UPAS AAR aids during the tactical training exercises. The snapshot display was preferred for most exercises, as it constituted 40% of the 220 requests. However, some other displays were preferred for specific missions. The exercise timeline was preferred for the troop leading procedures, and battleflow requests were more frequently preferred for the tactical road march than the other exercises. Again, instructors indicated a need for feedback on communication. They also wanted feedback on fire-fight performance.

Knerr et al. (2002) had Soldiers participate in dismounted Soldier, urban operations simulations at the Soldier Battle Laboratory at Ft. Benning, GA. AAR aids included: visual playbacks, different view modes (two-dimensional, from any Soldier, etc.), battleflow/movement markers, digital recording and playback of audio communications, ability to view floors of buildings in playbacks, and various types of statistical graphics with target engagement information. In general, Soldiers reacted positively to the automated aids, indicating the aids

were effective in displaying movement, in determining what happened and in understanding why it happened, and in determining the sequence of events.

Training Feedback Aids for Field Exercises

Some Army training areas are instrumented so that, at a minimum, video replays of live day and night exercises are possible during AARs. These features exist within urban operations areas at the JRTC at Ft. Polk, LA and the McKenna military operations in urban terrain (MOUT) site at Ft. Benning, GA. In addition, at the McKenna MOUT site, when Soldiers and the opposing force are appropriately instrumented, it is possible to obtain three-dimensional and two-dimensional replays similar to those described for virtual simulations.

In the Brown et al. (1998) study, two force modernization systems that relate to the GSS were examined: future fire control systems for small arms and C4I (command and control, communications, computers and intelligence) systems such as the MCS (Maneuver Control System), ASAS (All Source Analysis System), and FBCB2. Although these C4I systems are at battalion and brigade levels and this report focuses on squad, platoon and company levels, many of the implications regarding digital systems are the same at higher and lower echelons. The main points made by Brown et al. are included because they provide a broader picture on the training feedback requirements associated with the GSS.

Brown et al. (1998) and Brown, Anderson, Begley, and Meliza (1999b) indicated that current Combat Training Center (CTC) systems do not provide feedback on the location of rounds that missed a target, the type and amount of ammunition fired, and the type and amount of ammunition on hand, and there are limitations in simulating the effects of non-line-of-sight engagements with artillery and mortars. These limitations reflect the constraints of current current tactical engagement simulation (TES) systems. The Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI, 2004) is now sponsoring programs on TES and live instrumentation systems to provide this capability. However, until these capabilities are developed, live-fire AAR tools will not include automatic feedback on such engagements.

With regard to C4I systems, Brown et al. (1998) assumed that OCs and the Training Analysis Facility (TAF) analysts at JRTC could monitor blue force (BLUFOR) digital communications but that the instrumentation system could not time-stamp and collect all these messages. Thus the OCs and TAF analysts must manually transfer substantial amounts of information, which increases their workload. In addition, unless an OC continually observes an operator's activity at a computer screen for one of these battalion and brigade C4I systems, he does not know the decision tool the operator used, what messages he read, or how he applied information he received. To overcome this problem, Brown et al. suggest that the OC should elicit this information during the AAR process itself.

In addition, the authors (Brown et al., 1998) visited JRTC as part of their analytic effort. Several factors were noted which distinguish dismounted from mounted exercises at the CTCs. This is important because the mechanized/armor environment has been the primary focus of

automated AAR aids developed for simulations. They noted the following differences which could impact the type of enhanced feedback needed with the GGS and LW systems.

- Mission planning and preparation are more critical, particularly because the need to link-up with supporting vehicles for casualty evacuation and resupply leaves little room for error. Combat service support functions are emphasized at JRTC.

- Most light Infantry engagements at JRTC are measured in meters versus kilometers at other CTCs. For safety reasons, JRTC OCs perform intensive control actions during close engagements.

- OCs follow the unit closely. Instead of monitoring tactical nets they often "eavesdrop" or listen to the leaders' radio communications, and will transmit relevant information to other OCs to better understand the complete situation.

- The wooded terrain at JRTC can inhibit optimum functioning of the instrumentation system. OCs compensate for these limitations by sending their own reports to the TAF or manually recording the necessary information.

- There are some light Infantry weapons that are absolutely critical to battle outcome, but cannot be employed at JRTC because currently there is no associated TES capability, or the manning requirement would make coverage of these systems impractical. The MK-19 40mm grenade machine gun, claymore mines, M203 grenade launcher, and hand grenades were cited in the report.

- For some OC duty positions, the responsibilities for controlling units and collecting data over dispersed locations can limit their ability to coach and mentor.

- Battle damage assessments (BDAs) are not always viewed as critical to identifying unit strengths and weaknesses as this can often be accomplished through direct observation of leaders. However, such BDAs are useful in documenting unit performance and eliciting comments on strengths and weaknesses.

- The reporting load to the TAF is substantial. The OCs must radio large amounts of information to the TAF, typically at the end of the mission when the TAF analysts are trying to prepare aids for the Battalion AAR.

  Of particular relevance to the GSS and LW systems was the following paragraph:

  A few [JRTC] OCs have had experience with digitized communications. In these cases, the OCs and the TAF analysts did not have access to their own system for monitoring the flow of digital messages. Instead, the OCs asked their BLUFOR counterparts to print out copies of messages sent and received as a short-term solution. Better methods are required for OCs to monitor these messages in a less obtrusive manner. (Brown et al., 1998, p. 18)

In a later study, Brown et al. (1999b) found that the OCs preferred the TAF analysts to interact with the digital data stream and provide the OCs with relevant information. In summary, these reports point to some major challenges that new equipment presents to all trainers – the inability to observe all critical events, the abundance of information to disseminate and monitor, the difficulty in simulating force-on-force engagement outcomes with the variety of weapons and sensors available, and the complexity in isolating and disseminating relevant information for an AAR. Despite the attempts to reduce OC workload at the CTCs and to "automate" AAR aids, these aids do not replace the trainer's observations and the role trainers have in discussing and examining mission outcomes with the unit.

Although not cited in the Brown et al. (1998) report, with regard to the GSS it is reasonable to assume that current CTC AAR systems cannot track the sensor the firer used when engaging targets (e.g., daylight video sight, thermal weapon sight, aiming light). In fact, in a later report by Brown, Anderson, Begley and Meliza (1999a), possible AAR aids for the Land Warrior system were examined. None of these aids cited the ability to monitor the use of different sensors by the firer. Nor did they examine the possibility of modifying the system to enable the trainer to flag critical messages, fragmentary orders, or display screens in real-time in order to facilitate the AAR, as is examined in this report. The AAR aids focused primarily on feedback provided by tactical engagement simulation system information, embellished by graphical display of engagements on the map.

Displaying Information

Graphs can effectively display multiple dimensions which can be absorbed and understood quickly. Figure 2 below depicts the fate of Napoleon's army in Russia, and has been cited frequently as a superb example of graphic displays that describe and also help explain.

Tufte (1983) described the graph by the French engineer Minard in 1861, shown in Figure 2 above, as perhaps "the best statistical graph ever drawn" (p. 40). Minard, through a combination of a data map and time-series, shows the "devastating losses suffered in Napoleon's Russian campaign in 1812 (p. 40)." As pointed out by Tufte, what makes this graph so valuable is that it plots multiple variables in a two-dimensional space: the size of Napoleon's army over time – the approach and retreat from Russia, the Army's location on the European continent during the campaign, the Army's direction of movement both to and from Russia including that of auxiliary troops, the temperature, dates, and major geographic features. The distance traveled can be computed from the map scale. The size of the Army as it marched toward Russia is depicted by the gray band and also by specific numbers, starting with 420,000 men and ending with 100,000 when it reached Moscow. The dark lower band indicates the Army size, and path of movement as it retreated from Moscow, with only 10,000 men in Poland. The temperature line at the bottom of the graph indicates the progressively colder temperatures that occurred during the retreat from Moscow. In addition, the graph shows a sudden contraction in the Army's size after crossing the Berezina River during the retreat.

CARTE FIGURATIVE des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
Dressée par M.Minard, Inspecteur Général des Ponts et Chaussées en retraite.

TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro

X^bre = December   9bre = November   8bre = October
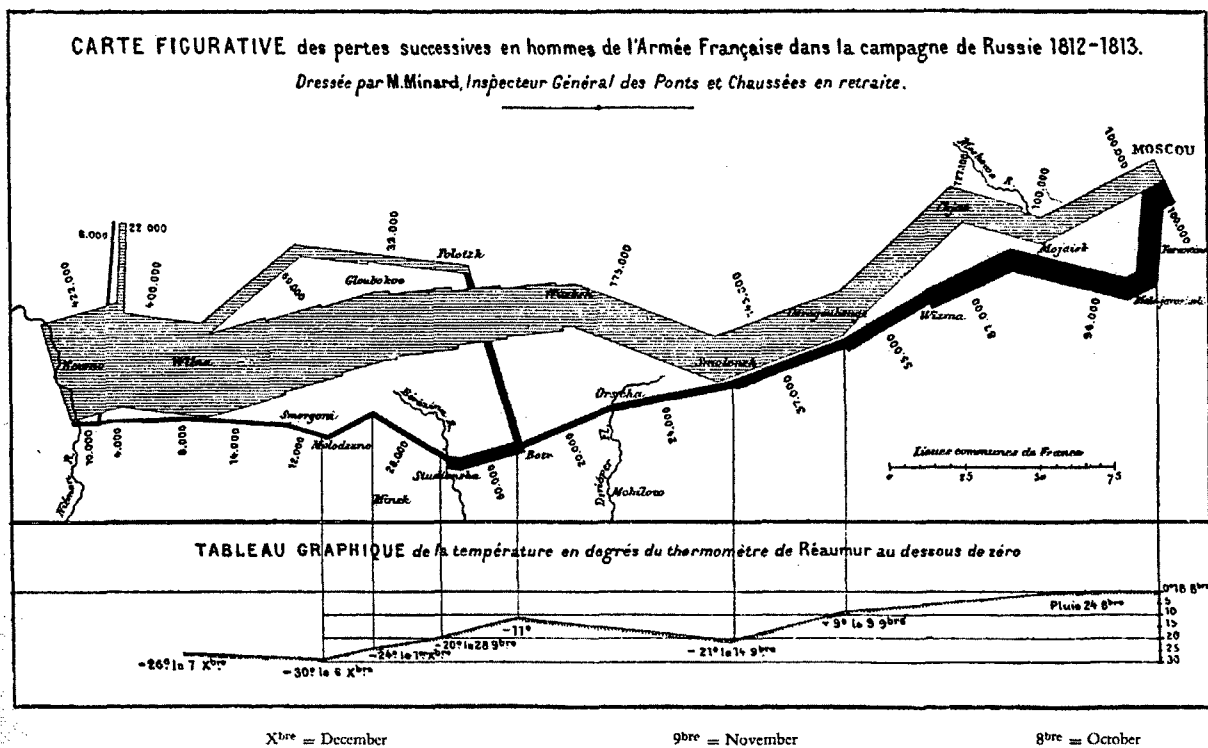
Figure 2. Minard's (1861) drawing of Napoleon's 1812-1813 Russian campaign.
Note. Presented in Tufte (1983) and Wainer (1997). [Copied from the first-author's personal copy of a reprint of the graph purchased from Graphics Press.]

Minard's graphic has direct relevance to graphics that could be generated for military AARs. Some of the critical dimensions in this graph, such as time and terrain, are central to AAR discussions. The graph indicates how a very carefully crafted graphic display can illustrate both what happened during a military operation and the factors contributing to the outcome. However, it must be recognized that Minard's graph was drawn about 50 years after Napoleon's campaign and represents a historical perspective on that critical event. We cannot expect AARs conducted quickly after a mission to show the same integration of critical events with such richness and clarity, but we can consider various ways of displaying events and which displays best help convey the desired training themes and objectives.

Many AAR training aids are graphics or tables. However, there are good graphs and bad graphs. Some graphs show clearly the important points; some do not. Graphs can be designed so the appropriate inferences or comparisons are drawn by the viewer, or they can hide or distort information. Relatively recently, there has been great interest in how to generate good graphical and tabular displays of information (Cleveland, 1994; Tufte, 1983, 1990, 1997; Wainer, 1997).

Often people think of graphics as a means of simply describing information or data, and perhaps as a means of telling a story. But Tufte and Wainer have drawn attention to how graphics can help identify causes of events as well. Both authors described how graphs have either described important historical events or led to important decisions. For example, Tufte

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(1983) cited that in 1954 a London physician, Dr. John Snow, plotted the geographical locations of deaths from cholera. This graphic led to the identification of a particular city pump as the source of the contamination, and explained how the cholera was transmitted and consequently how to prevent it. Wainer (1997) cited the work of Abraham Wald during World War II. Wald was trying to determine where to add extra armor to planes based on the location of bullets in returning aircraft. After he drew an outline of the planes, and marked the location of bullets in returning planes, he found that the "entire plane had been covered with marks except for a few key areas" (Wainer, 1997, p. 59). He concluded that extra armor should be placed in the few locations where there were no bullet marks, the assumption being that the planes that did not survive had been hit in the unmarked areas, and no additional armor was needed in the marked areas because those planes returned.

On the other hand, both Tufte and Wainer describe how incomplete graphical data contributed to the decision to launch the Challenger space shuttle (which exploded shortly after lift off). If a more complete set of launch data had been used, the decision to launch may not have been made. As stated by Tufte (1997), the shuttle example illustrates that "There are right ways and wrong ways to show data; there are displays that reveal the truth and displays that do not." (p. 45).

Some Principles for Creating Graphical Displays and Telling a Story

Tufte (1983) espoused concepts that can lead to good graphs and developed indices that can help distinguish good from poorer graphics. Basically, Tufte states that graphics should be used to show lots of data; that graphs should be data-dense and avoid superfluous or distorting information, words, and pictures. Two-dimensional surfaces can often be used to show multiple variables or outcomes. However, if other techniques are better, graphics should be avoided. Most likely, many of the graphs on the front page of newspapers such as *USA Today* would not meet Tufte's criteria.

In summary, "Graphical displays should
- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production, or something else
- avoid distorting what the data have to say
- present many numbers in a small space
- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- serve a reasonable clear purpose: description, exploration, tabulation or decoration
- be closely integrated with the statistical and verbal description of the data set." (Tufte, 1983, p. 1).

Tufte (1983) and Wainer (1997) cited some principles that help discriminate good from less good graphs. Tufte (1983) used such phrases of "data density," "data-ink ratio," and "chart junk" to characterize concepts that can be applied to assess the quality of a graphic. Graphics can be assessed in terms of "data-density," an index which reflects the number of data points in

the graph compared to the square area of the graph. For example, a Powerpoint or Excel chart with just two vertical bars has a very low data density. Tufte (1983) showed many ways in which graphics can be shrunk with little loss in information and legibility. In addition, much of the ink on a graphic should present data; graphics can be assessed in terms of their "data-ink" ratio. A graph with a high data-ink ratio would be one where nothing or very little on the graph can be erased without losing information. Often you will see graphics with redundant "data-ink" or "non data-ink." Another Tufte concept is "chart-junk. " Chart-junk should be avoided, e.g., pictures, crosshatching, unnecessary grids, lots of words. Sometimes if many words or labels are necessary, a table should be used instead. All these techniques are means of making the data evident and clear to the viewer.

One of the points made by Wainer (1997) regarding poor displays is that they emphasize the trivial and ignore the important. Another point is that if a graph or display format has worked well in the past, don't find a new display, but continue to use the one that works. Wainer also states that complete and unambiguous labels help direct the viewer's attention to the principal idea of the display.

Application to AAR Display Aids

Many of the graphical display principles cited by Tufte and Wainer have direct application to AARs, and many of these principles are reflected in the AAR displays used to support training simulations. We examined some of the major principles which are very relevant to using static displays as AAR tools.

First, even the experts in graphic design do not advocate graphs or tables to illustrate everything. Other techniques may work better. For example, a trainer should not spend time making a chart or graphic that shows very little information.

Second, having displays that enable the unit and unit leaders to consider and compare different pieces of critical information, and that show the data at several levels of detail are principles that are particularly relevant to AARs. Comparing pieces of information in an effective manner is critical to AARs. The location of different elements of the force, the timing of critical events, the length of time required to execute various actions, and alternative routes to the objective are all examples of comparisons and interrelated activities that are pointed out during AARs. Discussing the mission from different levels of detail is frequently done within AARs, (e.g., different echelons, a detailed analysis of a specific fire fight and its impact upon the mission as a whole). Graphics can be used to help put such mission events in context.

Third, important information should be shown in a graphical display. This may not be easy as the most easily accessible data may not be the most important. This is probably one of the most challenging concepts in creating automated AAR displays - how to filter the volume of information that is available in order to pull out the information that will help to effectively describe and explain/understand what happened. Is it possible to know in advance of a mission what aspects will be important, so the automated aids are appropriate for the AAR discussion? How can volumes of information, such as voice communications, be filtered to highlight the

critical communications? One approach used in training simulations is to have the trainer tag significant events as they occur for possible discussion in the AAR.

It is clear that good graphics often take time to create. The graphics in the Wainer book and the Tufte series of books clearly illustrate this point. Many of their good graphics are not generated by common statistical or spreadsheet packages. This lends support to having a pool of graphic or tabular formats that have been developed and refined over time, and that have been demonstrated as valuable ways of showing critical points within an AAR. Ideally some formats could apply to the majority of missions. Some might primarily describe events; others might help the unit better understand how and why events happened.

JRTC OC Interviews

The interviews with the JRTC OCs were conducted to learn what aspects of a mission they typically stress and what aids they use in the field to conduct AARs. We were interested in their reactions to various graphics we had generated that highlighted use of LW capabilities and also reflected multiple dimensions of potential interest in an attempt to show critical relations among battlefield dynamics. Lastly, we were interested in how they might design a Soldier system to provide them with information they could use in an AAR.

Scope of the Interviews

The LW system was employed by a LW-equipped platoon at the JRTC in September 2000 as part of the JCF AWE. The JRTC OCs were in a unique position to provide valuable information regarding AARs with LW-equipped units, as the JCF AWE was the only external assessment of this LW-equipped unit. In addition, the JRTC OCs are superb at the craft of conducting AARs and have the advantage of observing many units at the JRTC.

Interviews were conducted with JRTC OCs who worked with the LW platoon during the JCF AWE. The interviews covered five broad areas. The interview protocol is at Appendix A.

- The topics the OCs typically address during an AAR.
- How they address these topics - from personal observation or from information provided by the TAF. This included how they present information – visually or orally and, if visually, by what means.
- How they would use the LW system itself to assist them in an AAR. Here the OCs were told to assume they were wearing a LW system, and asked what they would monitor.
- What additional information should be captured or retained from the LW system for an AAR. (This would require modifications to the LW system used at JRTC.)
- Reactions to sample displays/graphics that could be used during LW AARs.

OC Background and Experience

Ten OCs assigned to the LW platoon during the JCF AWE were interviewed. Four were force-on-force OCs; six were live-fire OCs. OC positions ranged from squad to platoon/

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company. Half had served in other OC positions. As indicated in Table 2, the live-fire OCs were more experienced than the force-on-force OCs, having served as a JRTC OC for twice as long as the force-on-force OCs. As a group, the live-fire OCs were very experienced, senior OCs, and some were at the end of their JRTC assignment. Only two had been a member of the opposing force (OPFOR) at JRTC. All but two had attended the JRTC OC Academy.

Table 2
Background Information on the JRTC OCs

OC Background	Force-on-Force	Live-Fire	Total
# of OCs	4	6	10
OC position	Squad 2 Platoon PSG 1 Senior Plt OC 1	Sqd 2 Sqd/Plt 2 Plt 1 Plt & Co 1	Sqd 4 Sqd/Plt 3 Plt 2 Plt/Co 1
# who had held other OC positions	1 of 4	4 of 6	5 of 10
# rotations observed prior to JCF AWE in Sep 2000	Mean = 9.5 Range: 4-18	Mean = 21.8 Range: 16-30	Mean = 16.9 Range: 4–30
# who had served in the JRTC OPFOR	1 of 4	1 of 6	2 of 10
# who attended the JRTC OC Academy	4 of 4	4 of 6	8 of 10
# who received LW training prior to JCF AWE	4 of 4	6 of 6	10 of 10
# who worked with the LW system during the rotation	0 of 4	4 of 6	4 of 10

All had received some training on the LW system, but only four had had an opportunity to work with it while the platoon was at JRTC. The OCs thought their LW training was valuable, but characterized it as an overview or familiarization and felt it was too abbreviated. Those who had an opportunity to work with the LW system stated the training was not adequate. They stated you must know the system in order to coach users on system employment.

Interview Procedures

Interviewers

Three individuals interviewed the OCs. Interviews with the force-on-force OCs were conducted prior to the interviews with the live-fire OCs. The force-on-force interviews were conducted individually. With the live-fire OCs, each interviewer talked to two OCs simultaneously – a joint interview.

AAR Topics Addressed in the Interviews

Even though the structure for an AAR can vary, there are generally four parts. An AAR starts by reviewing what was supposed to happen. This review is usually accomplished by discussing the operation order, mission statement, or training plan for the event. Next, there is a discussion to establish what actually occurred during the event, including the viewpoint from the

force undergoing training and any opposing force that was involved. Third should be a discussion to determine what was done right and what went wrong. These second and third steps are each accomplished by allowing the participants to offer information from their perspective, usually with leading questions from the AAR trainer. Lastly, the trainer conducting the AAR tries to determine what should be done differently in the future to build upon what worked well and preclude the problems that caused actions to be done wrong (DA, 1990). This structure applies to the process of conducting an AAR, but does not identify a core of topics to address.

For the interviews with the JRTC OCs, we wanted to address basic or core topics, a "standard" list of areas, that OCs are likely to discuss with different echelons (squad, platoon, company) and in the context of different training missions. In determining these topics, we started with the basic purpose of an AAR. As stated in FM 25-100, "an AAR is a structured review process that allows training participants to discover for themselves what happened, why it happened, and how it can be done better" (DA, 1988, pg 5-1). However, FM 25-100 does not identify specific topics that should or could be covered during an AAR.

TC 25-20 (DA, 1993) devotes a chapter explaining how to conduct an AAR, which identifies some topics to cover in an AAR. It even offers options for structuring the AAR discussion. One option is to discuss key issues in a chronological order following the sequence of training or operational events. This could easily lead to a variety of different topics and does not provide a standard identification of topics for an AAR. Another option is to discuss the key issues, organized into the seven battlefield operating systems (BOS). The BOS are intelligence; maneuver; fire support; mobility, countermobility, survivability; air defense; combat service support; and command and control. The BOS categories provide a standard set of topics that would be applicable to multiple training events and operations. The TC does note that only the BOS that relate to mission accomplishment should be discussed in the AAR, so some variation from the standard seven BOS areas might be appropriate. A third method for structuring an AAR is to focus on key events, themes, or issues that might be selected by the unit chain-of-command. While there is merit to using this structure, the topics emerging from this approach could vary significantly.

In addition to the broad structure for conducting an AAR, TC 25-20 (DA, 1993) offers suggested optional topics for inclusion in an AAR. For example, an AAR might address some specific Soldier or leader skills. It could also focus on the tasks that might need further training. The TC does identify two topics that should be addressed in all AARs. First, any fratricide or near incident of fratricide, regardless of the means in which it was inflicted, should be discussed in detail. Second, every AAR should address force protection (safety) issues.

Given the general AAR guidelines and the required topics specified in TC 25-20, our intent was to identify a finite set of topics that could be used for all AARs. As mentioned above, using the seven BOS (intelligence; maneuver; fire support; mobility, countermobility, survivability; air defense; combat service support; and command and control), in conjunction with the required topics, seemed to be the best starting point for interview topics.

Our next step was to determine if the seven BOS could be reorganized into a smaller set of topics and still retain the potential full scope of information that should be addressed in an

AAR. Another consideration was to link this set of topics to the chronological sequence that operations follow. Regardless of the operation or training exercise, the three major segments are planning, preparing, and executing. After considering various possibilities, a previously used grouping was selected as the foundation for identifying topics: shoot, move, and communicate (Furman & Wampler, 1982).

A unit's ability to "shoot" involves effective and efficient employment of both direct and indirect fires. This involves attacking enemy forces as well as protecting actions of friendly forces. Several of the BOS are included in this topic, for example, intelligence (knowing where to attack the enemy), fire support (from artillery, mortars, and other assets), countermobility (placing indirect fires in a location to restrict or prevent enemy action), and air defense.

Before conducting "movement" on the battlefield, a unit will plan and prepare for its operation. Several of the BOS are included in this topic. Examples are intelligence (knowing how to take advantage of the terrain to conceal or protect forces during movement), maneuver, mobility (knowing which routes to follow that best support the operation), combat service support (having sufficient fuel and refuel supplies and repair parts), and command and control (being able to monitor and coordinate friendly movement during execution).

Even excellent plans that are well rehearsed can fail if the proper and adequate communication is not in place and maintained. The ability to "communicate" includes several of the BOS. Examples are maneuver (directing forces to change movement plans if the situation changes), fire support (calling for indirect fires), survivability (having secure and reliable means to disseminate information that do not compromise friendly actions), and command and control.

We decided the three main topics of shoot, move, and communicate provided sufficient coverage of the seven BOS, and accommodated the planning and execution phases of an operation. The required AAR topics of force protection and fratricide had to be included, as well as unit preparation for an operation. This led to the following six major topics for the interviews.

- **Shoot** (anything to do with weapons, optics, ammo)
    - Ammunition expended by the unit (by weapon type, by individual systems, etc.)
    - Enemy casualties (people, vehicles by type, facilities)
    - Friendly casualties (by weapon type, by individual, leaders)
    - Weapon status (which ones functional, proper employment, positioning)
    - Sensors and/or optics (which ones functional, proper employment)

- **Move** (anything to do with maneuver, formations, fuel)
    - Locations of individuals, vehicles, units (at specific times, over a period of time)
    - Routes that the unit followed (trafficability, cover and concealment, avoid enemy strength)
    - Dispersion (individuals, elements, units)
    - Rate of movement (speed for situation, maintain contact, maintain commo)

- **Communicate** (planning, coordination, messages, synchronization)
    - Planning for the operation
    - Number of transmissions
    - Average length of transmissions
    - Content of transmissions
    - Who talks to whom
    - What information was passed and when
    - Efforts to synchronize activities
    - Efforts to coordinate
    - Efforts to avoid or overcome electronic countermeasures (ECM)/ electronic counter countermeasures (ECCM) (jamming)

- **Force Protection** (protective obstacles, mission-oriented protective posture (MOPP), safety)
    - Obstacle locations to include supporting fires
    - Planned fires and/or actual fires (including smoke)
    - MOPP level and other protection from nuclear, biological, and chemical (NBC)
    - Warning for enemy aircraft

- **Preparation** (pre-combat inspection (PCI), rehearsal, maintenance)
    - Pre-combat inspections (PCI)
    - Rehearsals
    - Maintenance
    - Other (orders, etc.)

- **Fratricide.** No specific subtopics were identified for fratricide.

Possible AAR Displays

Examples of possible AAR graphic displays that could be used with the LW system were shown to the OCs (see Appendix A, starting at Page A-10). The basic features of each display were presented to the OCs. They were then asked two questions: "Would this type of display be helpful to you?" and "What changes, if any, would you want in this display?" Six displays were shown:

- A timeline with move, shoot, and communication events plus blue strength over time.
- Force strength paired with unit location on a map
- Locations and dispersion of squad members (on a map) at three distinct points in time
- A set of graphics depicting use of the thermal weapon sight (TWS) by each squad
- Graphic depicting extent of use and time of use for LW sensors/optics being proposed for squad members. Four sensors were displayed: TWS, daylight video sight (DVS), laser range finder (LRF), and individual combat identification system (ICIDS).
- Graphics depicting average dispersion (in meters) among squad members over time.

Topics Covered in AARs

AAR Topic Frequency

The OCs rank ordered the six topic areas in terms of the frequency with which they addressed them in all their AARs at JRTC (not what they emphasized with the LW unit). They assigned a rank of 1 to the topic they addressed most frequently, a rank of 2 to the second most frequent topic, and a rank of 6 to the topic addressed the least often.

Communication and then Move and Preparation were the most frequently cited topics (Table 3). Next was Shoot. Force Protection and Fratricide received the lowest ranks.

Table 3
Order of AAR Topics by Frequency With Which They are Discussed in an AAR

Order	Topic	Rank Order	Mean Rank
Cited Most Frequently	Communication (includes planning)	1st	2.1
	Move	2d (tie)	2.7
	Preparation	2d (tie)	2.7
	Shoot	4th	3.4
	Force Protection	5th	4.7
Cited Least Frequently	Fratricide	6th	5.4

The shift in the ranks is clear in Table 4. Communication, the most frequent topic, was ranked first by half (5 of 10) the OCs. On the other hand, fratricide, the least frequent topic, was ranked last by half the OCs. Two OCs recommended that planning/mission intent should be treated as a separate topic of discussion, rather than being included under communication.

Table 4
Number of OCs who Assigned a Given Rank to Each AAR Topic

AAR Topic	Rank					
	1	2	3	4	5	6
	Number of OCs (Each √ indicates one OC)					
Communication	√√√√√	√√√		√		√
Move	√√	√√√	√√	√		√
Preparation	√√	√√√	√√	√√	√	
Shoot	√	√	√√	√√√√	√	
Force Protection			√√√		√√√	√√√
Fratricide				√	√√√	√√√√

Note. The first cell in the Communication row shows that five OCs gave a rank of 1 (most frequent) to Communication. The first three cells of the Fratricide row show that no OC listed Fratricide as being one of the three most frequent topics.

For each major topic (except for fratricide), we asked questions on specific subtopics that could be addressed in an AAR. The next sections present the results from the interviews with the JRTC OCs for each of the six AAR topics. For each section there is a table that summarizes the results in each topic. For each subtopic, we asked four questions. First, we asked whether the subtopic was addressed in the AAR. Second, we asked what source(s) of information was (were) the basis for the discussion in the AAR. OCs could have listed more than one source. In the tables, "Obs" stands for observation, and "TAF" stands for obtaining information from the TAF. Third, we asked how they presented the information: visually, orally, or a combination of these two modes. Last, if they used visual means, we asked them to specify the visual mode that was used. An OC could list more than one visual mode. The topics are presented in terms of the most frequently cited topics to the least frequently cited topics (refer to Table 3). The numbers in the cells are the number of OCs who gave a particular answer.

Communication

Nine communication areas were addressed in the interviews (see Table 5). The most frequently addressed aspects of Communication are listed first in Table 5; the least frequently addressed are cited last. Planning, synchronization, and coordination were listed by every OC, and information passing was listed by all but one. On the other hand, number of transmissions and electronic countermeasures (ECM) were not mentioned. Length of transmissions was also an infrequent topic. Who talked to whom and the specific content of that information was typically addressed by at least half the OCs. The typical source of information about communication was personal observation by the OC. Of interest is that some form of visual aid was used for the most frequently mentioned topics, particularly planning and synchronization.

Planning was covered in various ways by the OCs. For one OC, it was the major topic. He obtained information on the plan from higher headquarters and graphics from the TAF to assist him in his AAR. Others also revisited the mission intent, how the platoon leader developed his plan from the plan sent by the company commander, whether the platoon leader asked for more information, etc. Several OCs used graphics/sketches and/or maps to assist them.

The most common methods of addressing synchronization involved using a critical event timeline, and focusing on whether synchronization was coordinated during rehearsals. Crisis planning was stressed by one.

For coordination, the OCs were concerned about adjacent unit coordination (not necessarily what is coordinated, but did the leader coordinate with the adjacent unit), and coordination with indirect fire units. One OC indicated he would stress this highly if there was a problem during the mission.

Regarding the passing of information, message content, and who to talks to whom, the OCs monitor the radio nets, and often get feedback from other OCs. Also the JRTC TAF records radio traffic and OCs can use this if they desire. OCs monitored radio transmissions for different purposes. Examples were: unnecessary information being transmitted, accuracy of reports (critical information that was incorrect), communication regarding signals, receipt of orders and translation of orders into actions, timeliness (critical information not reported at the right time),

and monitoring reports up and down the chain of command to determine if they were effective. Several OCs indicated they time-stamped all communications. Some indicated it was critical in the AAR to probe to determine what was actually understood and communicated by members of the unit, not just what was received or transmitted. For example, they might ask a question such as "How did you know that a star cluster meant to shift fire?".

Table 5
Responses to Questions on Communication

Subtopic	Address in AAR?	Information Source	Mode of Presentation	Visual Modes Used
Planning	Yes 10 No 0	Obs 7 Obs/TAF 3	Oral 4 Oral/Vis 5	Sketch 4 Text 4 Map 1 Sand table 2
Synchronization	Yes 10 No 0	Obs 9 Obs/TAF 1	Oral 5 Oral/Vis 5	Sketch 2 Text 3 Sandtable 1 Timeline 1
Coordination	Yes 10 No 0	Obs 10	Oral 7 Oral/Vis 3	Text 3
Information passing	Yes 9 No 1	Obs 8 Obs &Monitor Nets & Use MOUT controllers 1	Oral 7 Oral/Vis 2	Timeline 1 Video 1
Content	Yes 6 Sometimes 1 No 3	Obs 5 TAF 2	Oral 7	NA
Who talks to whom	Yes 6 No 4	Obs 6	Oral 6	NA
Length of transmissions	Yes 3 No 7	Obs 3	Oral 3	NA
Number of Transmissions	Yes 0 No 10	NA	NA	NA
ECM	Yes 0 No 10	NA	NA	NA

Note. NA means not applicable. "Obs" means personal observation was the source of information. "TAF" means the Tactical Analysis Facility at JRTC was the source of information. "Vis" stands for "visual."

Lastly, two OCs indicated they would address length of radio transmissions if these transmissions created a problem. Examples of problems were when a leader delayed movement to talk on the radio, the leader kept requesting information from others, or a leader was not concerned about compromising his position through the enemy's use of radio direction finding equipment.

Move

The two Move subtopics discussed by all OCs were the location of individuals and units, and the dispersion of units and individuals (see Table 6). Most OCs (70-80%) discussed the other two areas that were addressed in the interviews, routes and rate of movement. Visual aids of various types were commonly used in the AARs to make critical points. Some OCs depended on the TAF for the desired information.

Table 6
Responses to Questions on Movement

Subtopic	Address in AAR?	Information Source	Mode of Presentation	Visual Modes Used
Location of Individuals, Vehicles, and Units	Yes 10 No 0	Obs 4 Obs/TAF 4 TAF 1 Obs & Other OCs 1	Oral 1 Oral/Vis 9	Sketch 6 Text 2 Timeline 1 Video 2 Map 1
Dispersion	Yes 10 No 0	Obs 8 Obs/TAF 2	Oral 5 Oral/Vis 5	Sketch 1 Text 1 Sandtable 1 Video 3
Routes	Yes 8 No 2	Obs 5 Obs/TAF 2 TAF 1	Oral 1 Oral/Vis 7	Sketch 5 Sand table 2 Map 3 Text 1 Video 2
Rate of movement	Yes 7 No 3	Obs 6 Obs/TAF 1	Oral 4 Oral/Vis 3	Video 3

With respect to location of individuals and units, some OCs used a critical event timeline in their AAR, available from the TAF. Typically, they focused on key individuals or elements, not all individuals and elements (e.g., key leaders, support by fire element). Within an urban operations scenario, they try to track locations from about 1.5 kilometers outside the urban operations site. One OC said that he monitored how the unit moved against the OPFOR; who within the unit went on the recon, the adequacy of the area covered by the recon elements, and whether the unit was close to the OPFOR but not aware of this fact. He also noted that the OCs have a global positioning system (GPS) system to accurately determine locations.

The OCs indicated that routes are typically designated at JRTC. Consequently, they stated they did not address routes unless there were difficulties in navigation, the unit got lost, or the planned route differed from the actual route. One OC indicated he would keep a "snail trail" when problems or differences were detected. Another indicated that if the unit got lost, he would discuss the planning process and the use of GPS in the AAR.

Dispersion was addressed in an AAR only when problems occurred (e.g., the unit bunched up or broke contact). In addition, rate of movement was addressed only when problems occurred (e.g., movement was very slow). However, with rate of movement, OCs sometimes depended on information from other OCs. One OC indicated that with future systems, it would be interesting to capture dispersion of unit members at various points in a mission, for example, at an ambush or during movement when a unit changes from a wedge formation to a column and then back to a wedge.

One area addressed in the AAR by the OCs was the tendency for some units to "rush to failure" – rush toward sound during contact – thus forgetting or not executing their plan. Another area was whether the maneuver was performed logically and was tactically sound.

Preparation for Operations

With regard to preparation for operations, each of the subtopics was addressed by all the OCs in their AARs (see Table 7). The source of information for each area was personal observation by the OC. Typically, they discussed this topic with the unit, rather than using charts or graphics.

Table 7
Responses to Questions on Preparation for Operations

Subtopic	Address in AAR?	Information Source	Mode of Presentation	Visual Modes Used
PCI (Precombat Inspections)	Yes 10 No 0	Obs 10	Oral 6 Oral/Vis 4	Text 3 Timeline 1 PP slides 1
Rehearse	Yes 10 No 0	Obs 10	Oral 8 Oral/Vis 2	Sketch 2 Sand table 1 Text 1
Maintain	Yes 10 No 0	Obs 10	Oral 3 Oral/Vis 3	Text 1 Bar chart 1 Pictures 1

Note. "PP" stands for PowerPoint slides.

For precombat inspections (PCIs), OCs used various techniques. Some would consult the unit's standing operating procedure (SOP) and checklists to determine whether unit personnel really used these tools. Others would examine the effectiveness of the leaders' judgments during preparation. PCI discussions were based on doctrinal guidelines and checklists (e.g., FM 7-8).

With regard to rehearsals, the OCs were concerned with whether the unit rehearsed the right events: the priorities of tasks, the unknowns, coordination, and synchronization. The OCs noted what parts of the mission were rehearsed (e.g., did the unit rehearse room clearing, but not movement to the urban operations site or breaching obstacles?). Even though time was scheduled for a rehearsal, did the unit actually rehearse or did the leader simply talk to the unit

(called "a leader talk down"). One OC mentioned that he addressed cause and effect in the AAR -- whether a rehearsal would have avoided a mistake during the mission.

Maintenance was often related to PCI. One OC indicated he would sometimes take pictures of equipment or weapons that were not maintained and show them in the AAR. Another OC would address cause-effect, for example, if a weapon malfunctioned was it because of lack of maintenance or improper maintenance. Some OCs reported items of equipment (such as the number of machine guns) that were operational to the TAF.

In conjunction with preparation, OCs stressed that they addressed time management in a variety of areas (security, time for maintenance, checking ammunition supply, cleaning equipment, planning for changing batteries, requests for resupply, etc.). One OC also stated he focused on rest plans.

Shoot

All OCs discussed friendly and enemy casualties, weapon status, and use of sensors/optics (see Table 8). Ammunition expended was mentioned by at least half the OCs. A variety of visual modes was used by the OCs to present points of discussion on shooting during the AARs.

Table 8
Responses to Questions on Shooting

Subtopic	Address in AAR?	Information Source	Mode of Presentation	Visual Modes Used
Enemy Casualties	Yes 10 No 0	Obs 8 Obs/TAF 1 TAF 1	Oral 3 Oral/Vis 7	Sketch 1 Text 2 Video 2 Timeline 1
Friendly Casualties	Yes 10 No 0	Obs 6 Obs/TAF 3 TAF 1	Oral 4 Oral/Vis 6	Sketch 2 Text 2 Video 3 Timeline 1
Weapon Status	Yes 10 No 0	Obs 8 Obs/TAF 2	Oral 6 Oral/Vis 4	Sketch 2 Text 1 Video 1 On site 1
Sensors/Optics	Yes 10 No 0	Obs 8 Obs/TAF 2	Oral 3 Oral/Vis 7	Sketch 1 Text 2 Video 3
Ammo Expended	Yes 6 Not Usually 2 No 2	Obs 8	Oral 4 Oral/Vis 4	Sketch 2 Text 2 Video 1

In force-on-force training exercises, casualties are assessed by the battle damage assessment (BDA) on the Multiple Integrated Laser Engagement System (MILES) and reported to the TAF. For enemy casualties, one OC said he discussed each battle contact and focused on who was killed and why. With regard to friendly casualties, the TAF is sometimes asked to verify these numbers. The OC can also ask the unit about the number of casualties. Several OCs indicated it was important to stress that friendly casualties occurred and discuss why they occurred (their location, etc), but not necessarily the number of casualties. Friendly casualty assessment is more subjective in live-fire than force-on-force.

Discussions regarding weapon status could include firing without a target present, how a weapon aided in contact, consequences of a weapon malfunction and actions taken to correct the malfunction, and machine gunner positions. With respect to weapon optics and sensors, some times video is used to determine if night vision goggles (NVGs) were used, or an OC may conduct a random check on NVG status. Fire discipline with aiming lights was also mentioned by the OCs. One OC indicated that it would be nice to capture video of Soldiers to know what they see through their sights, where they were looking relative to the enemy, and whether their fire was effective.

OCs also used personal observations to monitor marksmanship related areas. Because much of the urban operations mission is on video tape, OCs indicated they frequently used video in the AAR to show the unit the firing techniques they used, the distribution of the unit's fires, fire control measures, rates of fire, reflexive firing, suppressive fire, sustainment of fires, etc. One OC indicated that in a two-hour AAR covering an urban operations mission, he typically devoted 15 minutes to video of the mission (extracted from 45 to 60 minutes of tape). Cameras (day/night, image intensification, and thermal) are used inside and outside the buildings. These cameras can be used to tape units from about 1km from the urban operations site. Another OC indicated that an effective AAR technique is to give the AAR on the objective, reviewing all positions and relative locations to help the unit discuss what happened and why.

Force Protection

As indicated in Table 9, planned fires, and location of obstacles were likely to be addressed in AARs. Visual aids were often used for both.

With regard to indirect fire, one OC pointed out that at JRTC the live-fire objective can be rebuilt, something that is typically not possible in units. So, for example, they can take Soldiers to the impact area (the objective) and show them the actual effects of indirect fire on the ground.

The OCs can get obstacle locations from the TAF, make their own sketch, or use a map with overlays. One OC indicated he focused on the purpose of the obstacle (to disrupt, delay, block, or turn). He asks the OPFOR how long it took them to breach the obstacle. The OCs use the GPS to report the defensive position to the TAF. In urban operations offensive operations, the breach is always video-taped. In the AAR, the OCs will also focus on the plan for suppression and obscuration of obstacles, and employment of the engineers. A final topic addressed was protective gear for the breach – goggles, gloves, armor.

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Table 9
Responses to Questions on Force Protection

Subtopic	Address in AAR?	Information Source	Mode of Presentation	Visual Modes Used
Planned Fires	Yes 10 No 0	Obs 9 Obs/TAF 1	Oral 5 Oral/Vis 5	Sketch 5 Sand table 1 Text 2 Video 1 On-site 1
Location of Obstacles	Yes 8 No 2	Obs 5 Obs/TAF 3	Oral 1 Oral/Vis 7	Sketch 6 Text 1 Sandtable 1 Video 1
Enemy Air Craft Warnings	Yes 3 No 7	Obs 3	Oral 3	
MOPP (Mission – oriented protective posture)	Yes 1 No 9	Obs 1	Oral 1	

The OCs mentioned other force protection topics: risk assessments and rules of engagement; security included alertness and use of night vision goggles (NVGs) at night; sustainment – what did they pack – did they drop their rucks with essential items, did they have adequate food, water and weather gear; did fighting positions have adequate drainage; etc.? Typically, there is not much nuclear, biological and chemical play at the platoon level at JRTC. OCs will ask whether enemy aircraft were in the OPORD as a possible threat.

Fratricide

The OCs indicated that fratricide is addressed if there was an incident. It then becomes a high priority topic for discussion.

OC Use of the LW System in the AAR Process

The OCs were asked how they would use the LW system to monitor or "observe" a unit in order to obtain information to help them conduct an AAR. For all these questions, it was assumed the OC would have a LW system throughout the mission. The questions focused specifically on operational features of the LW system: the digital map, the radio net, digital messages and orders, digital overlays, the medical alert button, and day and night images that could be captured. It was felt these features could be used by the OC to both monitor and to record actions by unit members. Regardless of the type of digital message (order, overlay, image capture), we wanted to know whether the OC felt he should be aware of it and be a message recipient. As the LW system allowed each user to identify message recipients, the OC could simply be identified as another recipient.

As indicated by the responses in Table 10, the JRTC OCs agreed they would use the actual LW system to help them in their OC role. They would use the system to track individuals on their map and monitor information exchanges appropriate to the echelon observed via radio nets and digital messages. They stressed the importance of receiving messages from the next higher echelon as well as messages generated for the next lower echelon. Receipt of overlays was viewed as very important. Lastly, the OCs wanted the flexibility to change who they monitored as the need arose. This last point is consistent with responses by NTC OCs (Brown et al., 1999b) who expressed a desire to select the screens and data they wanted to see rather than simply view a mirror image of the commander's display. There was less consensus on LW features that provide new capabilities, specifically the medic alert and digital image capture features. Some said if an image was sent, they would want to see it.

The OCs distinguished between how they would use the LW system as a trainer or OC versus a unit leader. The distinction was characterized by one OC as the difference between being a problem identifier (trainer) and a problem solver (unit leader). Trainers/OCs are not actively involved in decision-making, and can step back and examine what is happening, require a unit to repeat an exercise, etc. Some information a trainer may want may not be critical to a leader. For example, the above OC also mentioned that as a trainer he would like to see who activated the medic alert button, but as a unit leader he would not want this information.

Designing a Soldier System to Capture and Display AAR-Related Information

The OCs were asked what information should be captured and displayed by the LW system for later use in an AAR. They were asked to put themselves in the role of a "king." No restrictions were placed on their ideas and concepts for using the LW system in this mode. Nor were they asked to provide a technological solution to how the information they specified could be captured, retained, and displayed. The OCs were also asked to indicate what information they would still have to collect by personal observation or other means in order to conduct a successful AAR. The topics addressed were communication, movement, preparation, shooting, and force protection.

Communication

The OCs cited the following information and data regarding Soldier and leader use of the LW system communication capabilities that they would like the system to capture and display for AAR purposes:
- Content of transmissions (4 OCs)
- Synchronization of activities (3 OCs)
- What was passed and when it was passed – coordination (2 OCs)
- Who talks to whom (1 OC)
- Planning (OPORD) and updates (FRAGOS, SITREPS) (3 OCs)
- Tag orders, overlays, sketches, graphics, and messages already stored on the computer, but may need to expand screen for visibility during AAR (2 OCs)
- Average length of transmission (1 OC)
- Record when number of transmissions exceeds a certain threshold (1 OC)

Table 10

Ways an OC Would use the LW System When Monitoring a Unit

Questions Related to LW System Features	Responses (# OCs providing response is in parentheses)
What individuals would you want to display on your map?	Response depended on the echelon for which the OC was responsible. General consensus was: • Key leaders, one level down and one level up, and any other leader/individual with a central role in the mission
Who would you want to monitor on the LW radio net?	• PL, PSG, SL (3 OCs, one of them mentioned the need to change to lower levels as needed) • PL (1 OC) • Whole squad and PL or SL and PL net (1 OC) • Same as PL net (1 OC) • One up and one down (2 OCs) • Scan multiple nets (1 OC)
From whom would you want to receive digital messages and orders?	• PL, PSG and/or SL (5 OCs, 1 OC mentioned team leaders) • FRAGOs to PL (2 OCs) • Call for fire, MEDEVAC, Spot Report (3 OCs) • Any product the PL is producing (copy of PL and Co Orders and his overlays and changes, refinements to fire support plan (1 OC)
What overlays would you want to receive?	• All that are available (2 OCs) • Whatever the PL and/or SL get (3 OCs) • 1 or 2 up and 1 down (2 OCs) • Fires, operational graphics (2 OCs)
Would you want to see a display for any individuals who activate the medical alert button?	• Yes (6 OCs) • No, because we are out there. Would be useful from a remote site (1 OC) • Key leaders (1 OC) • Should be echeloned; not necessary to know everyone who is a casualty (1 OC)
Is there anything else, such as day and thermal images?	• All images (e.g., DVS images). If it is important enough to send an image, then I want to see it (4 OCs) • If using the image for planning (2 OCs) • Not necessarily, because we are on the ground with the unit (1 OC)

Two OCs felt that a communications log, audio and digital, would be good for trainers – recording who sent what and when, when a message was received and by whom. The log should also show timeliness of the messages, their relationship to the enemy situation, whether messages were received/sent at the right times, and what actions followed as a result. They focused on using this information to show cause-effect links and/or help the OC determine these links and discuss them during the AAR. Lastly, one OC questioned whether a distributed AAR

would work over the local area network, as Soldiers might not pay attention in this mode (e.g., move their cursor, play solitaire, fall asleep).

Some OCs felt the LW system could not obtain everything. OCs would still have to observe planning, synchronization and coordination efforts, and efforts to overcome jamming. Three OCs felt they would still monitor and observe communication activities as they do now.

Move

The OCs indicated they would like the following information on movement captured and displayed via the LW system for later use in an AAR.

- Locations of units and elements at specific/critical times (5 OCs)
- Routes, a snail trail (4 OCs)
- Rate of movement (2 OCs)
- Dispersion (2 OCs)
- Replay, by time, events and formations on the map (1 OC)
- Replay events such as rushes and room clearing (1 OC)
- Depict location of unit/icons over a span of time, and then interject with a view of the terrain as seen through the thermal weapon sight (TWS) (2 OCs)

One OC indicated he would still be required to observe unit dispersion, as maps do not show the necessary vegetation and terrain detail needed to make an assessment of unit dispersion. In addition, the OC must still monitor the position of the unit relative to the enemy and what happens upon enemy contact. Three OCs indicated that they viewed such "automated" information as an augmentation to what they do, not a replacement.

Preparation for Operations

The interviewers asked the OCs the following "Would you like the system to mark a checklist of functions as individuals perform them?". OC responses were as follows.

- Maybe a PCI checklist, but would still check individually (1 OC)
- Automated PCI checklist of what items were turned-on and checked (2 OCs)
- Copies of leader checklist and SOPs (2 OCs)
- See screens the key leaders have up and what they are doing (1 OC)
- OC needs a copy (template) of what the unit has and then use it himself to check when the unit has completed preparation actions (1 OC)
- Map/sketch to conduct small unit rehearsals; use the system to rehearse (2 OCs)
- Battery status and when changed (1 OC)

Four OCs said no PCI checklist was needed. The squad or team leader must check. The OC knows from personal observation, and must personally check to ensure actions are being completed. There were mixed responses regarding automated checklists and feedback to the OC, ranging from the OC being given copies of a unit's checklist, to getting an automatic feed of some items, to having an "OC checklist or template" for his own means of recording the unit's

status. In general, OCs saw a continuing need to make their own check of whether PCI were completed.

Shoot

The OCs indicated they would like the following information on target engagement captured and displayed via the LW system.

- Weapon/optics/sensor status (what items of equipment are operational) (2 OCs)
- Enemy and friendly casualty numbers (2 OCs)
- Who shot who and when (engagement pairings) (1 OC)
- Rate of fire (1 OC)
- Ammunition expended (1 OC)
- Rounds on target (fire distribution) (1 OC)
- Through-sight target engagements like streaming video for replay in the AAR to know where aiming lights were directed and to assess effectiveness of engagements for suppression (O/C mark the video segments/engagements of interest) (3 OCs)
- Integrate identification friend/foe into the system (1 OC)
- Ammunition status for individual Soldiers (2 OCs).

One OC indicated he did not desire any additional information from the system if he accompanied the unit during the mission. There could be too much data to collect and evaluate which could distract an OC from the important real-time observations of how the missions and tasks were being executed. The OCs indicated they would still have to track enemy status/information (unless the OPFOR was LW-equipped), weapon status, whether the right weapon was selected for the right situation, and whether Soldiers took aimed, accurate shots. Two OCs indicated that they viewed "automated" information as an augmentation to what they do, not a replacement.

Force Protection

With respect to force protection, the most commonly mentioned items were overlays of obstacles (5 OCs) and fires (3 OCs) as part of operational graphics. One OC wanted a download of obstacle positions on the LW system, rather than sending the positions to the TAF or in addition to sending them to the TAF. He indicated the tough part of the AAR is determining why things happened and what to do differently next time. Direct information on obstacles and fires from the system would assist this determination. Another OC cited pictures of equipment, any input to the forward observer, warnings for MOPP level, and an identification friend or foe system. Most OCs felt they would still have to personally observe and record such factors as MOPP level, casualties from enemy aircraft, re-supply, adequacy of perishables such as food and water, adequacy of latrines, and other unit sustainment factors.

Other OC Reactions

Of interest is that the most experienced OCs wanted everything possible, preformatted in various ways so they could pick and choose what to present in an AAR. Some visualized an AAR where a map display was shown of the unit's route to the objective, with a video insertion of what a machine gunner saw through his TWS (like streaming video) from his position, in order to explain what happened and why. On the other hand, the less experienced OCs were concerned about having too much information with such AAR capabilities.

The OCs thought any automated AAR capability should be user-friendly, requiring no more than 5 or 10 minutes to learn how to use. The greatest challenge posed by the OCs for such AAR capabilities was how to present "cause-effect" relationships and the connections between events --- what led up to critical events, the timeliness of actions, and the consequences of actions. This was in contrast to an AAR capability that simply lists events as a function of time.

The OCs were asked whether the LW system would change the basic areas addressed in AARs. They did not see a change in the basic areas. But some felt that the system could affect what is emphasized, as well as the expectations of how units can perform and what units can do (e.g., indirect view shooting). In addition, the increased system capabilities could mean that OCs may have more factors to consider during an AAR.

OC Reactions to Prototype AAR Displays

OC reactions to the proposed displays are in Figures 3 through 8. Reactions are integrated as comments in a text box next to each display, and discussed in more detail following each display.
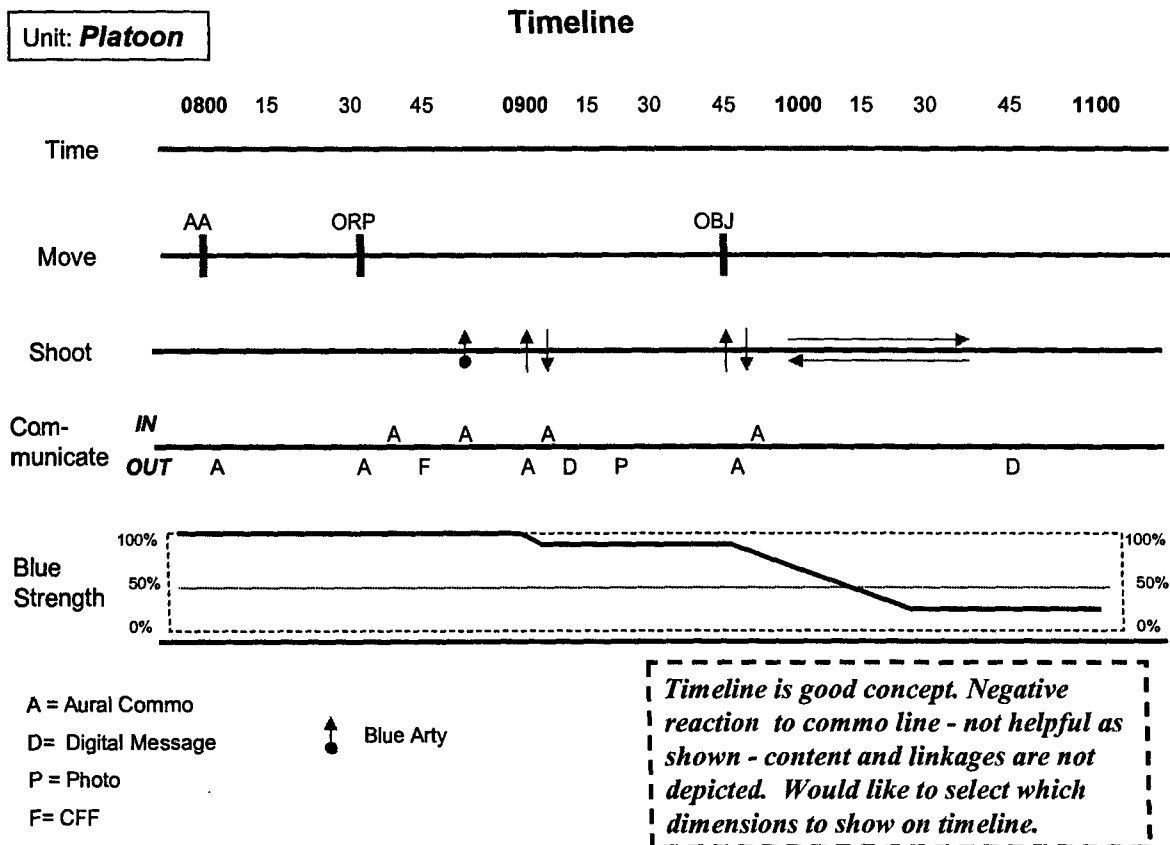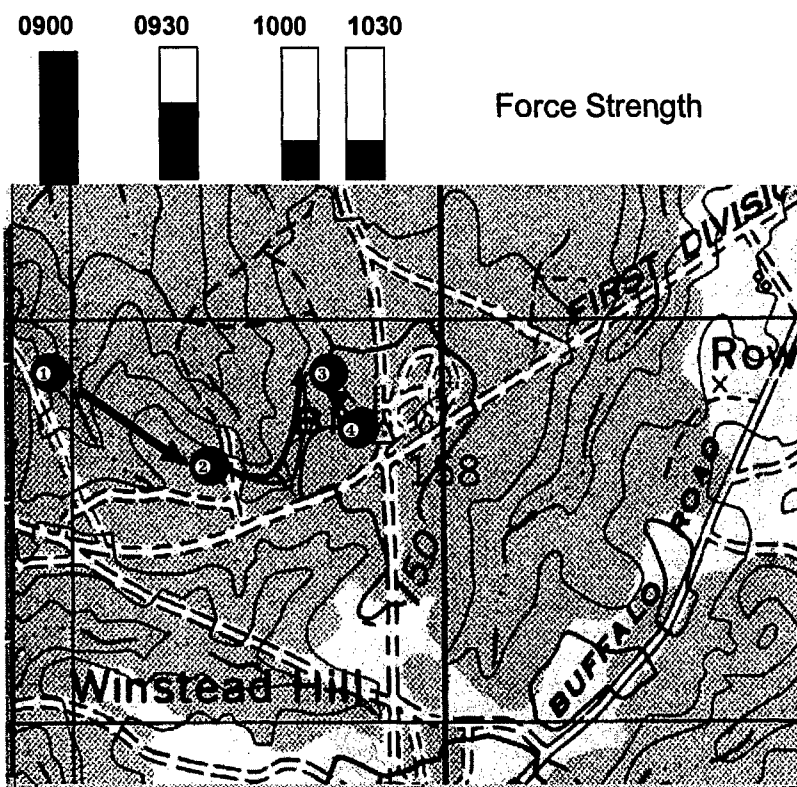
Figure 3. Timeline example.

Figure 3 was consistent with the exercise timeline concept used in AARs conducted in conjunction with simulation exercises. The multiple timelines shown in Figure 3 focused on movement, shooting, communication, and the strength of the platoon. The communication timeline was annotated to represent the different forms of communication available with the LW system (aural, digital, photos, and the specific call for fire message), and distinguished between incoming and outgoing messages. The OCs indicated that the timeline is a good concept. However, the communication timeline did not indicate the content of the communication and the linkages between critical messages.

The OCs also indicated that they would like more flexibility with this type of display. They indicated they would like to be able to select which dimensions to show as a function of time. To accommodate this requirement, the AAR aids should include a pool of mission-related dimensions that are displayed as a function of time, instead of a pre-determined timeline graph. Then the OC could generate his own timeline display(s) by selecting the dimensions he wants to stress in the AAR.

Figure 4. Unit location and force strength, variation of battleflow, snail trail.

Figure 4 showed the unit location at four points in time (numbered 1 2, 3 and 4) and the corresponding force strength. Arrows drawn between the points showed the unit's route. It was assumed that an OC wearing a LW system could show the squad location on his situation awareness (SA) display, and time-tag that display at different points during the mission to save for later use. At the end of the mission he could then merge the desired SA displays to present an overall picture of squad movement at different phases of the mission.

The OCs thought this type of display would be a good one to talk from. However, the unit locations should be keyed to events not time. Time could be shown as a correlate of the events. Force strength could be illustrated as a function of time. In order to show a snail trail, the Soldier system would have to save locations (grid coordinates) of a unit or the unit leader at regular time intervals. Recording and saving of position location data was not part of the LW system at JRTC. Real-time position locations were shown on the Soldier's display but were not saved.
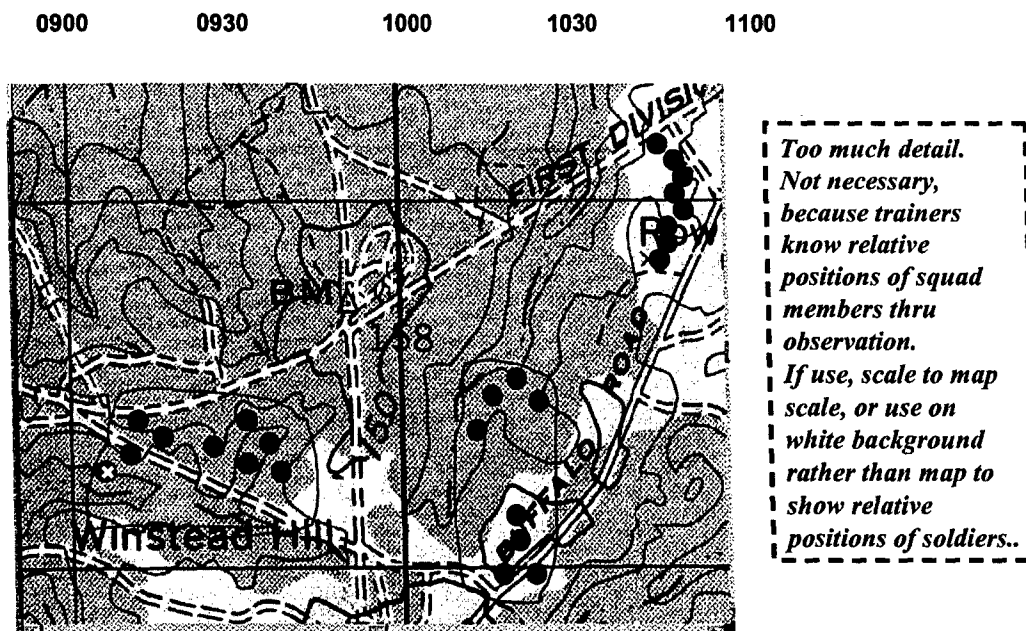
0900　　　　0930　　　　1000　　　　1030　　　　1100

Too much detail.
Not necessary,
because trainers
know relative
positions of squad
members thru
observation.
If use, scale to map
scale, or use on
white background
rather than map to
show relative
positions of soldiers..

Figure 5. Route of squad members as a function of time.

Figure 5 was a variation of the battle flow or snail trail display. However, it showed all nine squad members as opposed to the collective entity of a squad. And it only showed position as a function of three time periods, rather than a continuous snail trail. In addition, time was correlated with movement. The first set of nine dots indicated one member was a casualty (X in the dot). The second set of dots (eight) showed that the two fire teams had separated and that only eight squad members remained. The last set of dots (eight) indicated the squad was on line. It was assumed that an OC wearing a LW system could show all squad members on his SA display, and time-tag that display at different points during the mission to save for later use. At the end of the mission he could then merge the desired SA displays to present an overall picture of squad member/unit movement and formations at different phases of the mission.

The OCs thought there was too much detail with this display, and that it was not necessary as the squad OC observes the relative position of squad members. If this type of display was used, they would prefer the squad member symbols be scaled to the map (made smaller), or simply use a white background to show the relative position of members.
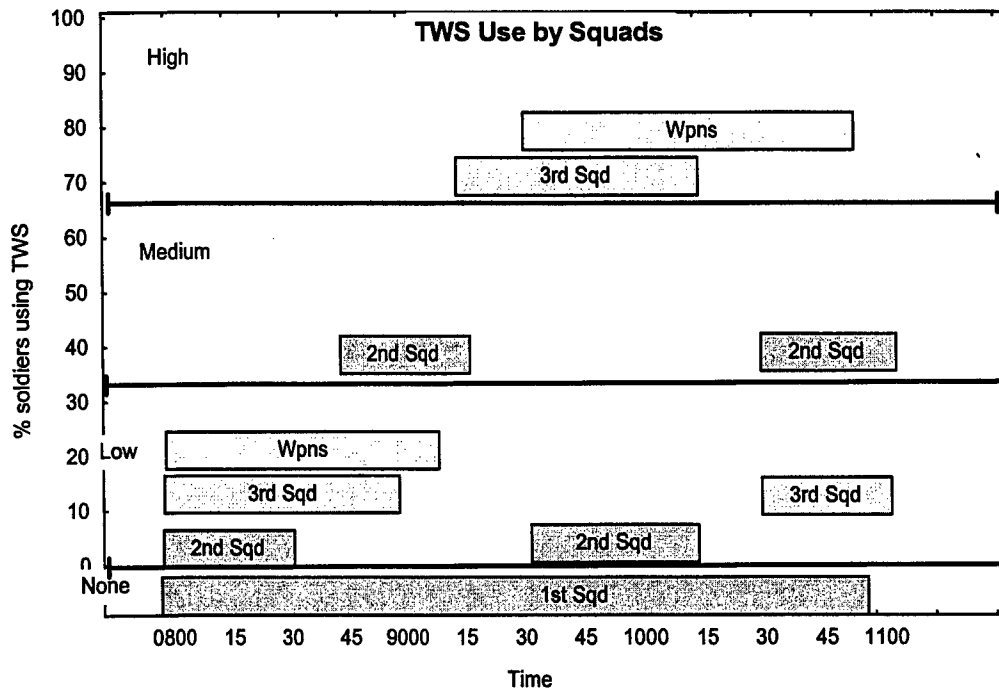
TWS Use by Squads

Figure 6. Use of TWS.

Figure 6 was an attempt to show use of specific LW capabilities such as a critical sensor or sight within each squad in the platoon. In this case, the thermal weapon sight (TWS) was used. The content in this display does not correspond to any of the displays cited previously that have been used with constructive and virtual simulations, but is a form of a timeline. The assumption was that the use of the TWS (amount of time one, when on and when off) could be stored in a data base on each Soldier's LW system, and later used for this type of display.

The OCs thought this display could be useful, but use of TWS should be keyed to events, not time. Such displays should be integrated with events and outcomes.

1st Squad: Use of TWS, DVS, LRF | ID •

100

90

80 High   DVS
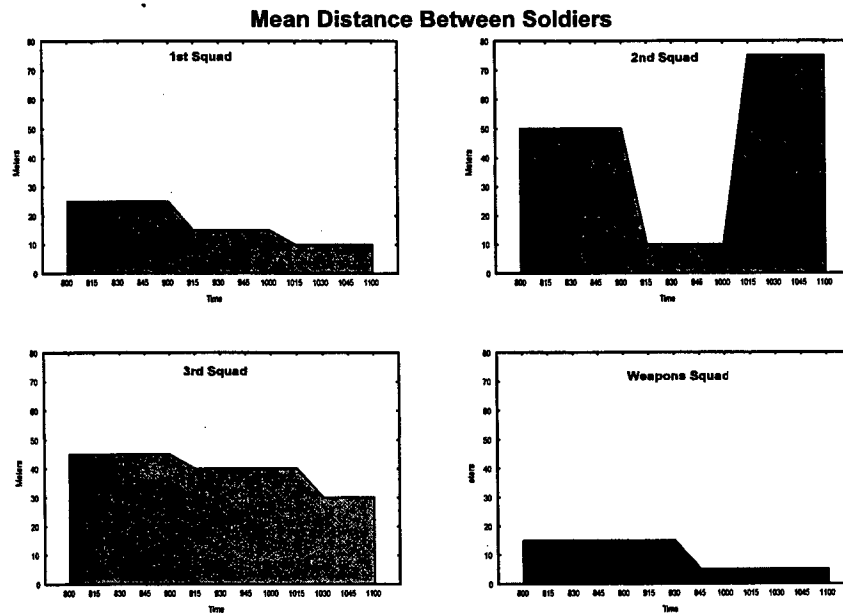
70   TWS

60

50 Medium   DVS

40   TWS

30

20 Low

10   DVS

0

LRF & ID

0800 15 30 45 0900 15 30 45 1000 15 30 45 1100

Time
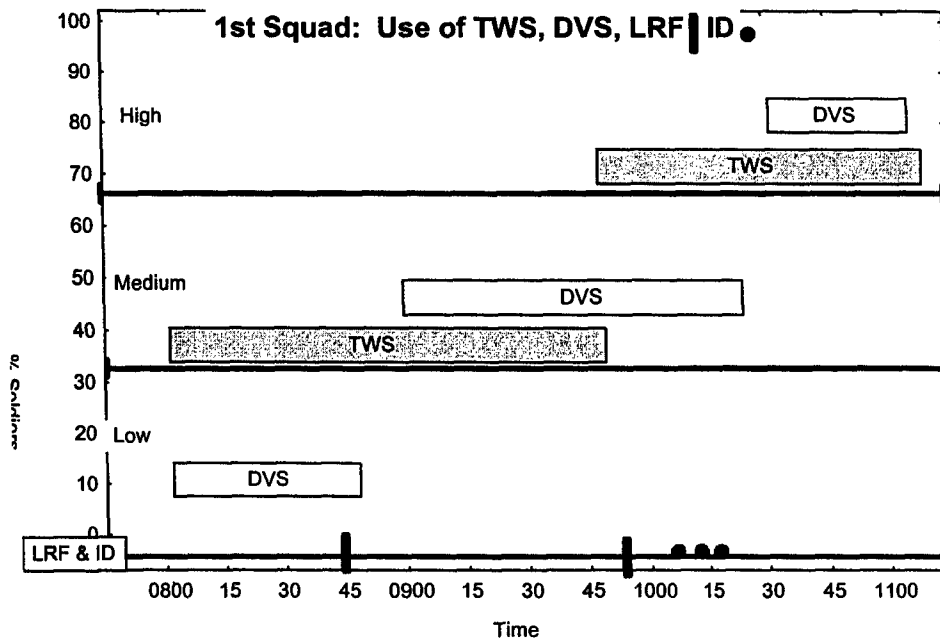
Figure 7. Use of the sensors and devices on the LW system. [DVS stands for daylight video sight. TWS stands for thermal weapon sight. The short vertical bar in the graph reflects used of a laser range finder (LRF) in the LW system. The small dot reflects use of the combat identification (ID) capability, which was proposed for the LW system.]

Figure 7 was similar in concept to the previous display (Figure 6), but showed use of the variety of sensors and sights organic to a LW squad. The OC comments were similar to those made regarding the prior figure; that the use of a particular sensor or sight should be keyed or linked to events and outcomes.

Mean Distance Between Soldiers

Figure 8. Squad dispersion.

Figure 8 was an attempt to show squad dispersion in meters as a function of time. The OCs did not find this display beneficial, as the average dispersion can be skewed by "outliers." In addition, the squad OC knows about squad dispersion from his personal observations and can relate variations to mission events and the terrain.

Impact of the LW System on What OCs Observe and Monitor

The OCs were asked whether they thought the LW system would change the emphasis on what they observed, and if so, how. Three OCs felt there would be no real change. Two others indicated that they would now have to monitor what happens when the system fails or is degraded, and how Soldiers function without all the LW capabilities. One OC thought there would be more emphasis on communications. Two OCs noted that they would have additional areas to check and monitor. For example, OCs would have to address maintenance and use/employment of more items of equipment. There would probably be more factors to examine in battle drills as possible causes for actions. Communications jamming may become an issue. Lastly two OCs indicated that their expectations regarding unit performance will be different because of the increased capabilities associated with the LW system, such as reduced exposure firing with the daylight video sight (DVS) and the TWS.

Applications of the Results to AARs with the Ground Soldier System

Use of the Operational System in an AAR

This section examines how the operational Soldier system, without embedded features or capabilities designed specifically for an AAR (as has been done with constructive and virtual simulations), can help the trainer. The following assumptions are made. The trainer is wearing a leader's system. The leader's radio can communicate at longer distances than the Soldier's radio, and the leader also has a separate tablet or device with a larger display. The capabilities listed below exist for both the LW system and the proposed GSS. The AAR is given in the field where the mission was conducted, without access to training analysis facilities or instrumented ranges.

Given sufficient computer storage capacity on the GSS systems, the displays and information cited below could be distributed by the trainer to all participants through the network for pull-up as appropriate in the AAR. Or it might be possible for participants to see this information on the trainer's tablet. These techniques could supplement other information the trainer chooses to present by using a larger display surface such as a poster board or a sand table.

Mission and Commander's Intent

With these systems, orders (warning order (WARNO), operations order (OPORD), fragmentary order (FRAGO)) are digital text messages, which can contain graphic overlays as appropriate. The unit leader has the order from his commander. In turn the unit leader modifies the order and overlays as needed for his echelon and relays this guidance to his subordinate leaders. They, in turn, repeat this process for their subordinate leaders. For example, a platoon leader receives the Company Commander's order. He then generates his platoon order and sends it to his squad leaders. They in turn generate a squad order and send it to their squad members. These OPORD messages are saved on the respective leader systems and can be retrieved during

the AAR. Associated with each message on this networked, e-mail system is the date each message (order) was sent, by whom, and to whom.

The trainer can request that all orders also be sent to him as they occur during the mission (or after the mission). He can then resend the orders he wants to address in the AAR to all participants, so they share the same information during the discussion. The trainer can focus such dimensions as how the commander's intent was interpreted; the clarity of the order, the completeness of the order, the timeliness of the order process, etc. Thus the Soldier system, with its tactical capabilities and without specific AAR features, does allow the trainer to focus on many aspects of planning and TLPs which were stressed by the JRTC OCs.

Events and Associated Chronology

Several operational features of the Soldier system can assist the trainer with focusing on critical events, and when and why they happened. First, all digital messages sent during the mission are saved on the system (e.g., Spot Report, Call for Fire). Any digital photographs taken with the DVS or TWS are also retained as messages. Each can be retrieved if needed to help support the AAR. The overlay that accompanies the OPORD is a saved graphic on the system. Without software enhancements to the operational system, the trainer cannot display the actual Soldier/unit locations as they occurred in real time.

However, the trainer can use the overlays that accompany the order as a means of eliciting participation from the unit regarding the mission. He can ask whether the planned route was followed – why and why not? He can focus on where critical events occurred, and then focus on why they occurred. He can pull up or share text messages sent during the mission (e.g, spot, call for fire, digital imagery) that were relevant to these critical events. He can place additional graphics on the overlays (e.g., lines on the graph) to illustrate points. And so on. Given that the AAR is held shortly after the mission, Soldiers' memory of the mission is fresh.

Distributed AAR

A distributed AAR, where not all participants are at the same location, is possible. A trainer, using the networked audio and digital capabilities of the GSS, could hold an AAR with unit members being physically dispersed.

However, as the OCs pointed out in the interviews, there are disadvantages with this procedure. There is no guarantee that Soldiers/leaders are attending to the visual displays or the audio communications. In addition, not all AAR aids frequently used by OCs would be available. More to the point, however, is that a distributed AAR does not allow important face-to-face communication to occur, whereby an OC can sense whether the unit understands the training points and can determine how best to elicit unit participation.

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Embedding Additional AAR Capabilities

In this section of the report, we assume the trainer has the all the operational system capabilities mentioned in the prior section. However embedded, additional capabilities are proposed in order to generate enhanced and other AAR aids. The proposed additional embedded AAR capabilities were based on the previous automated AAR work conducted in support of virtual and constructive simulations, as well as suggestions the JRTC OCs made in the interviews conducted as part of this research. These proposed capabilities are:

The general capability for the trainer to create "supplemental overlays" as graphic displays by combining independent "snapshots" into a single image or overlay. These supplemental overlays could be annotated, saved as a digital message, and disseminated via the GSS network.

The trainer can screen capture SA displays in real time, flag and save them with a time tag whereby they can be retrieved later and displayed individually, shown in fast sequence, and/or merged with other individual displays. The SA displays could depict friendly and OPFOR elements, and graphic control measures.

Capability of automatically calculating the center of mass of the unit (grid locations) in pre-specified time increments and automatically generating a snail trail that is geo-referenced to the digital map on the trainer's system. A snail trail could be based on key leaders as opposed to the unit's center of mass. The snail trail could be "overlaid" on any other display, as desired.

The trainer can annotate the SA displays and/or terrain map as desired. This includes free-hand drawings.

The same concepts cited above should be able to be applied to any overlay in the system. If different overlays (obstacle, fire plan, enemy) are saved as separate pieces of data, the trainer would be able to combine these overlays as desired. Or if they can be shown simultaneously on the screen, he should be able to save this "combined view," annotate it as desired, save it, and distribute to AAR participants.

The trainer has the capability to note the occurrence of key events in real time, which are time tagged and flagged in order generate a key event time line. A user-friendly menu system could be developed listing typical key events to allow for speed in recording (e.g., WARNO, OPORD, cross line of departure, first contact with enemy). This information could be distributed to the unit participants or fed to a central training facility for later display.

Audio communications are recorded, saved, time tagged, linked to receiver and sender, and translated into text for later display/recall. The trainer can designate any message as potentially critical to the AAR discussion.

Ability to flag or tag key digital transmissions as potential for use in AAR. This means a technique for easily marking the digital transmissions relevant to the AAR, rather than searching for them after the exercise has ended.

The e-mail message system could be designed to indicate whether the recipient actually opened the message and when this was done. This would helpful in letting the trainer know if critical messages were responded to in a timely manner.

A quick reference to standard AAR format for trainers, which would be particularly valuable for less experienced leaders. Possible Socratic-type questions to ask could be included.

Engagement data based on tactical engagement systems (TES) and instrumented training area capabilities. Future TES systems will rely on digital networks, thereby enabling the recording, saving and display of engagement data (who shot whom, at what range, at what time, with what weapon; outcome of the engagement, etc.). Engagement data could be displayed at the individual level or by different echelons. These data would also enable the presentation of force strengths by event and time.

Many of these suggestions reflect what was implemented in the ATAFS editor for AARs with simulations. L.L. Meliza (personal communication, July 11, 2005) indicated that the ATAFS editor for simulation AARs saved definitions of aids rather than saving the aid itself. The editor allowed the trainer to change the period of time addressed by an aid, in order to focus on the event of interest. Thus if the trainer thought the information would generate a good battleflow aid, such an aid could be generated "on the fly" with the appropriate start and end points.

Examples of revised displays

The following two displays depict some of the above characteristics and also incorporate some of the recommendations made by the JRTC OCs, particularly the need to reference critical events on AAR displays. They are modifications of the prior displays in Figures 4 and 6. Consistent with one of the principles of graphic design, these two displays are more data-dense than the original versions. Figure 11 is a new display that focuses on a means of depicting audio communications and linking them to video displays.

In Figures 9 through 11, it is assumed that Soldiers in the unit can view the AAR displays through their inherent GSS display capability. The trainer could prepare the displays of interest and then distribute to them to the AAR participants. In addition, it is assumed the trainer could show the displays on the leader device/tablet.
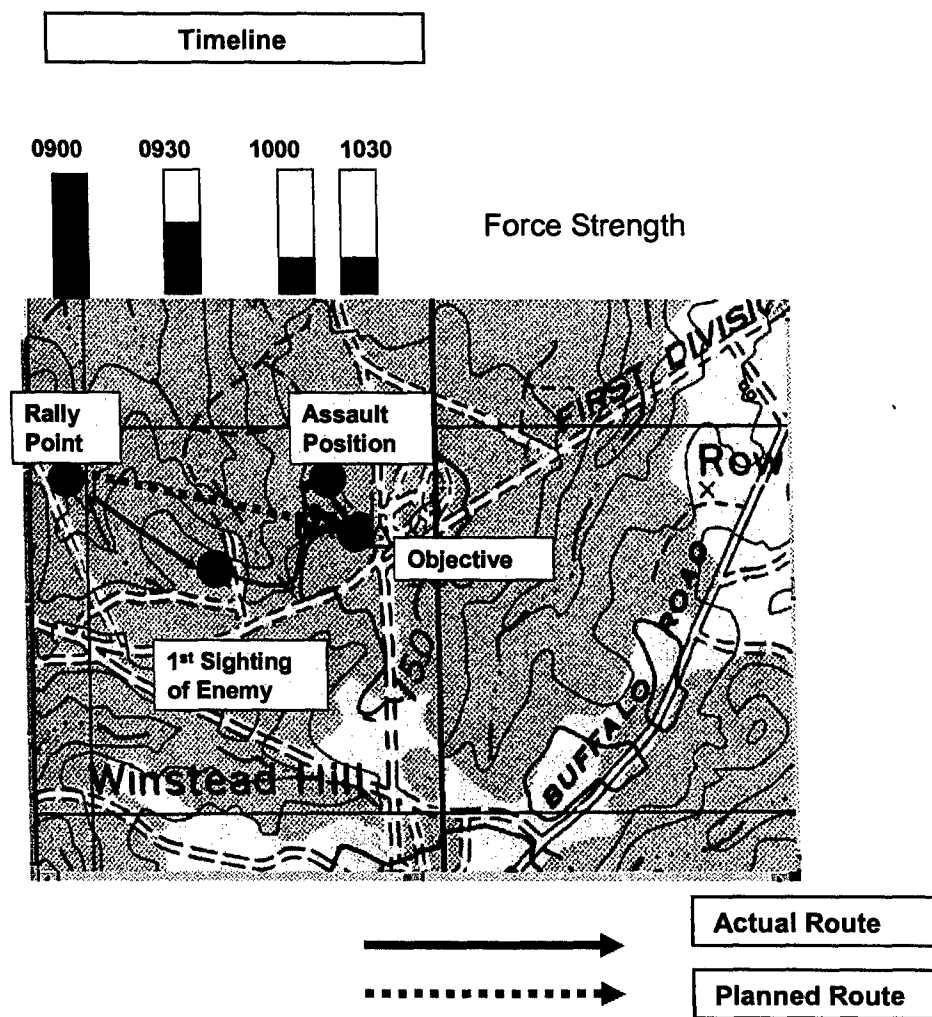
Figure 9. Modification of Figure 4 (battleflow) with key events and planned route annotated.

Figure 9 is a modification of Figure 4 where four key events (rally point, first sighting of the enemy, the assault point, and the objective) have been annotated by the trainer as well as the planned route (dashed line/arrow). Annotation of the key events by the trainer facilitates the discussion of these events in the AAR. The display also shows other factors related to the events: the physical location of each, the corresponding force strength, the time of event, and the route taken by the unit between the key events. This richer display allows the trainer to discuss with the unit the various factors that impacted each event and focuses the attention on the event rather than time (as was the case with the prior display, Figure 4).
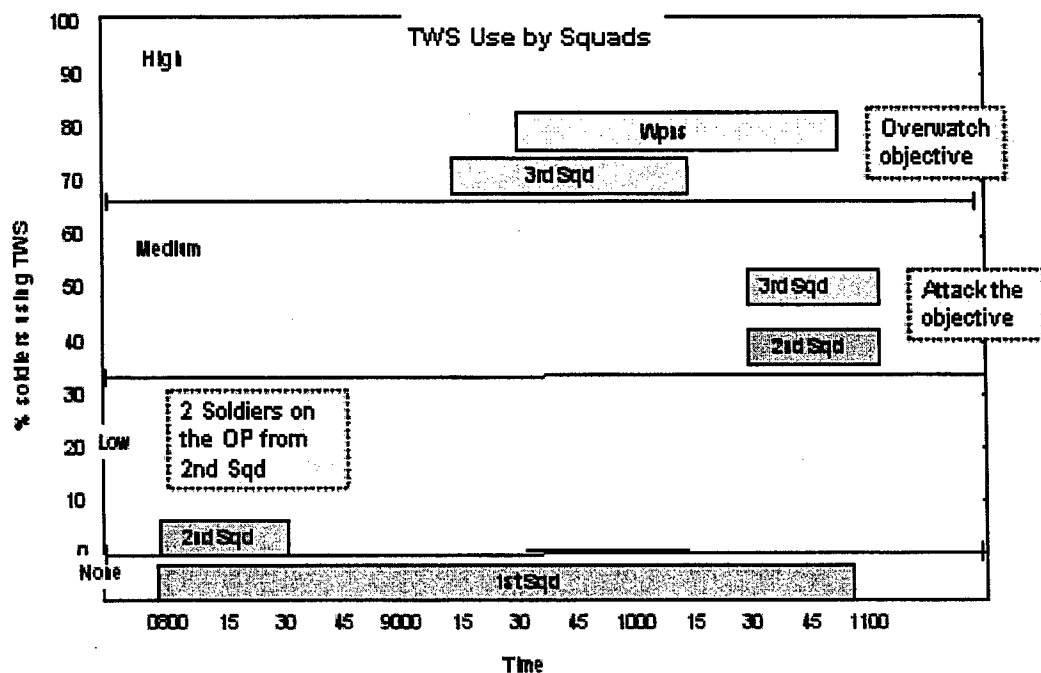
Figure 10. Modification of Figure 6 (use of TWS) with key events annotated.

Figure 10 is a modification of Figure 6. Again, in accordance with comments from the JRTC OCs, the events that triggered use of the TWS have been annotated by the OC. As with Figure 9, now the trainer can easily direct the unit's attention to whether the events cited were appropriate ones for use of the TWS. What additional or unique capabilities would be provided by the TWS in these situations? Or on the other hand, was employment of the TWS needed; did it provide an advantage? The time line and the amount of usage by the unit (in Figure 6 as well) provide indications of the amount of TWS usage, a primary consideration given the potential need to manage the use of TWS batteries.
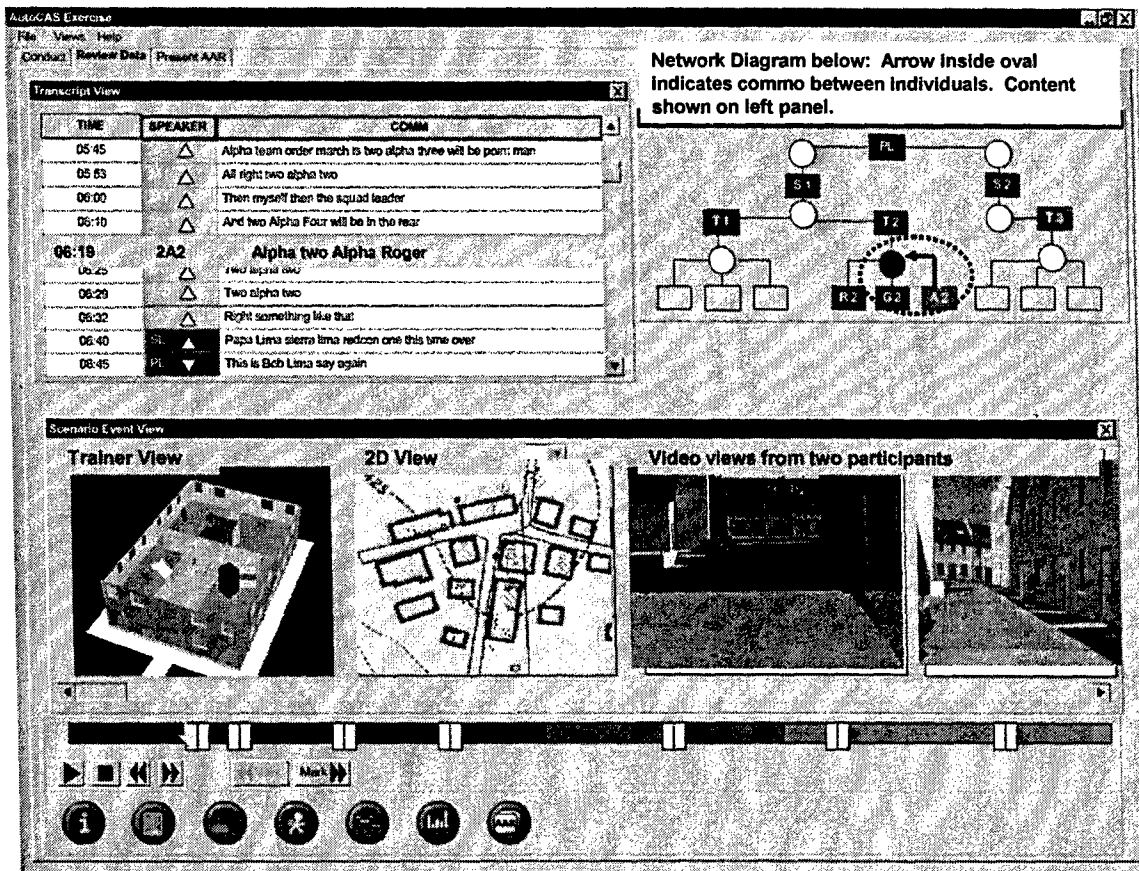
Figure 11. Illustrated replay of time-stamped communications. [Modified and reproduced by permission from Aptima, Inc. under Small Business Innovative Research Contract DASW01-03-C-0057, 2005).

The display in Figure 11 was designed for simulations but could be done with the enhanced, embedded AAR capabilities described in this section. Multiple factors are displayed. Audio communications have been translated into text, time-stamped, and displayed in sequence. Each communication in this sequence is then linked to who sent the message and who received it. In addition, image captures of the related 2-D map/terrain, as well as of the actual event itself, put the event in context for the trainer and the unit. If streaming video were an inherent part of the operational system, then a form of replay could also be used. These capabilities would not be easy to achieve, but illustrate how technology might be used to the advantage of the trainer and the unit in an AAR.

Discussion and Summary

Application of AAR Aids in Live Training Environments

AAR aids should assist the trainer in helping train the unit, and should be used when they are "value added." An aid should be used because it helps the quality and the intent of the AAR, not simply because it exists. For example, replays are a common feature of AARs given with training simulations. However, this does not mean replays should always be used. The aid itself should not be the thrust of the AAR. Aids should help the trainer and the unit understand what happened and why it happened. An aid should not be used when it detracts, is irrelevant, or simply does not contribute to the major points to be made. Lastly, not all topics examined in an AAR lend themselves to a visual aid or tool.

The JRTC OCs did not treat all areas equally in their AARs. The most common area was communications, which included mission planning. The next most frequent areas were movement and preparation for operations, followed by shooting/target engagement. Force protection and fratricide were the least frequent, although fratricide was always discussed when it occurred. Many of the automated AAR aids developed for simulations, cited in this report (e.g., battle flow, plan views, stealth views, fire fights, replay, battle scorecard), focus on movement, shooting, and some aspects of force protection and communications during mission execution. Timelines can emphasize aspects of preparation for operations. However, mission planning and mission preparation were typically not addressed with the automated aids. The fact that most of the automated AAR aids developed for simulations do not cover mission planning and preparation, important AAR topics in live training and operational environments, was an unexpected finding.

The experts on graphic displays of data advocate that displays should be data dense; should show multiple-dimensions in a two-dimensional space. These concepts apply directly to AAR aids, as the intent is to help the unit understand the dynamics of what happened and why it happened. And there are multiple dimensions involved in the execution of any mission, which may impact missions in different ways. However desirable, data-dense aids may not be easily or quickly generated as they require the integration of multiple factors and considerable reflection on the best way of presenting these factors.

Ground Soldier System AAR Aids

Using the Operational System

Some of the operational capabilities in the GSS, as reflected in current system requirements, can be used to assist trainers in the AAR process without additional embedded features. No special training facilities (e.g., instrumented ranges, a training analysis facility) would be required. However, the trainer must have his own GSS to take advantage of these operational capabilities. The system should be a leader system, which has a more capable radio for monitoring unit communications, and a leader device or tablet which provides a larger display screen for interacting with the unit. The system must "accept" the trainer as a member of

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the unit during the mission, so he can monitor any communication network, generate SA displays and monitor them in order to track individuals of interest, and be a recipient for all the digital messages from echelons above and below the echelon for which he is the trainer. It is assumed that the trainer could share any of the digital records that are saved on his system with the unit during the AAR, i.e., forward the digital messages to all AAR participants. This technique could be used for showing this information during the AAR, as opposed to a white board or poster paper.

In summary, the operational system does have capabilities that the trainer can use as AAR tools, without adding specific, additional AAR capabilities. These features primarily support the AAR topics of planning and communications cited in the report. They provide less direct support for the areas of mission preparation, movement, shooting, force protection and fratricide.

The primary operational capabilities of the GSS that could be used by the trainer are the orders and overlays that are received and sent as digital messages, other digital messages (e.g., MEDEVAC, spot reports, text), and image captures from the DVS and the TWS. The trainer would need to insure that he is on the recipient list for these messages. In addition, he can listen to the unit's audio communications; but he must designate which call groups he wants to monitor, and have the flexibility to change the call group during mission execution.

Digital orders with associated overlays would greatly assist the trainer in discussing the planning process during the AAR. As mentioned previously, the planning process has typically not been captured with the automated AARs that support simulations. Messages and video captures sent during execution of the mission would help as well, but without additional capabilities embedded in the system, the trainer cannot flag critical items for immediate recall and display. However, the trainer does have a digital record of what was sent, by whom and to whom, and at what time. This record could help establish what happened and why it happened.

AAR aids typically incorporate a map of the terrain, which serves as the focal point for examining key events. The system does not allow a screen capture of the map with locations of Soldiers during the mission. However, the trainer does have a map of the terrain on his system, and he also has the overlays, which are saved in a digital message format. The trainer can use these capabilities to facilitate the AAR discussion, and could point to key terrain features or locations with his cursor to emphasize points and ask questions.

Using Additional Embedded Capabilities

Additional embedded AAR capabilities refer to the capturing and storing of additional data or information, which can then be "magically" transformed into AAR feedback displays. Many of these capabilities assume that a training support facility is available to integrate information and generate the aid, but some capabilities do not require this facility.

The proposed additional embedded AAR capabilities were based on the automated AAR work conducted in support of virtual and constructive simulations, as well as suggestions from the JRTC OCs in the current research. The proposals encompass the capabilities inherent in the

system itself, cited above, and would allow the appropriate recording, saving, and merging/integration of this information with other data. The major additional capabilities proposed were: the ability to save SA displays in real time (flagged and time tagged) for later retrieval and merger with other SA displays; ability to save other overlays and merge and annotate them, free-hand drawing feature so the trainer can annotate displays; a snail trail depicting the movement route, the ability to save audio transmissions (time –tagged with sender and receiver and translated into text); and target engagement data derived from tactical engagement systems. In addition, it should be possible to disseminate the resulting AAR displays to the Soldier systems for use in the AAR. The intent is to generate a variety of tools to support the AAR.

A primary outcome of the interviews with the JRTC OCs was the need to develop graphic displays that show what the OCs determined to be critical mission events. These events needed to be integrated in the displays to focus the unit's attention on the event. Events could be linked to time; but in most cases, time should be secondary to the event itself. Two of the visual aids used in the interviews were modified and annotated with the key events. The revised graphs were an improvement, as they directed the participants' attention to the critical events, not the dimension of time as had been the case previously; they were more data-dense; and they provided a richer context to facilitate the desired Socratic dialogue with the unit.

A mew graphic was presented to illustrate aids for the communications process. This graphic addresses some of the OCs' concerns regarding showing communication content, the effect of the communication, the sender and recipient, and the context for the messates. This capability would require support from a training analysis facility.

Any automated AAR capability should be user-friendly, and easy for trainers to understand how it can be used. Nonetheless, it is probably advisable to provide trainers with instruction and illustrations of different applications of an aid to help them understand its utility.

Limitations of AAR Tools

The JRTC OCs felt automated aids were an adjunct or augmentation to what they were already doing, not a replacement. In addition, automated tools cannot provide all the essential information for an AAR. Clearly, for some critical areas, there is no substitute for direct observation. As indicated by the OCs, trainers still must observe the planning process, as well as synchronization and coordination efforts. Any automated feedback from the unit regarding precombat inspections would not be adequate as the OC must personally ensure actions were completed. The OCs also felt that they would still have to track enemy status, weapon status, whether the right weapon was selected, whether Soldiers took well-aimed shots, etc. Similarly, the OCs stated they would need to check MOPP levels, casualties from enemy aircraft, resupply, adequacy of perishables and other unit sustainment factors.

The greatest challenge posed by the OCs for automated AAR capabilities was how to present "cause-effect" relationships and the connections between events --- what led up to critical events, the timeliness of actions, and the consequences of actions. This is in contrast to an AAR capability that simply lists events.

Additional AAR Considerations

The OCs did not believe the introduction of the GSS/LW system into the force would change the basic areas addressed in AARs. But the system could affect what is emphasized or examined, and it could affect expectations about unit performance. In addition, the increased capabilities of the system could mean OCs could have more factors to consider during an AAR.

One OC made an interesting distinction between how he would use the LW system as a trainer or OC versus a unit leader; between being a problem identifier (trainer) and a problem solver (unit leader) respectively. Trainers are not actively involved in decision-making, and can step back and examine what is happening, can require a unit to repeat an exercise, etc. Consequently, some information a trainer may want for an AAR may not be critical to a leader.

The JRTC OC interviews revealed an interesting difference between the most experienced and the least experienced OCs, which could impact the design of automated AARs for the GSS. The most experienced OCs wanted everything possible, preformatted in various ways so they could pick and choose what to present in an AAR. Some visualized an AAR where a map display was shown of the unit's route to the objective, with a video insertion of what a machine gunner saw through his TWS (e.g., streaming video) from his position, in order to explain what happened and why. On the other hand, the less experienced OCs were concerned about having too much information with such AAR capabilities.

This difference between the experienced and less experienced OCs reflects findings in the research literature on human expertise; that experts and novices react differently to the same situations. Experts can process and retain larger volumes of information than novices, have better memory for stimuli in their domain of expertise, and can integrate large amounts of information presented to them. In light of these results it could be that any "automated" AAR capability should consider the differences in trainer expertise in the Army. A system designed for expert trainers may not work as well for less experienced trainers.

Summary

AAR aids should help the trainer facilitate the dialogue with the unit so participants understand more clearly what happened in an exercise, why it happened, and what can be done to improve and sustain performance. Of importance are the operational capabilities within the future Ground Soldier System that can be used to enhance AARs. Adding specific embedded AAR capabilities to generate data-dense/rich displays could help the trainer address other critical topics, thereby enhancing the AAR.

However, aids do not replace the trainer's essential role. They do not directly address why events or outcomes occurred, and how units can improve performance. Not all critical topics can be covered by an AAR aid. Nor should an aid be used in every AAR simply because it exists. Although it is tempting to believe an AAR can be automated, the heart of the AAR remains a Socratic discussion between the trainer and the unit.

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Appendix A

JRTC OC Interview Protocol

My name is _____. I'm from the U.S. Army Research Institute at Ft. Benning GA. We (introduce everyone) have been involved in research associated with the Land Warrior system for several years. This includes observation of the Land Warrior platoon's home station training this past summer prior to their JRTC rotation.

We are <u>not</u> here to interview you about how the LW platoon performed at JRTC. Instead, we are conducting research to make recommendations on how leaders can conduct AARs using the capabilities that might be available with the Land Warrior system. The objective is to identify the most useful types of information that should be captured and made available to leaders --- that would assist with conducting AARs.

We will talk to you about how you conduct AARs and the potential use of the LW system in that AAR process.

The responses you give are for <u>research purposes only</u> and the responses of any individual will not be revealed to anyone other than the researchers.

Name _____   Interviewer _____

First we want to know about your background as an OC at JRTC.

_____

Are you a force-on-force or live-fire OC?   Force-on-Force   Live-Fire

What OC position did you hold when you observed the LW platoon at the JCF AWE in Sep 2000?
        Squad   Platoon   Company

Have you held any other OC positions?   Yes   No
        If yes, what were these positions? _____

Prior to the LW platoon rotation, how many rotations had you observed at JRTC? _____

How many rotations have you observed now (April 2001)? _____

_____

Have you ever been a member of the OPFOR at JRTC?   Yes   No
        If yes, what position(s) did you hold? _____

Have you attended the OC Academy at JRTC?   Yes   No

Did you receive training on the Land Warrior system prior to the JCF AWE Sep rotation?
        Yes   No
        If yes, did this training give you a good understanding of the system?   Yes   No (explain)

Were you able to use or work with the LW system while the platoon was at JRTC?
        Yes   No
        If No, do you think additional experience with the system would have helped you in observing the unit or in giving feedback to the unit?

_____

What position did you hold prior to your assignment to JRTC? _____

A-2

1. Which of the following topics do you typically address during an AAR? Please indicate which one you use most frequently (1), second most (2), etc. [Show hand-out]

   Shoot (anything to do with weapons, optics, ammo)   _____

   Move (anything to do with maneuver, formations, fuel)   _____

   Communicate (coordination, messages, synch, planning)   _____

   Fratricide   _____

   Force Protection (protective obstacles, MOPP, safety)   _____

   Preparation (PCI, rehearsal, maint)   _____

2. What other topics do you typically address at an AAR? (specify)
   (Note: If other topics are provided, ask how they fit into the rank order provided above.)

3. Let's examine **shooting** first. I will present topics that could be addressed in an AAR about shooting. I would like to know which of these topics you typically address (show O/C list of topics.) And if you cover a topic, then please describe to me how you display or address information on that topic.

   Do you address ammunition expended by the unit?   Yes   No
   (by weapon type) (by individual systems) (etc)
        Where do you get the information you address?   Observation   TAFF
        How present?   Orally   Visually
        If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address enemy casualties?   Yes   No
   (people) (vehicles, by type) (facilities)
        Where do you get the information you address?   Observation   TAFF
        How present?   Orally   Visually
        If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address friendly casualties?   Yes   No
   (by weapon type) (by individual) (leaders)
        Where do you get the information you address?   Observation   TAFF
        How present?   Orally   Visually
        If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address weapon status?   Yes   No
   (which ones functional) (proper employment, positioning)
        Where do you get the information you address?   Observation   TAFF
        How present?   Orally   Visually
        If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address sensors and/or optics?   Yes   No
(which ones functional) (proper employment)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address other topics? If so, please specify.
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

4.   Now let's address **moving**. Which of the following topics do you usually cover in an AAR? (show list). Again, I would like to know how you display or address each topic.

Do you address locations of individuals, vehicles, units?   Yes   No
(at specific times) (over a period of time)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address routes that the unit followed?   Yes   No
(trafficability) (cover & concealment) (avoid enemy strength)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address dispersion?   Yes   No
(individuals) (elements) (units)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address rate of movement?   Yes   No
(speed for situation) (maintaining contact) (maintain commo)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address other topics? If so, please specify.   Yes   No
(control measures)
     Where do you get the information you address?   Observation   TAFF
     How present?   Orally   Visually
     If visually, how?   Text / sketch / bar chart / table of numbers / sand table

5. Now let's address **communication**. Which of the following topics do you usually cover in an AAR? (show list). Again, I would like to know how you display or address each topic.

Do you address the number of transmissions?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address the average length of transmissions?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address the content of transmissions?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address who talks to whom?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address what information was passed and when?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address planning for the operation?   Yes   No
(OPORD/FRAGO, overlay, briefings, meetings, etc)
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address efforts to synchronize activities?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address efforts to coordinate?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address efforts to avoid or overcome ECM/ECCM (jamming)?   Yes   No
   Where do you get the information you address?   Observation   TAFF
   How present?   Orally   Visually
   If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address other topics? If so, please specify.   Yes   No
   Where do you get the information you address?   Observation   TAFF
   How present?   Orally   Visually
   If visually, how?   Text / sketch / bar chart / table of numbers / sand table

6. Now let's address **force protection**. Which of the following topics do you usually cover in an AAR? (show list). Again, I would like to know how you display or address each topic.

   Do you address obstacle locations and include supporting fires?   Yes   No
      Where do you get the information you address?   Observation   TAFF
      How present?   Orally   Visually
      If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address planned fires and/or actual fires (including smoke)?   Yes   No
      Where do you get the information you address?   Observation   TAFF
      How present?   Orally   Visually
      If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address the MOPP level and other protection from NBC?   Yes   No
      Where do you get the information you address?   Observation   TAFF
      How present?   Orally   Visually
      If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address warning for enemy aircraft?   Yes   No
      Where do you get the information you address?   Observation   TAFF
      How present?   Orally   Visually
      If visually, how?   Text / sketch / bar chart / table of numbers / sand table

   Do you address other topics? If so, please specify.   Yes   No
      Where do you get the information you address?   Observation   TAFF
      How present?   Orally   Visually
      If visually, how?   Text / sketch / bar chart / table of numbers / sand table

7. Now let's address **preparation for operations**. Which of the following topics do you usually cover in an AAR? (show list). Again, I would like to know how you display or address each topic.

Do you address pre-combat inspections (PCI)?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address rehearsals?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address maintenance?   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

Do you address other topics? If so, please specify.   Yes   No
    Where do you get the information you address?   Observation   TAFF
    How present?   Orally   Visually
    If visually, how?   Text / sketch / bar chart / table of numbers / sand table

8. During the LW platoon rotation, you observed some of the capabilities of the LW system. How might use of a LW system as an O/C provide you with information to assist you in your AAR? The following questions assume you have a LW system. What would you want to monitor with the LW system to help you conduct your AAR?

a. What individuals would you want displayed on your map? In other words whom would you track?

b. Who would you want to monitor on the LW radio net?

c. From whom would you want to receive digital messages and orders?

d. What overlays would you want to receive?

e. The LW system is equipped with a medical alert button. Would you want to see a display for any individuals who activate this button?

f. Other? (e.g., day/thermal images)

9. The next set of questions assumes you are king, and could design the LW system to capture and display information for later use during your AAR process. Our purpose for the following questions is to obtain your ideas/insights about what information should be captured or retained on a LW system to assist you in the AAR process. We will discuss each of the general topic areas typically addressed during an AAR. [Refer to AAR topics list.]

a. What would you like your LW system to capture or save for you to use when you talk about "**Shooting**" during your AAR?

What additional information about shooting would you still have to collect by personal observation or other means to obtain what you need to conduct a successful AAR?

What method would you use to collect it?

b. What would you like your LW system to capture or save for you to use when you talk about "**Moving**" during your AAR? .

What information about moving would you still have to collect by personal observation or other means to obtain what you need to conduct a successful AAR?

What method would you use to collect it?

c. What would you like your LW system to capture or save for you to use when you talk about "**Communication**" during your AAR?

What information about communication would you still have to collect by personal observation or other means to obtain what you need to conduct a successful AAR?

What method would you use to collect it?

d. What would you like your LW system to capture or save for you to use when you talk about "**Force Protection**" during your AAR?

What information about force protection would you still have to collect by personal observation or other means to obtain what you need to conduct a successful AAR?

What method would you use to collect it?

e. What would you like your LW system to capture or save for you to use when you talk about "**Preparation for operations**"?
[If they don't come up with checklists or the system recording when someone does a PCI we can ask: Would you like the system to mark a checklist of functions as individuals perform them?]

What information about preparation would you still have to collect by personal observation or other means to obtain what you need to conduct a successful AAR?

What method would you use to collect it?

10. Do you think the LW system will change the emphasis on what you observe as an O/C? If so, how? [eliminate or reduce the need to look for something; but increase the need to examine something else]

Displays [Show colored graphs and displays]

1. Timeline *(Graphs shown are inserted below. During the interviews, OCs were shown a landscape view of each slide.)*

     This display shows a time line of critical events related to movement, shooting, communicating, and force strength. Time is at the top. The move line shows the time at which the platoon arrived at critical locations. The shoot line indicates both direct and indirect fire. Communication line reflects incoming and outgoing messages and the type of message. Last graphic shows the force strength of the unit as a function of time into the mission.

Would this type of display be helpful to you?   Yes   No
What changes, if any, would you want in this display?

Unit: **Platoon**

Timeline

| | 0800 | 15 | 30 | 45 | 0900 | 15 | 30 | 45 | 1000 | 15 | 30 | 45 | 1100 |

Time

Move   AA   ORP   OBJ

Shoot

Com-municate   *IN*   A   A   A   A
        OUT   A   A   F   A   D   P   A   D

Blue Strength   100% ... 50% ... 0%

A = Aural Commo
D= Digital Message   Blue Arty
P = Photo
F= CFF

1

2. Force strength with 1-4 numbers.

Here we have a map. At the very top is the mission time. Just below each time period is a rectangle that represents force strength. On the map itself are dark circles indicating the unit's location at each of the time periods. These are numbered to indicate sequence of movement. And there is a line drawn between the locations to more precisely indicate the route taken.

Would this type of display be useful to you?   Yes   No
What changes, if any, would you want in this display?

A-11
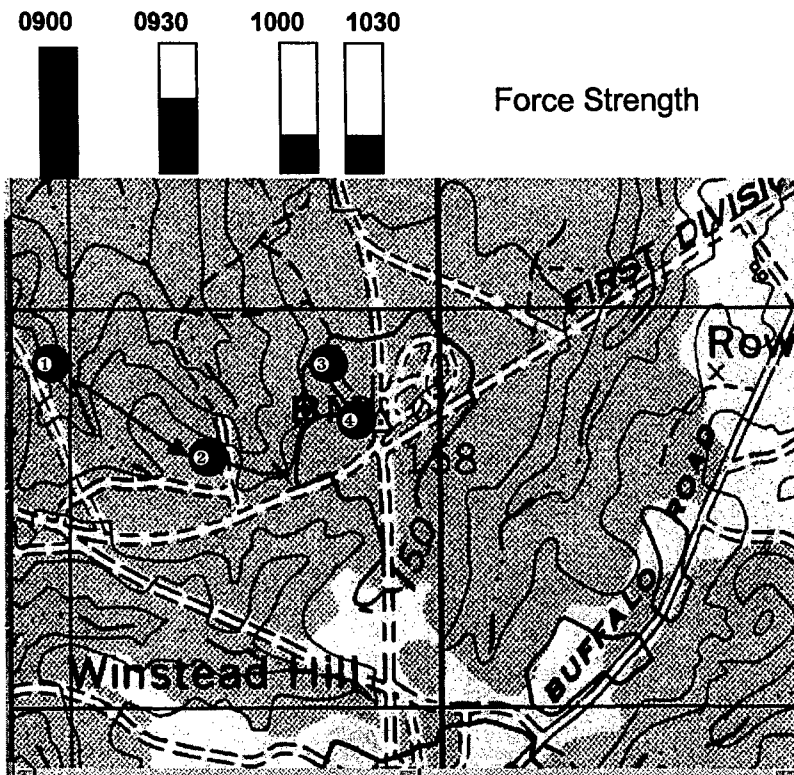
3. Squad dots

Here is another type of map display. Again, the time is shown at the top. Depicted here are the individual members of a squad and their locations. Three time periods are shown. With the first squad formation, the X on one squad member indicates he was a casualty at this time. The next set of squad dots shows that the two fire teams have separated. The last set indicates that the squad is on line.

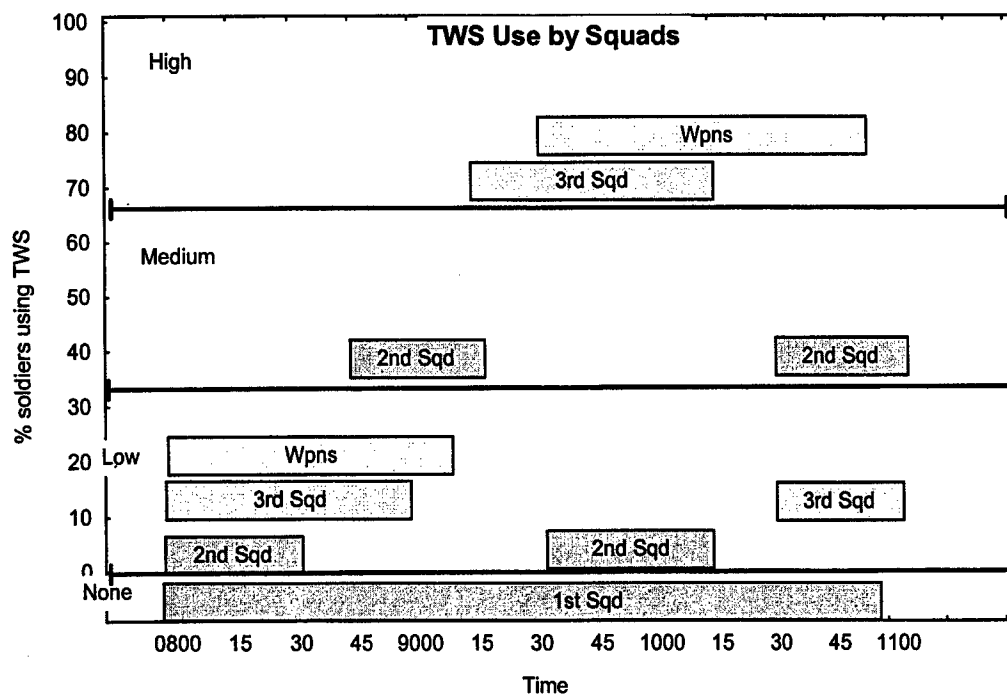Would this type of display be useful to you?   Yes   No
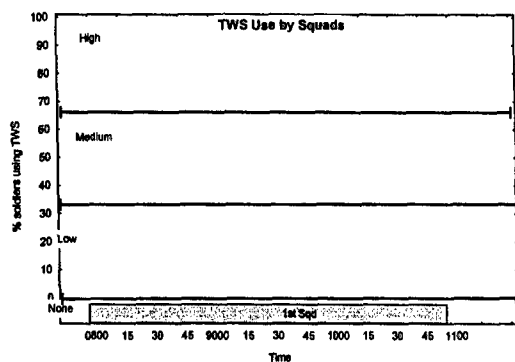What changes, if any would you want in this display?
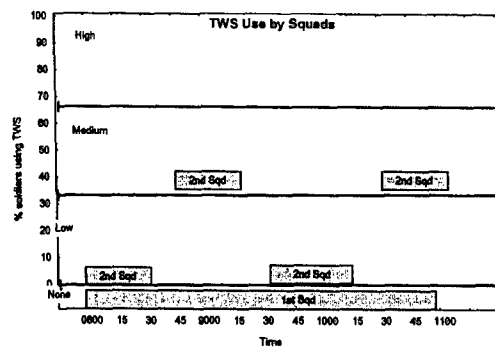

3
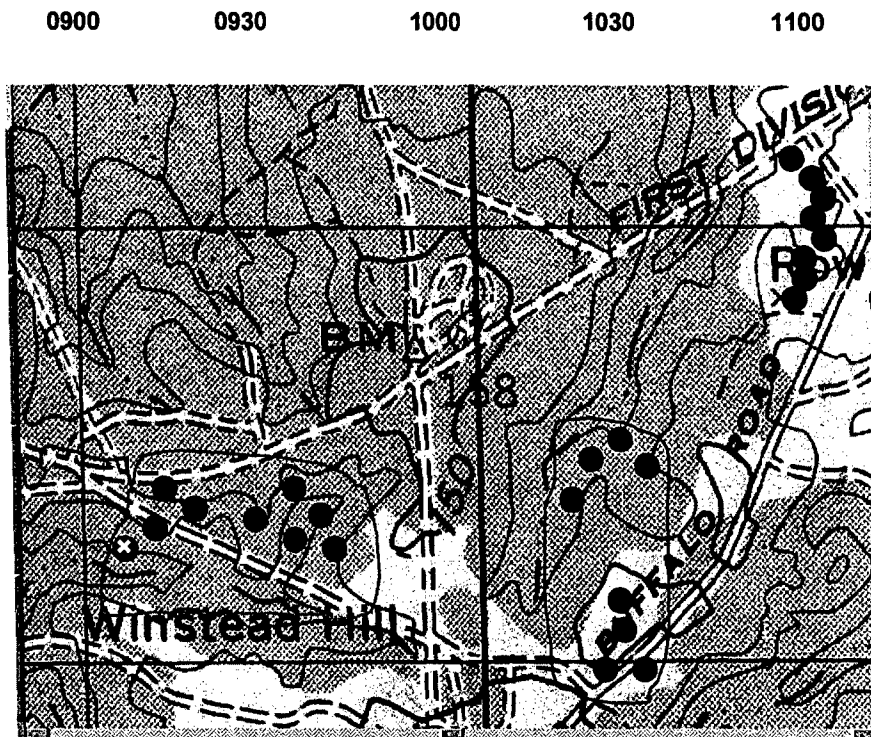
4. Set of TWS charts (5)

  As you know, one of the key sensors or devices in the LW system is the thermal weapon sight, also known as the TWS. A leader might want to know the extent to which members of his unit used the TWS during a particular mission. In the next set of charts, we have depicted use of the TWS by squads within a platoon. This first chart simply depicts usage by every squad.
In the next slide we start by showing only the first squad. In this case, there was no use of the TWS, perhaps the squad was not in a situation where the TWS was needed. The next slide adds the second squad, where we see a different pattern of use (low and medium use). And the next slide, adds third squad. The fourth slide adds the weapons squad.

Would this type of display be helpful to you?   Yes   No
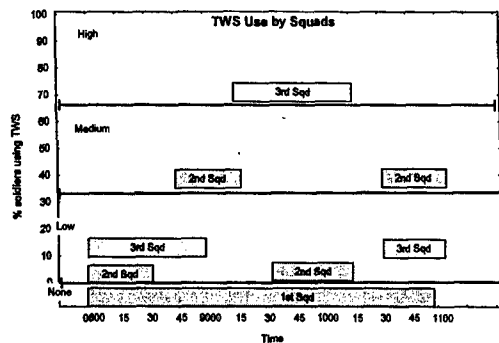What changes, if any, would you want in this display?

TWS Use by Squads

4

A-13

TWS Use by Squads

(Chart 5: High / Medium / Low / None; y-axis "% soldiers using TWS" 0-100; x-axis "Time" 0800 15 30 45 9000 15 30 45 1000 15 30 45 1100; bar labeled "1st Sqd")

TWS Use by Squads

(Chart 6: High / Medium / Low / None; y-axis "% soldiers using TWS"; x-axis "Time" 0800 15 30 45 9000 15 30 45 1000 15 30 45 1100; bars labeled "2nd Sqd", "1st Sqd")

TWS Use by Squads

(Chart 7: High / Medium / Low / None; bars labeled "3rd Sqd", "2nd Sqd", "1st Sqd")

TWS Use by Squads

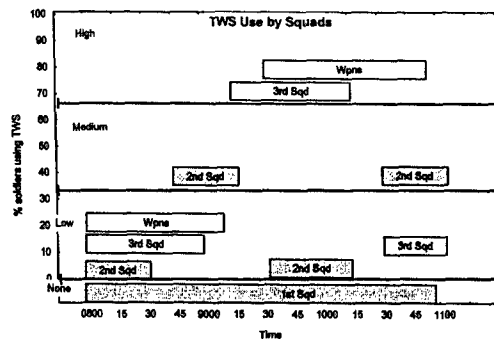(Chart 8: High / Medium / Low / None; bars labeled "Wpns", "3rd Sqd", "2nd Sqd", "1st Sqd")

5. Squad sensors.

The TWS is not the only sensor organic to the rifle squad. The squad also has the daylight video sight or DVS, they will have a laser range finder or LRF, and they will have an individual combat identification system (ICIDS, abbreviated here as ID). There might be a need to show when the squad used these sensors and the degree to which they used them. That is what is depicted on this chart. – extent of use by DVS and TWS, plus the times where the LRF and ID system were used.

Would this type of display be helpful to you?   Yes   No
What changes, if any, would you want in this display?

A-15
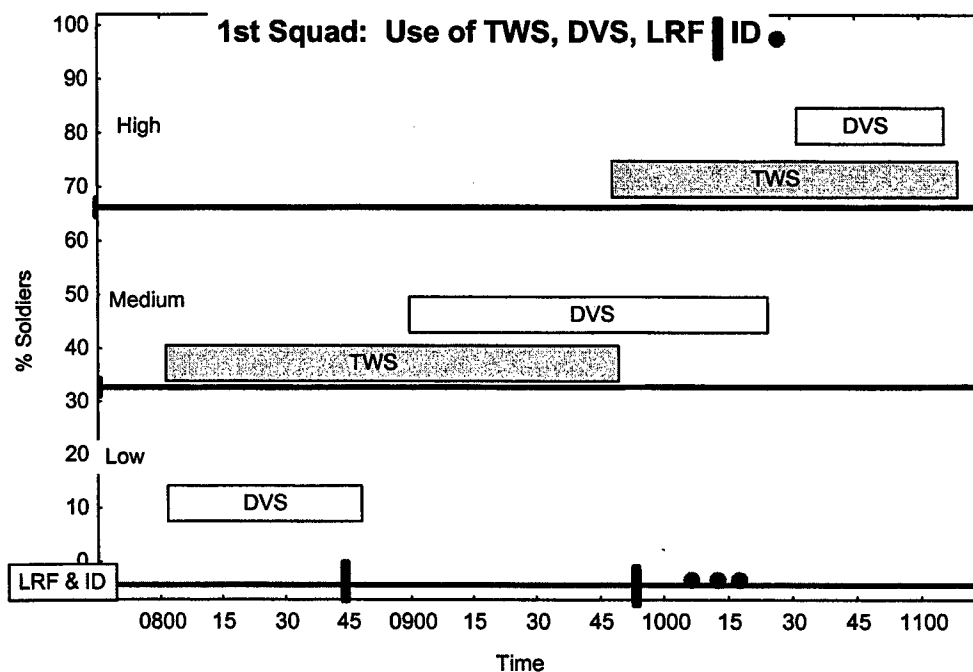
6. Dispersion

Lastly, we know that the LW system can track every individual. We've shown you some displays related to direction of movement and movement formations. But you might also be interested in dispersion of individuals within squads. This chart shows the average dispersion across time for the squads. We have plotted several different patterns for illustrative purposes. For example, both 1st and 3rd squad showed decreased dispersion over time, but 3rd squad was always more dispersed. 2nd squad was highly dispersed and then for some reason, perhaps when crossing a danger area, closed in. Then they dispersed again.

Would this type of display be helpful to you?   Yes   No
What changes, if any, would you want in this display?

Mean Distance Between Soldiers

10

A-16
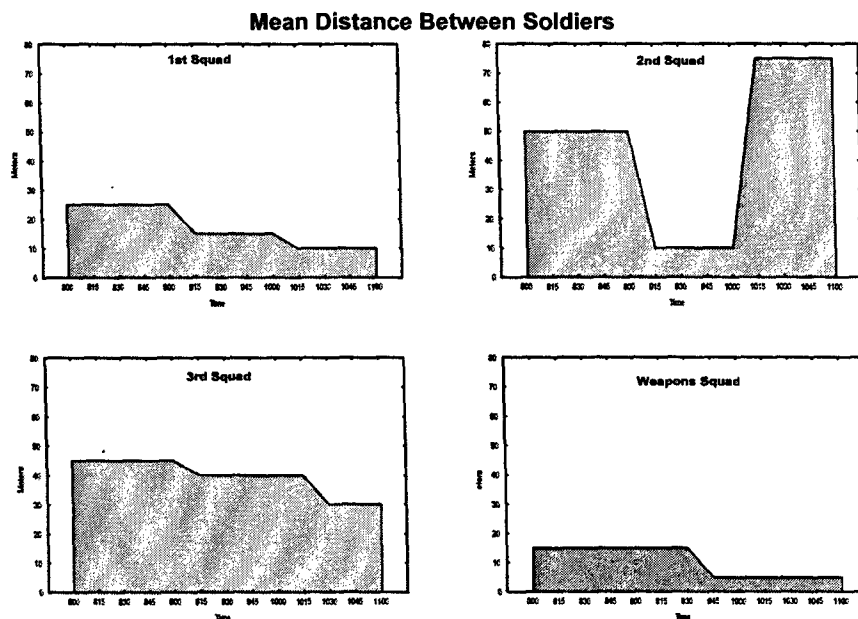
Handouts

(Handout – List of AAR topics to be ordered)

Please order the following topics in terms of the frequency that you address them in a normal AAR.

Shoot (anything to do with weapons, optics, ammo)

Move (anything to do with maneuver, formations, fuel)

Communicate (coordination, messages, synch, planning)

Fratricide

Force Protection (protective obstacles, MOPP, safety)

Preparation (PCI, rehearsal, maint)

(Hand out on topics to be addressed in interview)

Topics in an AAR

Shoot (anything to do with weapons, optics, ammo)
- Ammunition expended by the unit (by weapon type) (by individual systems) (etc)
- Enemy casualties (people) (vehicles, by type) (facilities)
- Friendly casualties (by weapon type) (by individual) (leaders)
- Weapon status (which ones functional) (proper employment, positioning)
- Sensors and/or optics (which ones functional) (proper employment)
- Other

Move (anything to do with maneuver, formations, fuel)
- Locations of individuals, vehicles, units (at specific times) (over a period of time)
- Routes that the unit followed (trafficability) (cover & concealment) (avoid enemy strength)
- Dispersion (individuals) (elements) (units)
- Rate of movement (speed for situation) (maintaining contact) (maintain commo)
- Other

Communicate (coordination, messages, synch, planning)
- Number of transmissions
- Average length of transmissions
- Content of transmissions
- Who talks to whom
- What information was passed and when
- Planning for the operation
- Efforts to synchronize activities
- Efforts to coordinate
- Efforts to avoid or overcome ECM/ECCM (jamming)
- Other

Force Protection (protective obstacles, MOPP, safety)
- Obstacle locations and include supporting fires
- Planned fires and/or actual fires (including smoke)
- MOPP level and other protection from NBC
- Warning for enemy aircraft
- Other

Preparation (PCI, rehearsal, maint)
- Pre-combat inspections (PCI)
- Rehearsals
- Maintenance
- Other

(Handout on types of visual displays)

<u>Types of visual displays</u>

Text

Sketch

Bar chart

Table of numbers

Sand table

Appendix B

Acronyms

AAR	After action review
ABCS	Army Battle Command System
ARTEP	Army Training and Evaluation Program
ASAS	All Source Analysis System
ATAFS	Automated Training Analysis and Feedback System
BDA	Battle damage assessment
BLUFOR	Blue force
BOS	Battlefield operating systems
CALL	Center for Army Lessons Learned
CCTT	Close Combat Tactical Trainer
CTC	Combat Training Center
C4I	Command and control, communications, computers and intelligence
DA	Department of the Army
DIVAARS	Dismounted Infantry Virtual After Action Review System
DVS	Daylight video sight
ECCM	Electronic counter countermeasure
ECM	Electronic countermeasure
FBCB2	Force XXI Battle Command Brigade and Below
FM	Field manual
FRAGO	Fragmentary order
GSS	Ground Soldier System
GPS	Global positioning system
JAWP	Joint Advanced Warfighting Program
JCF AWE	Joint Contingency Force Advanced Warfighting Experiment
JRTC	Joint Readiness Training Center
ICIDS	Individual combat identification system
LRF	Laser range finder
LW	Land Warrior

MCS	Maneuver Control System
MEDEVAC	Medical evacuation
MILES	Multiple Integrated Laser Engagement System
MOPP	Military Oriented Protective Posture
MOUT	Military Operations in Urban Terrain
MTP	Mission Training Plan
NBC	Nuclear, biological, and chemical
NVGs	Night vision goggles
OC	Observer/Controller
OICW	Objective Individual Combat Weapon
OPFOR	Opposing force
OPORD	Operation Order
PCI	Pre-combat inspection
PEO STRI	Program Executive Office for Simulation, Training, and Instrumentation
SA	Situation awareness
SIMNET	Simulation Networking
SITREP	Situation report
SOP	Standing Operating Procedure
STRICOM	Simulation, Training, and Instrumentation Command
TAF	Training Analysis Facility
TAFF Aids	Training analysis and feedback aids
TC	Training Circular
TEO	Training and evaluation outline
TES	Tactical engagement system
TTP	Tactics, techniques and procedures
TWS	Thermal weapon sight
UPAS	Unit Performance Assessment System
ViSSA	Virtual Soldier Skills Assessment
WARNO	Warning order