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Battalion Evaluation of the Combat Vehicle Command and Control System in Distributed Interactive Simulation: Preliminary Findings

Bruce C. Leibrecht, Beverly J. Winsch, Laura A. Ford, Alicia R. Sawyer, Glen A. Meade, Frances M. Ainslie, Paul G. Smith, Robert S. Sever, and William J. Doherty

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To meet command, control, and communications (C3) challenges of the future battlefield, the Combat Vehicle Command and Control (CVCC) research and development program evaluates automated C3 technology using soldier-in-the-loop simulation. The CVCC system includes a digital Position Navigation system, a digital Command and Control Display, the Commander's Independent Thermal Viewer, and digital workstations in the Tactical Operations Center. The battalion-level evaluation compares the CVCC system with a Baseline (conventional) configuration in terms of operational effectiveness. Soldier-machine interface (SMI) and training implications are also addressed. Using M1 tank simulators in the Mounted Warfare Test Bed at Fort Knox, Kentucky, unit commanders and executive officers with crews are integrated with semiautomated vehicles under their control to form complete tank battalions. Each battalion completes 4 days of training and testing, culminating in a simulated combat test scenario. This report presents preliminary data based on two Baseline battalions and two CVCC-equipped battalions. Improvements in the performance of unit and vehicle commanders are noted, and selected SMI and training results are discussed. The
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findings help determine operational effectiveness parameters, user requirements, and training requirements for future automated C3 systems for combat vehicles.

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Training Simulation

FOREWORD

The Fort Knox Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) conducts soldier-in-the-loop simulation-based research that addresses training requirements for the future integrated battlefield. These efforts are supported by Memoranda of Understanding (MOU) with (a) the U.S. Army Armor Center and Fort Knox, Subject: Research in Future Battlefield Conditions, 12 April 1989, and (b) the U.S. Army Tank-Automotive Command (TACOM), Subject: Combat Vehicle Command and Control (CVCC) Program, 22 March 1989.

The CVCC research program combines advanced digital and thermal technologies to enhance mounted warfighting capabilities to accomplish command, control, and communications (C3). The CVCC system includes digital map, report and overlay features, positioning and navigation functions, digital transmission capabilities, and independent thermal viewing for unit and vehicle commanders. This configuration provides a powerful medium for investigating training requirements of future automated technology for armored vehicles. The research reported here used distributed interactive simulation to evaluate the CVCC capabilities at the battalion level. The preliminary findings presented in this report support Army developers in determining user requirements, specifying training requirements, and assessing operational effectiveness of automated C3 systems for ground combat vehicles. In addition, the training and simulation techniques developed for this effort are of use to other Army training and testing agencies.

Information resulting from this research has been briefed to the following personnel: Commanding General, U.S. Army Training and Doctrine Command; Commanding General, U.S. Army Armor Center and School; Deputy Commanding General for Combat Developments, U.S. Army Combined Arms Command; Deputy Chief of Staff for Training, U.S. Army Training and Doctrine Command; Director, Directorate of Combat Developments, U.S. Army Armor School; and Director, Mounted Warfighting Battlespace Lab.

EDGAR M. JOHNSON
Director

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The following members of the U.S. Army Research Institute for the Behavioral and Social Sciences Fort Knox Field Unit provided invaluable input to this evaluation: Barbara Black, Field Unit chief; Kathleen Quinkert, Leader of the Future Battlefield Conditions (FBC) team; Carl Lickteig and Gary Elliott, FBC team members; and Major James Whitehead, the Field Unit's research and development coordinator.

In addition to the authors, the BDM Federal, Inc., research staff included Nancy Atwood, Major General (Ret.) Charles Heiden, Owen Pitney, and Ryszard Lozicki. Jeffrey Schmidt and Margaret Shay provided invaluable assistance in developing and editing the report. Research Assistants supporting the project included Silver Campbell, Ann Cash, Kenneth Fergus, Brian Gary, Gary Gulbranson, Michael Gustafson, David Johnson, Ronald Jones, William Myers, Robert Pollock, Ronald Reyna, Charles Sawyer, Daniel Schultz, Timothy Voss, and Harold Wager.

Personnel of the on-site support contractor, Loral Training and Technical Services, supported simulation equipment and data collection/analysis. These included Jimmy Adams, David Clippinger, Michael Krages, Paul Monday, Rob Smith, and Diane York.

BATTALION EVALUATION OF THE COMBAT VEHICLE COMMAND AND CONTROL SYSTEM IN DISTRIBUTED INTERACTIVE SIMULATION: PRELIMINARY FINDINGS

EXECUTIVE SUMMARY

Requirement:

Meeting the command, control, and communications (C3) challenges of the high-speed, high-intensity, widely-dispersed future battlefield requires automated C3 systems. Systematic research and development efforts, including careful assessment of training requirements, are necessary to field and deploy automated C3 systems. The U.S. Army's Combat Vehicle Command and Control (CVCC) research and development program uses soldier-in-the-loop, simulation-based methodology to evaluate future C3 technology. Previous CVCC research focused on tank crews, platoons, companies, and the battalion Tactical Operations Center. A focus on performance of unit commanders and executive officers led to the battalion-level evaluation.

Procedure:

An independent group's design compared two conditions: (a) Baseline, modeling conventional M1 tank and Tactical Operations Center (TOC) C3 tools (mainly voice radio and paper maps), and (b) CVCC, supplementing Baseline capabilities with a digital Position Navigation (POSNAV) system, a digital Command and Control Display (CCD), the Commander's Independent Thermal Viewer (CITV), and digital TOC workstations. Using autoloading tank simulators in the Mounted Warfare Test Bed (MWTB) at Fort Knox, Kentucky, eight qualified armor crews (battalion commander, battalion operations officer, three company commanders, and three company executive officers, each working with a gunner and driver) were integrated with semiautomated elements under their control to form a complete tank battalion. Two Baseline and two CVCC-equipped battalions completed a standard sequence of training scenarios and then executed a standard simulated combat test scenario. Each battalion used only its assigned equipment (Baseline or CVCC) throughout training and testing. Measures of performance were designed to reveal the impact of the CVCC capabilities.

Findings:

Based on only two CVCC and two Baseline battalions, the results in this report are strictly preliminary and do not constitute statistically reliable trends. The findings are indicative of trends that may be confirmed with the complete battalion-level database, which will contain six battalions in each condition. The CVCC capabilities appeared to enhance tactical communications, as reflected in reduced voice transmission time, fewer SITUATION reports submitted, and fewer requests to clarify fragmentary orders. CVCC-equipped battalions sent more accurate CALL FOR FIRE and SPOT reports and appeared more successful in controlling terrain. The CVCC groups executed combat missions more quickly, inflicted greater casualties on the enemy, and sustained fewer combat losses. Based on participants' questionnaire responses and debriefing comments, soldier-machine interface and training issues included concern about the information load generated by digital reporting, recommendations for improving the CVCC interface, and desire for additional task training.

Utilization of Findings:

The preliminary findings of the CVCC battalion evaluation provide important input in determining operational effectiveness parameters, training requirements, and user requirements for future automated C3 systems in ground combat vehicles. In addition, the training and simulation methods are of use to other Army training and testing efforts.

BATTALION EVALUATION OF THE COMBAT VEHICLE COMMAND AND CONTROL SYSTEM IN DISTRIBUTED INTERACTIVE SIMULATION: PRELIMINARY FINDINGS

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BATTALION EVALUATION OF THE COMBAT VEHICLE COMMAND AND CONTROL SYSTEM IN DISTRIBUTED INTERACTIVE SIMULATION: PRELIMINARY FINDINGS

Introduction

The command, control, and communications (C3) challenges of the future battlefield promise to exceed the capabilities of currently fielded combat systems. The U.S. Army's cornerstone document on combat doctrine, FM 100-5, (Department of the Army, 1986) portrays a combat environment characterized by speed, intensity, dispersion, and fluidity. The intense, rapid pace of operations will shorten planning and decision cycles, driving a need for faster gathering and exchange of tactical information. It also will necessitate rapid and accurate massing of fires, both direct and indirect. Highly mobile operations will increase the importance of timely, effective coordination with adjacent and supporting units of the combined arms team. Sustaining rapid, highly mobile initiatives will require timely, accurate logistics information, especially while in contact with enemy forces. The high technology character of future threat systems will severely threaten the survivability of friendly forces unless C3 systems can support more dispersed, highly flexible maneuvers while guarding against electronic surveillance and electronic counter-measures. Given the extremely fluid nature of the future battlefield, the ability of unit leaders to maintain an accurate, up-to-date picture of their battle sector will be a critical imperative. Situational awareness will be a compelling factor in preventing fratricide. The lessons learned in Desert Storm graphically illustrate many of the C3 problems of a high-tempo, highly fluid battlefield, such as navigation difficulties, delays or interruptions in disseminating information, confusion about friendly and enemy locations, and tragic instances of fratricide (Department of Defense, 1992).

Meeting the C3 challenges of the future battlefield will require automated capabilities based on advanced digital technology. To field and deploy combat-effective digital systems, extensive research and development efforts are needed. An important focus of these efforts must address the training requirements that will ensure optimum C3 on the combined arms battlefield. The Army's C3 modernization thrust aims to capitalize on an extensive network of digital nodes that are to be capable of rapidly and reliably exchanging combat-critical information. Under this thrust, the U.S. Army Tank-Automotive Command (TACOM) sponsors a U.S-German bilateral research and development effort. Known as the Combat Vehicle Command and Control (CVCC) program, this effort addresses automated C3 requirements for ground combat vehicles. The program is managed by four teams, each with a counterpart German team: the User Requirements Team, chaired by the Directorate of Combat Developments, U.S. Army Armor School; the Communications Team, chaired by the U.S. Army Communications-Electronics Command; the Vehicle Integration Team, chaired by TACOM; and the Soldier-

Machine-Interface and Simulation Team, chaired by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). The efforts of the four teams are interdependent and mutually supportive.

The capabilities of the CVCC conceptual system are typical of automated C3 systems in general. The capabilities span navigation, communication, target acquisition, battle monitoring, and mission planning. The functional features include: (a) a digital tactical map capable of displaying graphic overlays; (b) automated navigation functions, including generation of graphic routes, display of steering information to the driver, and graphic display of friendly element locations; (c) digital processing of reports, orders, and graphic overlays, to include preparation, transmission, storage, and retrieval; (d) input of precise location information to digital reports; (e) graphic presentation of key report information; (f) automatic reporting of tank/unit status; (g) independent thermal viewing for the vehicle commander; and (h) support of battalion staff planning and control by means of automated workstations. The CVCC incorporates presentation of processed information in graphic or pictorial form, making it easier for users to assimilate. Exchange of information among vehicles and staff elements is accomplished via digital burst transmission. The collective capabilities of the CVCC provide near real-time acquisition, processing, and dissemination of combat-critical information.

The CVCC capabilities are designed to support faster, more efficient, more effective C3. In turn, this will have important impacts in terms of enhanced combat effectiveness (Department of the Army, 1992). The greater accuracy and consistency of information transmitted across echelons will improve the overall quality of C3 processes. More rapid exchange of information will speed the plans-orders cycle, enabling commanders to react more effectively to mission changes while they are on the move. Battlefield lethality will benefit from more rapid and more accurate application of decisive combat power, including direct and indirect fires. The near real-time exchange of combat-critical information and graphic presentation of processed data will enhance situational awareness, owing especially to precise information on locations of friendly and enemy elements. This in turn will enable more effective mission planning and execution. Force survivability will increase through increased tactical dispersion and reduced electronic signature. Improved situational awareness, together with better coordination of direct and indirect fires, will reduce the incidence of fratricide. As a recent Army concept paper (Department of the Army, 1992) states, automated C3 "will contribute to a dramatic improvement in force effectiveness" (p. v).

The research described in this report was the fifth in a series of CVCC experiments conducted by the Future Battlefield Conditions Team of the ARI Fort Knox Field Unit. The research began with evaluations of individual components at the crew and platoon levels, then progressed to a company-level evaluation of integrated components. The next effort advanced the research to the battalion level, with a limited evaluation focusing on the role of the battalion Tactical Operations Center (TOC) equipped with automated workstations. At each stage of the research, the capabilities of the CVCC have been improved and expanded, along with the materials and procedures supporting the evaluation. The goal of the current evaluation was to compare the performance of CVCC-equipped armor battalions with that of conventionally-equipped battalions, focusing on unit commanders and executive officers as well as overall battalion capabilities. Specific objectives were to (a) evaluate operational effectiveness, (b) identify critical soldier-machine interface (SMI) issues, and (c) investigate training issues.

The current CVCC experimental configuration integrates digital reporting capabilities, digital tactical map and overlay functions, automated positioning and navigation features, and independent thermal viewing for the vehicle commander. A Command and Control Display (CCD) forms the heart of the system, integrating digital reporting and map functions with a Position Navigation (POSNAV) system. The Commander's Independent Thermal Viewer (CITV) affords the vehicle commander his own capability to search the battlefield, acquire targets by lasing, and hand off targets to his gunner. In addition, automated workstations enable the battalion staff to support the maneuver elements by preparing digital orders, overlays, and messages and by digitally monitoring the battle.

This report presents the preliminary findings of the battalion evaluation, based on a limited number of sample battalions. The preliminary data will be combined with those from the continuing data collection effort to produce a comprehensive database on battalion-level contributions of CVCC technology. At the conclusion of the evaluation, a series of reports will document the collective findings related to operational effectiveness, SMI implications, and training issues.

Six primary sections serve to organize the remainder of this report:

1. Background and Review of Key Literature - examines published research efforts pertaining to conventional and automated C3, previous CVCC research, and selected SMI issues.

2. Design of the Evaluation - presents the objectives and issues addressed by the research, along with the general approach and the experimental design.

3. Method - describes the participants, test unit configuration, equipment, facilities, materials, and procedures supporting the evaluation.

4. Performance Measures - summarizes the approach and hypotheses which guided the quantification of performance, and outlines the organized set of performance measures.

5. Results and Discussion - presents the preliminary findings regarding performance of unit leaders, discusses SMI and training implications, and reviews methodological issues.

6. Conclusions and Recommendations - recaps key findings and discusses implications for future research.

Background and Review of Key Literature

Command, Control, and Communications

As a crucial component of combat operations, C3 refers to the process and means through which the activities of a combat unit are planned, directed, coordinated, and controlled to accomplish the mission (Department of the Army, 1988). C3 is made up of systems and procedures all designed to achieve a common goal: successful accomplishment of the current mission while retaining sufficient combat capability to continue follow-on missions in accordance with the commander's intent. It is the execution of the command and control processes and the utilization of the various communication means that form the primary behaviors toward which this distributed simulation evaluation is directed.

Conventional C3

The literature on conventional C3 is extensive, primarily found in the myriad of Army Field Manuals, in tactics, techniques, and procedures (TTPs) publications, and in a variety of articles and papers published in Army periodicals (e.g., Military Review and Armor) or originating in the combat development/training development communities. All, however, have a common thread in terms of purpose and outcome of the C3 system: "... to enable the commander to make timely decisions during the turmoil of battle" (Department of the Army, in preparation). Observations and conclusions from the U.S. Army's National Training Center (NTC) identify the critical relationship between effective C3 and battlefield success. These conclusions emphasize that the commander must "SEE" the battlefield, (i.e., know the location, activities, and status of both friendly and enemy forces). He does this through fast and accurate reporting, and with the support of the TOC for information processing, planning, and coordination (Department of the Army, 1985).

More recent observations of combat operations during Desert Storm support the 1985 NTC conclusions. The Department of Defense's 1992 Final Report to Congress, Conduct of the Persian Gulf War, identified shortcomings for the M1A1 tank included a lack of a positive combat vehicle identification system, (e.g., a higher resolution thermal sight which would improve detection, recognition and identification, and the lack of an on-board navigation device). Solutions to these shortcomings are being implemented in the M1A2 by fielding a CITV and a POSNAV device for each vehicle (Department of Defense, 1992).

Conventional command and control procedures are most "... frequently dictated by the limitations of the Army's voice-based radio system" (Lickteig, 1991, p. 5), and are conducted using "manual" tools, (i.e., mapboards, acetate, grease pencils, and hand-written/maintained logs, journals, and workbooks). These procedures are cumbersome and inefficient at best, and, in the heat of battle, may result in the loss of critical information or misinterpretation of instructions or intent. In contrast, automated tools using improved communications linkages have the potential not only to enhance the accuracy and speed of the command and control process, but "... to provide an unprecedented capability ... to 'see the battlefield'" (Lickteig, 1991, p. 5).

Automated C3

The advent of automated command and control tools coupled with improved communications equipment (e.g., Single Channel Ground and Airborne Radio System--SINCGARS) have a potential significant impact on both the method and outcome of command and control in combat. In addition to the CITV and POSNAV capabilities being fielded for the M1A2, "the introduction of the IVIS [Intervehicular Information System] to the tank is expected to provide an exponential increase in the ability of the commander and the staff to plan, execute, and support missions, as well as enhance the ability of the crew to acquire, engage, and destroy enemy targets" (Department of the Army, 1992, p. v). The U.S. Army Armor Center has played a key role in developing automated C3 concepts.

The continuing series of CVCC evaluations, a recent assessment of the M1A2 and its C3 enhancements, and a just-completed demonstration of IVIS in a combined arms environment are past and current efforts using distributed interactive simulation facilities to investigate automated C3 concepts. Simulation tools developed within the Armor Center's Mounted Warfare Test Bed (e.g., POSNAV, CCD, IVIS, CITV, and automated TOC workstations) form the high technology nucleus with which to compare automated and conventional C3 methods and means. Planned efforts capitalizing on these and other technologies include Combined Arms Command and Control initiatives sponsored by the Mounted Warfighting Battlespace Lab, interactive integration with a Fort Leavenworth corps battle simulation exercise, and "seamless" support to large-scale Army training exercises.

The Mounted Warfare Test Bed

The U.S. Army's Mounted Warfare Test Bed (MWTB) is a pioneering battlefield C3 simulation environment where, among other research and development efforts, combat, training, and materiel developers can put their ideas on trial before "issuing doctrinal changes or ... bending ... metal" (Lunsford, 1989). More specifically, the MWTB is designed to provide low-cost, unit-level, full mission simulation using extended local and long-haul networking and families of simulators supported by site-specific microprocessors (Du Bois & Smith, 1989; Miller & Chung, 1987). Using a soldier-in-the-loop approach, the MWTB emulates a realistic C3 and battlefield environment in which to conduct combat simulations to assess the combat capabilities of experimental C3 configurations before final design, production, and field implementation.

The MWTB represents distributed networking architecture that can be modified to accommodate a broad range of soldier performance research and development (R&D). The evolution of the MWTB began with a Defense Advanced Research Projects Agency (DARPA) initiative called SIMulation NETworking (SIMNET) to demonstrate the feasibility of linking manned and unmanned simulators in a computer network (Alluisi, 1991). SIMNET-T (Training) was used to examine the use of SIMNET technology in training troops. SIMNET-D (Developmental) was established to apply SIMNET technology to testing, and to the development of materiel, combat and doctrine, and organizational concepts. The MWTB, originally the SIMNET-D Facility (and, until recently, called the Close Combat Test Bed [CCTB]), now supports a variety of initiatives sponsored by DARPA, ARI, the Mounted Warfighting Battlespace Laboratory and the Combat Developments community at Fort Knox, and others.

The SIMNET architecture was designed specifically to accommodate the introduction of newer and more powerful equipment as it became available. With the explosion of both simulator and simulation technology in the late 1980's, however, much of which was developed for specific purposes and often unique and/or proprietary, DARPA and the U.S. Army Simulation, Training, and Instrumentation Command (then Project Manager, Training Devices) initiated a project in 1989 to establish industry standards for the SIMNET protocols, called Distributed Interactive Simulation (DIS). The DIS architecture provides the structure through which "... independently developed systems may interact with each other in a well managed and validated combat simulation environment..." (Loral Systems Company, 1992). The MWTB is today closely involved with the development of and compliance with those DIS standards.

The MWTB's automated C3 capabilities (including the CVCC technologies) are characterized by selective fidelity of components, collective training, and an iterative approach to system design. Selective fidelity enables system performance to be sufficiently emulated to elicit the required levels of perceptual realism among users (Chung, Dickens, O'Toole, & Chiang, 1988). This "psychological fidelity" enables the battlefield-oriented perceptual cues within the test bed to be exploited without having to employ more expensive operational technology.

<u>MWTB Capabilities</u>

The MWTB's research capabilities have been thoroughly described by Leibrecht, Kerins, Ainslie, Sawyer, Childs and Doherty (1992). Central to the test bed are the manned vehicle simulators, which model actual vehicles to the minimum degree necessary for soldiers to accept them as realistic and useful (Chung et al., 1988). Sound and visual simulation components reproduce key aspects of the battlefield operating environment. A variety of computer-based systems provide tactical communications, scenario control and monitoring capabilities, and robust data collection and analysis support. Table 1 summarizes these capabilities, and Figure 1 shows a schematic of the basic system architecture.

Table 1

The MWTB's Major Features

Features	Description
Manned simulators	Selective fidelity crewstations, with supporting hardware and software, including terrain database.
TOC workstations	Automated workstations for selected TOC staff, with supporting hardware and software, including large-screen display and screen printer.
Tactical communications	Simulated SINCGARS network for linking manned simulators, TOC workstations, and control stations; capable of both voice and digital burst transmission.
Surrogate vehicles	Semiautomated forces program for creating and controlling unmanned vehicles and aircraft, both friendly and enemy; provides digital message traffic.
Scenario control	Management, Command and Control (MCC) system for initializing and monitoring manned simulators and implementing fire support. Workstation for inserting and monitoring digital messages.
Scenario monitoring	Plan View Display providing a "bird's eye view" of a simulation exercise; supports map manipulation and event flagging. Stealth station for out-the-window viewing of the battlefield.
Data recording and analysis	Data Collection and Analysis system for on-line recording of automated data and off-line reduction and analysis; supports playback. Includes DataLogger, DataProbe™, and RS/1™ (Registered trademarks of BBN Software Products Corporation).
Utilities	Network control station, capability to save and restart exercise states, SAFOR report generation, LISTEN system to record digital messages, and playback support.

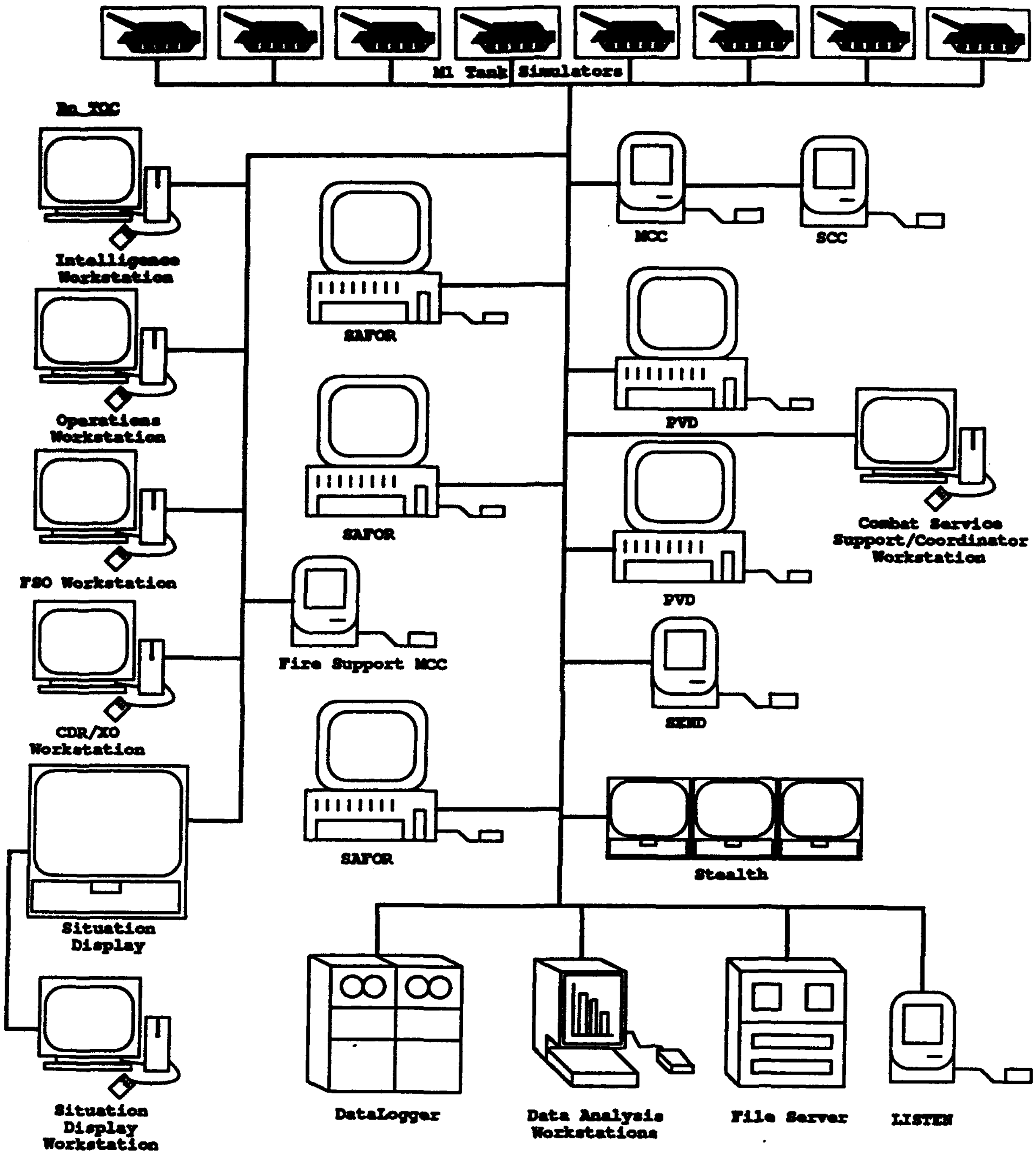

Figure 1. Schematic of the basic distributed simulation networking environment in the Mounted Warfare Test Bed. Tank simulators and battalion TOC workstations represent the battlefield environment. MCC, SAFOR, and PVD elements are exercise control systems. DataLogger, data analysis workstations, and file server are part of the Data Collection and Analysis system.

MWTB Advantages

Armor crew and unit performance-oriented research carried out within the test bed in recent years has produced data of substantial operational significance (Leibrecht et al., 1992; Du Bois & Smith, 1991; Atwood, Quinkert, Campbell, Lameier, Leibrecht, & Doherty, 1991). This is directly related to the MWTB's inherent advantages (O'Brien, Wigginton, Morey, Leibrecht, Ainslie, & Sawyer, 1992), including its:

1. Flexibility in allowing crews to perform a broad range of missions.

2. Versatility in providing realistic engagement interaction in a variety of simulated battlefield settings.

3. Capability to present tank crews and units with operationally realistic task and mission loading levels.

4. Fidelity of tactical communications.

5. Adaptability in ensuring standardization of experimental procedures.

6. Value in identifying training requirements.

7. Relatively low cost in evaluating experimental configurations of C3 and related systems.

8. Automated capability to capture and analyze objective performance data.

9. Unique analysis capabilities afforded by playback.

MWTB Constraints

As with any large-scale simulation, the MWTB has several constraints in its representation of operational combat settings. These limitations, many of which have been addressed by Du Bois and Smith (1989), include the following:

1. Limited visual fidelity of the computer-generated imagery, which limits depth perception, battlefield orientation, long-range target identification, and certain tactical maneuvers.

2. Maximum simulated viewing distance of 3500 meters, resulting in a potentially misrepresented horizon.

3. Loss of vision block imagery, especially for the driver, when the computer image generator is overloaded.

4. Inability to conduct open hatch operations, which, together with a limited number of cupola vision blocks, constrains the vehicle commander's view of the battlefield and complicates navigation.

5. Limited fidelity of the dynamic battlefield environment, including a zero-motion platform, limited representation of combat noises, absence of weather variations and atmospheric degradations, and lack of dynamic terrain.

6. Potential for vehicle commanders to follow semiautomated vehicles instead of navigating on their own.

7. Absence of machine guns and smoke grenades.

8. Problematic performance of the sighting and fire control systems, such as difficulty in maintaining proper bore sight and unrealistic implementation of target lead functionality.

9. Simplistic implementation of combat support (e.g., fire support, combat engineering) and combat service support (e.g., resupply).

10. Unrealistic behavior of semiautomated vehicles, including perfect identification of targets, unrealistic fire control and distribution, and failure to use cover and concealment when moving.

11. Lack of vehicle identification plates, resulting in problematic identification of friendly vehicles.

12. Lack of the gunner's auxiliary sight (GAS), constraining the use of terrain for protective positioning.

It is important to note that these constraints applied at the time the CVCC battalion evaluation was being planned and implemented. Ongoing technical efforts continue to improve the simulation technology, especially in the areas of semiautomated forces and combat support capabilities.

Several special features help offset the MWTB constraints. For example, a grid azimuth indicator and a turret-to-hull reference display (provided in each simulator) help compensate for the closed hatch constraint, providing cues that are critical for positioning, maneuvering, and navigation. To counter the limited visual fidelity, crews can be provided with special topographic paper maps that represent buildings, rivers, roads, etc. as they appear on the simulated battlefield. Also, special tactical guidelines have been developed to mitigate the limited viewing distance, along with navigation training.

ARI-Fort Knox Future Battlefield Conditions Research Program

The ARI-Fort Knox Future Battlefield Conditions Team has pioneered and sustained the application of the MWTB to evaluate emerging armor concepts, particularly under the CVCC program. In a ground-breaking study, Du Bois and Smith (1989) empirically evaluated an automated POSNAV system configured in either grid or terrain map format. The performance of armor crews using these formats was compared with that of crews using conventional navigational techniques. By using POSNAV, crews were able to navigate more accurately and efficiently than crews using conventional means in virtually all battlefield situations. For example, both POSNAV groups performed road marches significantly better than the control group.

Relative to the control group, POSNAV crews were better able to determine own-tank location, maintain own-tank orientation, determine locations of other battlefield elements, perform map terrain association, navigate point to point, bypass obstacles, and react to enemy fire. Differences between POSNAV and control conditions in their questionnaire responses were statistically significant for 32 of the 36 measures analyzed. The research clearly suggests that POSNAV systems can be expected to significantly improve the performance of tank crews and platoons on the battlefield.

In a similar effort, Du Bois and Smith (1991) evaluated the IVIS, an automated C3 display, using the MWTB. IVIS is a distributed information management system designed to provide improved capabilities to assess both friendly and threat battlefield situations. Findings of the IVIS study indicated that tank crews and platoons equipped with IVIS performed significantly better than conventionally-equipped control crews and platoons in virtually every capacity. Specifically, IVIS significantly improved unit performance in mission execution time and success, report times and accuracy, fragmentary order (FRAGO) execution, battle position occupation, and obstacle bypass efficiency. IVIS crews not only performed better overall than control crews, but perhaps more importantly, they also performed more consistently as indicated by smaller standard deviations for all measures. Significant differences in favor of IVIS-equipped crews were also found for a number of process measures, including fuel use and mean velocity. The benefits of IVIS were attributed almost solely to the system's POSNAV capabilities, as opposed to the automated report functions. This may have resulted, at least in part, because the platoon level used in the evaluation was not high enough to fully reveal the advantage of the automated C3 equipment. This underscored the importance of extending the research to the company and battalion levels.

Quinkert (1990) examined the performance enhancement capabilities of the CITV, using Conduct of Fire Trainer (COFT) facilities. The CITV is a surveillance and target acquisition system for use in the M1. It allows a vehicle commander to independently search a sector, identify and hand-off targets to the gunner, and continue searching for targets while the gunner engages another. The increase in "hunter-killer" efficiency afforded by the CITV led to a reduction in the time to detect and engage multiple threat targets.

Results of the CITV assessment (Quinkert, 1990) indicated that the CITV's principal advantage is for those targets that are acquired and engaged after the initial target. This advantage was represented by an increase in the number of detections and subsequent kills accomplished at a significantly faster pace. Accuracy, as defined by gunners' aiming error, was not improved by using the CITV. Gunners did not feel it necessary to take more time to engage the targets, even though the shorter vehicle commander search times nominally gave them more time. This reflected their high level of confidence in their gunnery skills.

Recommended improvements to the CITV included a directional orientation capability for the own-vehicle icon, shorter fire control commands, and ergonomic enhancements in the palm and designate switches on the control handle. It was also suggested that emphasis should be placed on training to improve the coordination between the vehicle commander's and gunner's use of the CITV.

In a follow-on effort, Leibrecht et al. (1992) examined the CVCC's impact on company-level performance. The company-level effort integrated the technologies of POSNAV, IVIS, and the CITV components to form CVCC vehicles and units. The study found that the enhanced capabilities of the CVCC experimental configuration enabled companies to complete both defensive and offensive missions in significantly less time. As a result, every CVCC company was able to complete all missions, whereas only 25% of the Baseline companies were able to complete offensive missions and 50% were able to complete defensive missions. The POSNAV capabilities led to CVCC companies traveling significantly less distance and consuming significantly less fuel in executing both defensive and offensive missions.

The CCD's automated reporting functions significantly improved both accuracy and timeliness of FRAGOs and CONTACT reports. Especially useful was the ability to input locations to digital reports by lasing to a target or by touching the digital map display. Digital transmission improved the clarity of FRAGOs and INTELLIGENCE reports. At the same time, the net-wide routing of digitally transmitted reports and the absence of confirmation of reception by the addressee resulted in numerous duplicate reports. Directly related to this, soldier-participants frequently complained about receiving excessive numbers of reports. This pointed to the need to reduce redundant reports (e.g., filtering based on report identifiers) and to provide verification of report reception. CVCC vehicle commanders frequently transmitted voice radio messages (e.g., brief orders or queries) that did not fit the established report formats, indicating a need to provide free text capabilities on the CCD.

The CVCC capabilities enhanced target engagement performance, extending maximum lasing range as well as ranges for hitting and killing targets. These improvements were significant only during defensive missions. Further, more timely unit displacement during the delay mission was observed. The CCD-related C3 demands on CVCC leaders did not decrease their vehicles' participation in firing activities.

The battalion TOC evaluation (O'Brien et al., 1992) built on previous CVCC efforts by extending the research to the battalion level, integrating the CVCC into battalion C3 activities. To fully achieve this integration, automated TOC workstations were developed to interact with the digital data capabilities of the CVCC-equipped vehicles. Procedures for successfully integrating the TOC with the other CVCC elements were developed and assessed. Participants indicated they received too many reports and that creating and reading reports consumed too much time, particularly during engagements. Questionnaire responses indicated the CVCC significantly reduced some of the workload on unit commanders, especially for determining battlefield locations, monitoring and directing navigation, and monitoring the unit's position. This effort established the foundation for a full-scale battalion-level evaluation.

Soldier Training Factors

The training requirements for soldiers have become more difficult as technological advances increase the complexity of C3 systems. Concerned with the early identification of training requirements to keep pace with the introduction of new technologies, ARI has embarked on efforts to develop/refine the CVCC training package (Atwood et al., 1991), to conduct detailed task analyses (Morey, Wigginton & O'Brien, 1992), to prototype training methods (Lickteig, 1991; Winsch et al., in preparation), and to explore innovative training applications for the CVCC technologies (Atwood, Winsch, & Quinkert, in preparation). One concern from a training perspective is the allocation of information processing workload. As these systems evolved technologically, task demands on the soldier shifted. Now there is more emphasis on visual processing than in the past. This shift in utilization dictates a change in training procedures for armor crews. Therefore, much attention has been focused on the impact of training procedures.

Collective training encompasses several guidelines which have been identified as necessary components in an advanced-technology environment (Alluisi, 1991). Generally, these are: a) identify realistic objectives before training needs are developed; b) employ viable technologies; c) utilize repetitive, rapid prototyping, and innovative approaches; d) provide explicit demonstrations; and e) encourage participants' support and effort in training development. In prior CVCC efforts, all of these guidelines were part of the routine developmental approach (e.g., Atwood et al., 1991).

The current effort identifies where these guidelines have been employed and where improvement is needed in the procedures that are used for training soldiers on the CVCC system. As a preliminary account based on a limited database, this report focuses only on major training-related findings and issues.

Soldier-Machine Interface Considerations

Previous evaluations have examined SMI issues of the CVCC technology at crew, platoon, company, and battalion TOC levels (e.g., Du Bois & Smith, 1991; Ainslie, Leibrecht, & Atwood, 1991; O'Brien et al., 1992). Through this series of evaluations, a design-evaluate-design cycle has been established as an iterative approach to the development of automated C3 systems. The present effort was aimed at evaluating the design changes (e.g., CCD, CITV) that were made as a result of the CVCC battalion TOC evaluation (O'Brien et al., 1992). These changes are described in the "Method" section of this report under the "CVCC M1 Simulator" sub-heading. The design-evaluate-design cycle will lead to a CVCC system that is responsive to the needs and capabilities of its users.

In a soldier-machine system, the soldier and his equipment have a complementary relationship with one another (Grandjean, 1986). Soldier and machine can combine to form a very productive system, as long as their respective capabilities are utilized sensibly. The interface between the soldier and the equipment can be improved by studying the exchange of information between the two.

As an example of this information exchange, a representative pathway for the task of processing a SPOT report follows:

1. The vehicle commander (company commander or executive officer) receives a digital SPOT report from one of his platoon leaders on his CCD.

2. On the strength of his interpretation, and the depth of his knowledge and experience, he makes a decision to relay this information to the adjacent and higher headquarters.

3. The next step is to communicate this decision to the CCD by using the input controls. The display shows the soldier the result of his action (i.e., highlights the "Send" input key).

4. The machine carries out the process as programmed (i.e., the report is transmitted).

5. The cycle is completed when significant parts of the process are displayed for the soldier to see (Grandjean, 1986). In this case, a "message sent" indicator appears on the display.

Effective interfaces can make a substantial difference in learning time, performance speed, error rates, memory load, long-term retention of information, and system satisfaction (Mueller, 1991). Well-designed interfaces can also positively impact the amount of technical support required, and the number of system modifications and enhancements needed following implementation. As a result, system design should be accomplished from the user's point of view and requires repeated testing of the interface.

This approach has been followed throughout the design-evaluate-design cycles of the series of CVCC evaluations.

Since poorly designed interfaces can lead to negative consequences that match or exceed the positive impact of the system, the importance of the SMI should not be overlooked. Further, the consideration of SMI issues becomes even more critical when the additional complexities of working within a highly automated environment are considered. Automated systems are a feature of much state-of-the-art technology and are prevalent in our society, ranging from video-cassette recorders to automated teller machines to nuclear power plants. Designers must consider the impact of new technologies on human performance. This requires close analysis of performance on different kinds of tasks and serious consideration of SMI issues.

This report addresses SMI issues based on preliminary objective and subjective data collected in this effort.

Design of the Evaluation

Research Issues

Earlier research evaluating CVCC technology began with individual components at lower echelons and progressed to the integrated CVCC system at the company and battalion TOC levels. An emergent focus on the CVCC's impact on battalion commanders interacting with company commanders led to the battalion evaluation, reported here. At the battalion level, several questions are of direct interest. How does the CVCC experimental configuration impact battalion-level performance, especially in the context of operational effectiveness? What improvements are necessary to optimize utilization by unit commanders and TOC personnel? How will the CVCC system affect requirements for training armor unit leaders and crews?

These questions set the stage for the battalion evaluation, designed to establish a database to help guide doctrine, training, and design decisions and concepts for utilizing the CVCC system in the armor environment. Based on the questions of interest, the planning and execution of this evaluation incorporated three overall objectives:

1. Evaluate the operational effectiveness of armor battalions using the CVCC experimental configuration, compared to conventionally-equipped battalions.

2. Identify critical SMI concerns and make recommendations regarding CVCC design and utilization.

3. Investigate operational training issues and concerns associated with the CVCC.

Each of these objectives formed the basis for specific research issues. In generating the research issues linked to the operational effectiveness objective, the Blueprint of the Battlefield (Department of the Army, 1991) provided an established doctrinal basis. An integration of current warfighting principles, the Blueprint of the Battlefield is a systematic framework for organizing tactical activities. As outlined in Table 2, the framework consists of seven Battlefield Operating Systems (BOSs), each of which encompasses a family of related functions required for effective combat operations. Because of the expected contributions of the CVCC to armor battalion operational effectiveness, the following four BOSs were selected for use in this evaluation: Maneuver, Fire Support, Command and Control, and Intelligence. Based on these BOSs, four research issues were generated to identify key areas where the CVCC was expected to improve performance relative to the Baseline system, as follows:

1. Does the CVCC system enhance the Maneuver BOS?

2. Does the CVCC system enhance the Fire Support BOS?

3. Does the CVCC system enhance the Command and Control BOS?

4. Does the CVCC system enhance the Intelligence BOS?

Table 2

Battlefield Operating Systems Associated With the Blueprint of the Battlefield

- Maneuver
- Fire Support
- Air Defense
- Command and Control
- Intelligence
- Mobility and Survivability
- Combat Service Support

The remaining research issues are associated with the training and SMI objectives. These issues provide information needed to further understand performance effects related to the operational effectiveness issues and to evaluate the SMI and training requirements. They are

5. What SMI factors critically affect utilization of the CVCC configuration, and how do they impact CVCC design?

6. What training considerations and implications are important in training unit commanders and crews to operate and utilize the CVCC?

General Approach

To enable realistic quantification of CVCC contributions to unit leader performance, both Baseline and CVCC conditions were simulated. In the Baseline condition, C3 functions were accomplished by means of voice radio, paper maps, manual navigation techniques, and manual recording and processing of messages. In the Baseline TOC, battlefield information was processed manually with the aid of wall charts and staff journals. In the CVCC condition, the manual means available in the Baseline condition were supplemented with the CVCC's enhanced capabilities, principally the CCD integrated with the POSNAV, the CITV, and a digital link between the CVCC system and the SINCGARS communications system. The CVCC TOC included automated workstations designed to support digital processing of battlefield information. These workstations simulated the link between the maneuver elements and the TOC staff, providing a robust capability to exchange digital information.

Utilizing an independent groups approach to directly compare the Baseline and CVCC conditions, participating armor battalions used either Baseline-configured simulators or CVCC-configured simulators, interacting with battalion TOC elements. The methodology combined MWTB tank simulators modeling an autoloader, a doctrinally-based combat scenario designed to fully exercise the C3 capabilities of an armor battalion, and a variety of data collection methods. To optimize scenario consistency, manned simulators were not permitted to be killed. Multiple stages within the scenario enabled repeated observations of performance.

Four different Fort Knox units furnished armor soldiers as participants who formed key crews within the battalion: battalion commander, battalion S3, three company commanders, and three company executive officers (XOs). This manning structure was shaped by the evaluation's focus on the C3 interactions among battalion and company leaders, battalion TOC evaluation lessons regarding the importance of the company XO, the relative availability of supporting troops, and the number of available tank simulators. Each crew also included a gunner and a driver; the autoloader obviated the need for a loader/crewmember. The eight crews formed by the participants were combined with semiautomated forces (SAFOR) controlled by the participants to constitute the full tank battalion. Training incorporated classroom, supervised hands-on, and crew and unit practice exercises.

Other battalion personnel, generally corresponding to key SAFOR vehicle commanders and TOC staff, were role-played by test support personnel. The TOC staff, which included military subject matter experts (SMEs), assumed the roles of the battalion XO, intelligence officer (S2), assistant operations officer (assistant S3), and fire support officer (FSO). Other support staff members played the roles of the brigade commander, adjacent unit commanders, and platoon leaders. Semiautomated opposing forces (OPFOR) units comprised the entire enemy force and were controlled by test support personnel to simulate a realistic threat environment.

A single multi-stage simulated combat scenario, defensive in orientation, generated the environment for test data collection. Designed to be briefed, executed, and debriefed in two-thirds of a day, the test scenario comprised three stages: an initial delay mission, then a counterattack, followed by a concluding delay operation. This structure sampled different types of combat activities. Each week's participating battalion executed the test scenario only once.

Research Design

The primary independent variable, condition, formed a between-subjects variable with two levels--CVCC and Baseline. These conditions were defined in the preceding subsection. A secondary independent variable resulted from the two echelons of manned positions within the battalion's organizational structure: battalion command group (battalion commander and S3) and company command elements (company commanders and XOs). This structure resulted in a between-subjects variable with two levels, the number of subjects varying between echelons by the ratio 2:6.

In addition, one incidental variable, stage (for which data were analyzed separately, but for which no statistical comparisons were planned), completed the design. The test scenario's three stages--delay, counterattack, delay--represented different types of combat missions sharing a unifying overall structure. Thus there were three levels of this repeated measures variable. However, due to the dissimilar performance requirements resulting primarily from widely varying enemy force structures between the delay and counterattack stages, direct comparison of the stages was deemed inappropriate.

Measurement requirements spanned tactical performance, participant assessment of battle outcomes, CVCC equipment usage, training effectiveness, and recommendations for CVCC improvement. Data collection was accomplished through a combination of direct observation, self-report questionnaires, automated data collection, transcription of recorded radio traffic, and post-scenario debriefings. The types of measures and their associated measurement methods appear in Table 3.

Table 3

Types of Measures With Associated Measurement Methods

Type	Measurement Method
Maneuver	Automated, Observational
Fire support	Automated, Observational, Transcription
Command and control	Automated, Observational, Transcription
Intelligence	Automated, Transcription
Battlefield assessment	Self-report
SMI	Automated, Observational, Self-report
Training effectiveness	Observational, Self-report
Biographical factors	Self-report

Method

This section describes the participants, facilities, materials, and procedures supporting the evaluation. The section concludes with a discussion of the major limitations of the evaluation.

Participants

A total of 96 U.S. Army personnel participated in this evaluation. These participants included 32 officers and 64 enlisted men. The personnel for each of the four test weeks (two Baseline and two CVCC conditions) included eight officers and 16 enlisted men. All participants were males stationed at Fort Knox, Kentucky and ranged in age from 19 to 42. Table 4 presents the troop requirements requested for the evaluation (both Baseline and CVCC conditions). A new set of participants was required for each test week.

Table 4

Summary of Participant Requirements

Position	Requested personnel characteristics
Battalion commander	LTC/MAJ, SC 12
Battalion operations officer	MAJ/CPT, SC 12
Tank company commanders (3)	CPT/1LT, SC 12
Tank company XOs (3)	1LT/2LT, SC 12
Tank gunners (8)	SGT/CPL, CMF 19
Tank drivers (8)	CPL/PFC, CMF 19

Note: Specialty Code (SC) 12 and Career Management Field (CMF) 19 are armor personnel designators.

For each test week, 24 participants were provided by supporting units. All participants were armor qualified. Each group included one major who served as the battalion commander. The remaining officers were assigned the roles of battalion S3 (one), company commander (three), or company XO (three). Each officer commanded a crew with two additional crewmembers (gunner and driver) assigned by the battalion commander from the available enlisted personnel.

Configuration of the Test Battalion

The participants for each test week were organized into a test battalion forming the core of the evaluation. The unit modeled a tank-pure armor battalion composed of four tank companies, a six-vehicle scout platoon, and command group. Participants manned the battalion commander and battalion S3 vehicles in the command group, as well as the company commander and company XO vehicles in A, B, and C companies. The battalion's remaining combat vehicles (i.e., the tank platoons, all of D Company, and the scout platoon) were represented by SAFOR elements controlled by unit commanders and operated by role-playing test personnel. Friendly forces may be referred to as BLUFOR (Blue Forces) and are comprised of both the manned simulators and SAFOR tanks. The OPFOR (Opposing Forces) consisted of SAFOR only. Figure 2 illustrates the battalion (BLUFOR) configuration (minus the scout platoon and the battalion TOC), and differentiates between the manned simulators and SAFOR.

Battalion TOC Staff

The battalion TOC was staffed by four test personnel who emulated the functions of a battalion main command post. These personnel, subject matter experts (SMEs) in the areas of command and control, operations, intelligence, and fire support, role-played the positions of battalion XO, assistant S3, S2, and FSO. Performing as an integral part of the battalion organization for combat, the TOC staff provided C3 support for combat operations in a standardized and doctrinally-based (albeit abbreviated and streamlined) manner. In the CVCC condition, these individuals performed their tasks using the TOC workstations augmented by voice radio. In the Baseline condition, these staff members performed their tasks manually and communicated with the simulators solely by voice radio. The responsibilities assigned to members of the battalion TOC staff appear in Table 5.

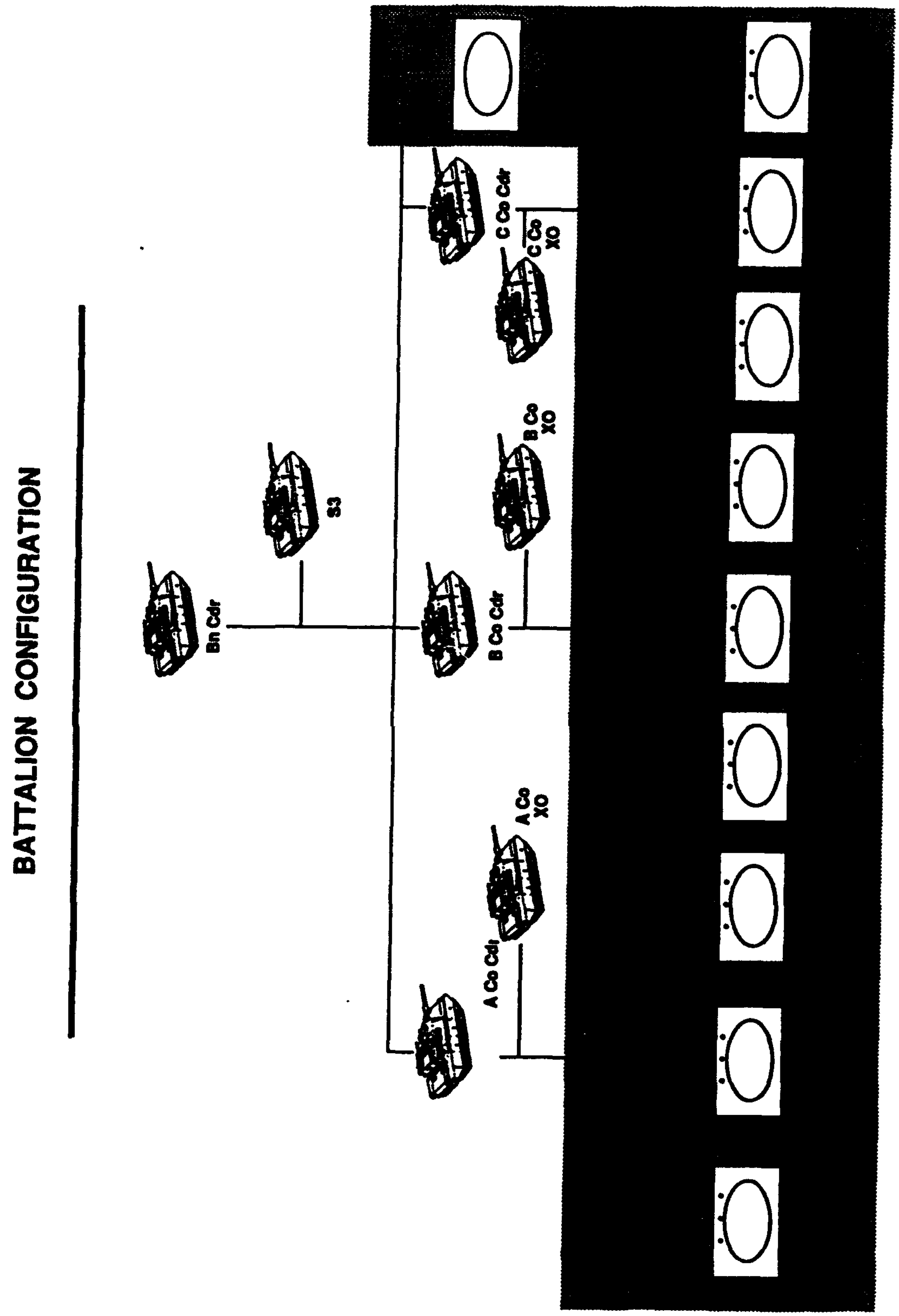

Figure 2. Illustration of the battalion configuration (minus the Tactical Operations Center and scout platoon).

Table 5

Responsibilities of Battalion TOC Staff During Scenarios

Battalion XO
- Supervise TOC configuration and set-up
- Initialize/operate CDR/XO workstation (CVCC condition)
- Supervise TOC operations before and during scenarios
- Conduct battalion orders briefing prior to scenarios
- Participate in mission preparation
- Conduct leader's reconnaissance
- Conduct battalion TOC staff briefing
- Provide C3 support during scenario execution
- Participate in unit debriefings

Assistant S3
- Set-up operations maps and charts (Baseline condition)
- Initialize/operate S3 workstation (CVCC condition)
- Assist during battalion orders briefing
- Participate in mission preparation
- Operate battalion command net control station (NCS)
- Monitor brigade command net
- Maintain/report friendly situation
- Maintain/report friendly operational status (CVCC condition)
- Maintain operations staff journal
- Participate in unit debriefings

S2
- Set-up intelligence maps and charts (Baseline condition)
- Initialize/operate S2 workstation (CVCC condition)
- Attend battalion orders briefing
- Participate in mission preparation
- Assist in leader's reconnaissance
- Operate battalion operations and intelligence (O&I) NCS
- Monitor brigade O&I net
- Maintain/report enemy situation
- Maintain/report friendly operational status (Baseline condition)
- Maintain intelligence staff journal
- Participate in unit debriefings

FSO
- Set-up fire support maps and charts (Baseline condition)
- Initialize/operate fire support terminal
- Initialize/operate FSO workstation (CVCC condition)
- Attend battalion orders briefing
- Participate in mission planning
- Conduct fire support coordination
- Receive/process calls for fire (CFF)
- Execute fires using the Fire Support MCC
- Maintain/report fire support asset status
- Control movement/positioning of battalion mortars
- Maintain fire support staff journal
- Participate in unit debriefings

Test Facilities and Materials

This subsection describes the test facilities, equipment, and materials used to control the execution of training and testing. It also describes the additional materials used to support training and testing, and the equipment used to collect and analyze the data from this evaluation.

Test Facilities

MWTB facilities used in this evaluation included a classroom, eight vehicle simulators, the TOC, the Exercise Control Room (ECR), a Stealth station, and the Data Collection and Analysis (DCA) system. Figure 3 presents a schematic of the MWTB identifying the components used for this evaluation. More complete facility descriptions may be found in previous CVCC publications, especially O'Brien et al. (1992). Details on these components are presented in the following paragraphs.

Baseline M1 simulators. Eight M1 tank simulators were used in the evaluation. As depicted in Figure 4, the M1 simulator consists of two major sections: a driver's compartment and a turret crew compartment. The turret crew compartment has stations for the vehicle commander, gunner, and loader. More detailed descriptions of the components and operation of both the Baseline and CVCC simulators may be found in the M1 SIMNET Operator's Guide (U.S. Army Armor School, 1987), in the SIMNET Users' Guide (U.S. Army Armor School, 1989), and in the SIMNET Combat Vehicle Command and Control (CVC2) System User's Guide (Smith, 1990).

All M1 simulators in the MWTB contain the following major functional components: a simulation host computer, a computer image generation (CIG) system, a sound system, and several interactive device controller (IDC) boards. The simulation host computer simulates the vehicle dynamics, kinematics, and the hydraulic, electrical, and fuel systems. The IDC boards read the status of crew controls and send the information to the host computer. The host processes this information, along with information from other simulation elements transmitted over the simulation Ethernet. The host then sends messages to the CIG system (what views to display), to the sound system (what sounds to transmit), and to the IDC boards (current status of crew controls). Messages about the current vehicle status are broadcast over the simulation Ethernet to other simulators and exercise control systems.

The MWTB simulators were developed using a selective fidelity approach. The simulators do not include all functions and controls found in an actual M1 tank, but only those necessary to fight. The simulator is equipped with a 105mm main gun capable of firing HEAT and SABOT rounds, three out-the-window views in the driver's and commander's stations, a gunner's primary sight (GPS), a GPS extension (GPSE) at the commander's station, and a single rotatable view in the loader's station. The vehicle commander's station also includes a rotatable cupola that allows him to manipulate his three out-the-window views. A headset with boom microphone is used for radio and intercom communication. The M1 simulators do not have the machine guns, Muzzle Reference System (MRS), Gunner's Auxiliary Sight (GAS), nor open-hatch views available on the fielded M1. The visual system is limited to views out to 3500 meters.

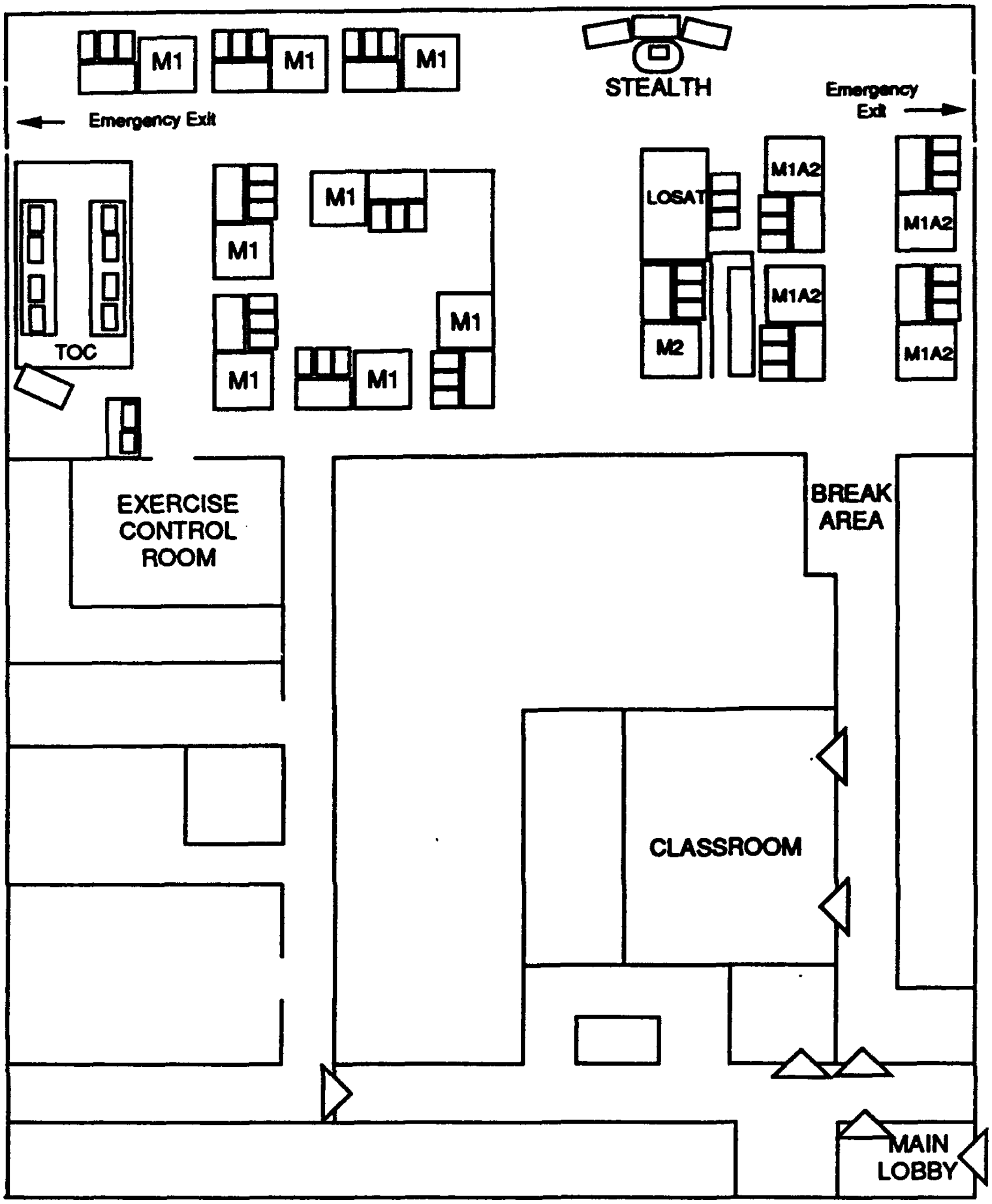

Figure 3. Floor plan of the Mounted Warfare Test Bed.

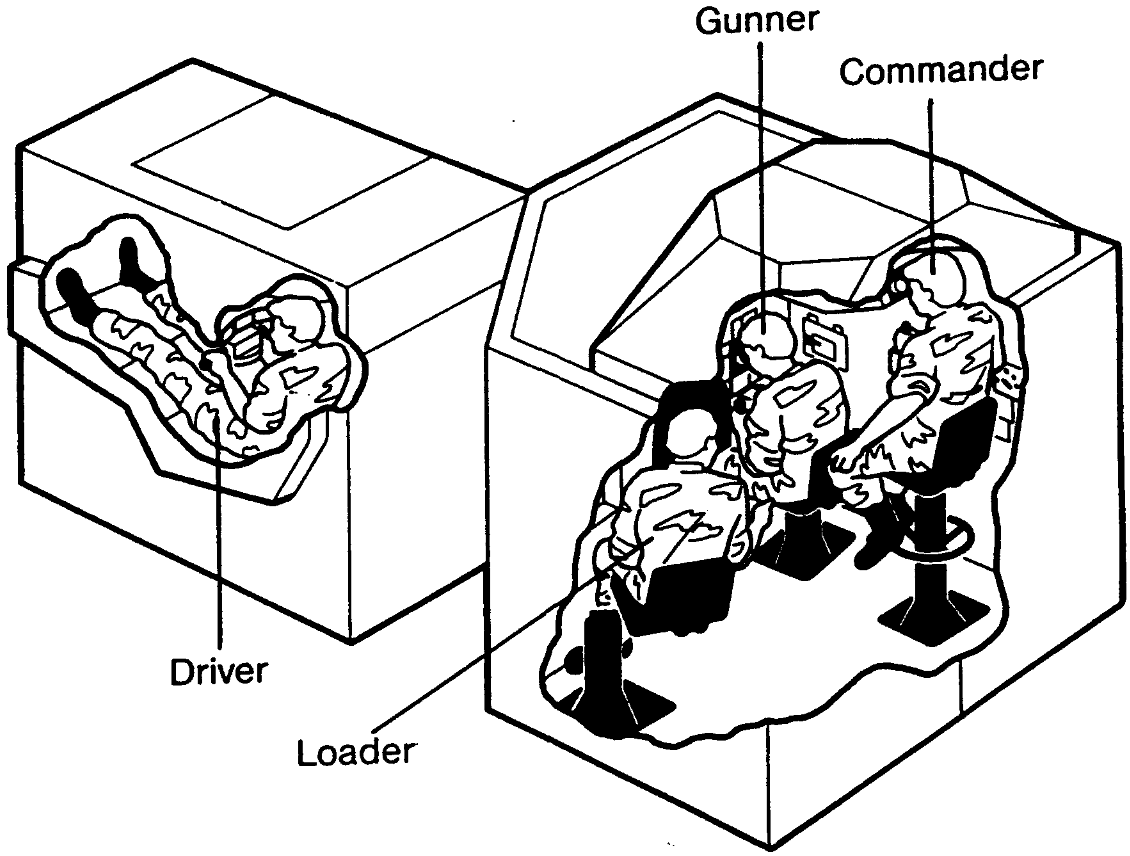

Figure 4. Basic M1 simulator used in the evaluation, showing the turret crew compartment and driver's compartment.

The sound system recreates realistic battlefield sounds from simulated vehicle operation, weapons fire, and impacts. Vehicle sounds include engine whine, track movement, turret/main gun movement, and the opening or closing of the ammo doors. Weapons fire sounds include direct fire, indirect fire, aerial fire, and own-vehicle fire. Impact sounds include impacting rounds and misses.

CVCC simulators used in the Baseline and CVCC conditions contain several modifications not found in other MWTB M1 simulator configurations. The gunner's sight is equipped with a Thermal Imaging System (TIS) that can be toggled for the normal daylight view. The simulator also includes a simulated autoloader. The full cycle time to reload a round after firing is approximately eight seconds. During the first three and one-half seconds, the system waits for the gunner to select the desired ammunition type. In the remaining four and one-half seconds, the system opens the breech and the ammo doors, loads a round of the selected type, and closes the breech and ammo doors. The autoloader is also capable of unloading a round when the gunner changes the ammo select switch before firing.

Each simulator is also equipped with two simulated SINCGARS radios. These radios replace the CB radios found in other MWTB simulators. The radios convert voice transmissions into digital signals, which are broadcast over the simulation Ethernet. This capability also makes it possible to capture voice transmissions along with simulation data broadcast over the Ethernet.

CVCC M1 simulators. In addition to the basic M1 simulator hardware and software described in the previous paragraphs, the simulators used in the CVCC condition include several other major capabilities. Table 6 summarizes the key differences between the M1 simulators used in the Baseline and CVCC conditions. The major components which distinguish the CVCC M1 from the Baseline M1 are the CCD, POSNAV, and CITV. The CVCC integrated crewstation area is illustrated in Figure 5.

Table 6

Comparison of Baseline and CVCC M1 Simulator Capabilities

	Baseline	CVCC
Navigation		
Out-the-window views (vision blocks)	X	X
Paper map with overlays	X	X
Odometer	X	X
Grid azimuth indicator	X	X
Turret-to-hull reference display	X	X
Main gun laser range finder (LRF)	X	X
CCD tank icon and status information		X
Digital terrain map and tactical overlays		X
Digital navigation routes		X
Driver's navigation display		X
Target acquisition and engagement		
Out-the-window views (vision blocks)	X	X
GPS/GPSE (with TIS, magnification, main gun LRF)	X	X
Turret-to-hull reference display	X	X
CITV (with LRF, 3 scan modes, magnification, polarity)		X
CITV target designate		X
Communications		
Radio intercom (communication with crew)	X	X
SINCGARS radios (voice communication)	X	X
SINCGARS radio interface unit (data communication)		X
Digital combat report communication		X
Digital tactical overlay communication		X
Digital navigation route communication		X

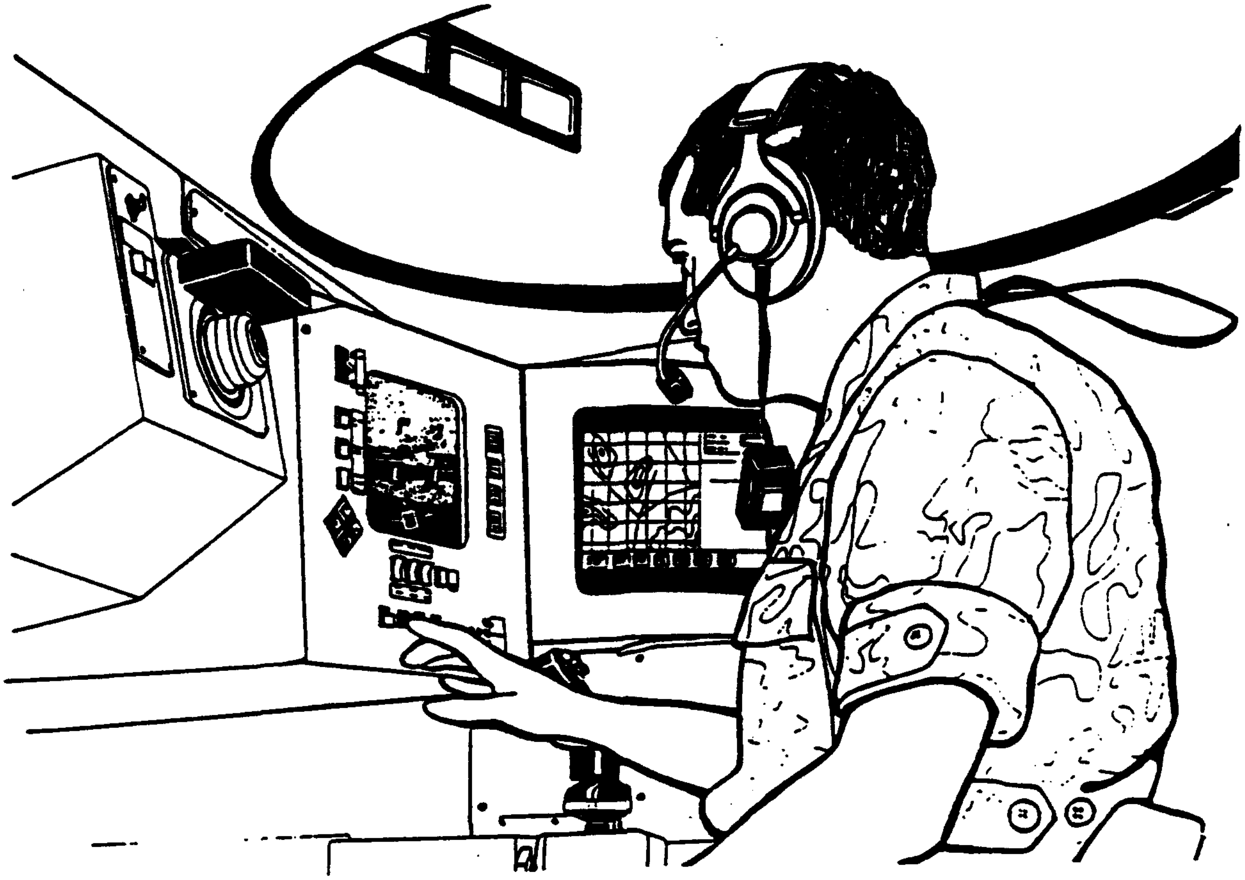

Figure 5. Vehicle commander's crewstation as seen in the CVCC condition.

Table 7 lists the basic capabilities of the CCD and POSNAV systems. Smith (1990) and Leibrecht et al. (1992) have described the CCD's and POSNAV's functional features. A description of basic functional capabilities adapted from Leibrecht at al. (1992) follows.

Command and Control Display (CCD). The CCD is designed to provide commanders with rapid access to accurate battlefield information and to speed the unit and vehicle commanders' decision cycles. The CCD configuration used in this experiment (SIMNET Version 7) has been upgraded from previous versions evaluated in the battalion TOC evaluation (O'Brien et al., 1992), the company evaluation (Leibrecht et al., 1992), and the platoon evaluation (Du Bois & Smith, 1991). Since the battalion TOC evaluation, the CCD hardware platform has also been upgraded from Masscomps with approximately 16-20 megabytes of memory to SPARCstation IPXs with 48 megabytes of memory. The change in platforms and increased memory has greatly enhanced the processing speed for the CCD and POSNAV components.

Table 7

C3 Capabilities of the CVCC CCD and POSNAV Configuration

<u>Navigation</u>	
	Digital tactical map with selectable grid lines, scales, and terrain features
	Digital tactical overlays
	Own-vehicle location (grid and icon)
	Own-vehicle orientation (azimuth heading and directional icon)
	Friendly vehicle location icons
	Report-based icons
	Graphic navigation routes with waypoints and storage/retrieval
	Navigation waypoint autoadvance
	Driver's display (with steer-to-indicator)
<u>Digital Communication</u>	
	Combat report preparation
	Laser range finder location input to combat reports
	Send/receive/relay combat reports (including report icons)
	Receive/relay tactical overlays
	Send/receive/relay navigation routes
	Friendly vehicle locations (mutual POSNAV)
	Automated logistics reports, with autorouting
<u>General Characteristics</u>	
	Thumb (cursor) control
	Touchscreen input

CCD interface overview. A 10.5-inch diagonal SPARC cathode ray tube (CRT) mounted to the right of the vehicle commander houses the CCD display. The interface display uses only a 7 by 5.75 inch rectangular working area of the CRT. Figure 6 shows the display itself with its CCD and POSNAV components. At the bottom of the display are the main function keys. When a function key is pressed, the corresponding menu will appear in the variable menu area. The variable menu area displays the menus (e.g., the Map menu) and the submenus (e.g., the Map Features submenu) when primary keys (e.g., MAP) and secondary keys (e.g., Exit, Back, and Cancel) are pressed. The tactical map area comprises most of the left portion of the screen and shows the features of the terrain database in color. In the upper right hand corner of the display is the Information Center displaying date/time information along with own-vehicle status elements. The following paragraphs describe the CCD and POSNAV features and functions.

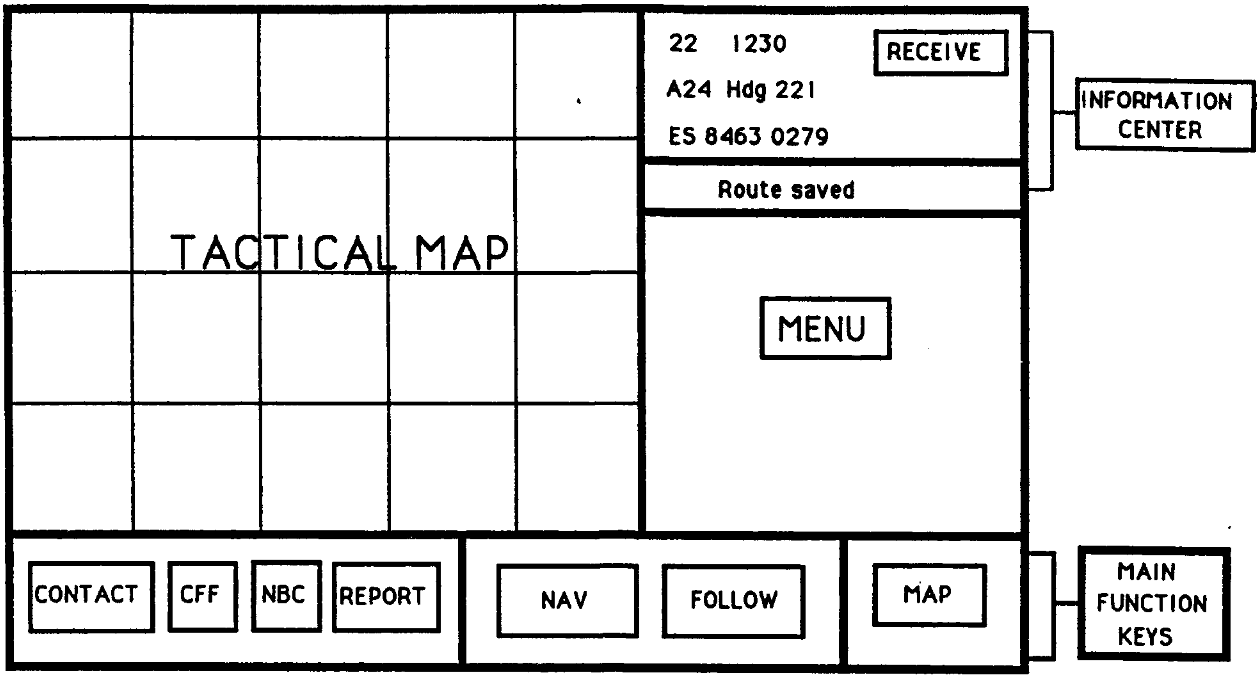

Figure 6. Command and Control Display (CCD) interface. See text for description.

Control inputs. The unit or vehicle commander controls the operation of the CCD by manipulating a cursor appearing on the display screen. He selects menus and functions by positioning the cursor on the desired key. The CCD has two input modes, finger touch control utilizing the touch sensitive screen and the thumb control mounted on the commander's control handle. With finger touch control, the actual location of the cursor is slightly offset above the fingertip to allow the commander to view it clearly while positioning it. Touching the screen automatically shifts the cursor to the new position. When the cursor is located correctly on the display, the commander lifts his finger, activating the function which corresponds to the key or map area selected.

The thumb control is located on the modified commander's control handle. When operating the thumb control, the vehicle commander places the tip of his thumb into the depression in the thumb control knob. By moving his thumb, he can move the cursor in virtually any direction at variable speed. When the cursor is resting on the function key or map area desired, the thumb control is pressed and then released to indicate a selection has been made.

Report functions. The CCD supports preparation of digital reports by means of menu-driven screens. The participant is able to prepare any of the eight types of formal reports available on the CCD: CONTACT reports, SPOT reports, SITREPs, INTELLIGENCE (INTEL) reports, CFF reports, ADJUST FIRE reports, Nuclear/Biological/Chemical (NBC) reports, and SHELL reports. The commander can call up CONTACT, CFF, and NBC report formats directly from fixed function keys along the bottom of the display. When preparing the other five report types, he must select the REPORT function key first, then select a report type and "New" from the Report menu.

Each CCD report is composed of one or more pages of fields tailored to that report type. The commander enters grid location information into these report fields by lasing to a vehicle or terrain point or by indicating a location on the map using the touchscreen or thumb control. He enters numbers of vehicles into report fields from a soft numeric keypad. He enters vehicle types, activities, and other report information by making selections from pulldown menus. Blank fields are permitted. As he enters "what" and "where" information into a report, a doctrinally correct North Atlantic Treaty Organization (NATO) symbol, called a report icon, appears on the tactical map at the location cited. The icon may be blue for friendly elements, red for enemy elements, or green for obstacles (friendly or enemy). SPOT, SHELL, and INTELLIGENCE report icons may have small numbers above them to reflect the numbers given in the report.

Participants may begin a report and then exit before finishing to perform another CCD or POSNAV function. For example, a vehicle commander may be creating a routine SITREP when he comes in enemy contact. He can leave the SITREP without completing it, create a CONTACT report, follow it up with a SPOT report, and then return to complete the SITREP later. Multiple types of reports may be open and stacked on the screen simultaneously, with the most recently accessed one visible on top. However, only one of each type of report can be open at a time. When the participant has finished the report, he can send it digitally by pressing the SEND key.

Digital report transmission. A simulated radio interface enables the unit or vehicle commander to transmit reports prepared on the CCD. A routing menu offers the option of sending any report on the CCD nets available. The battalion commander and S3 have access only to the battalion command net on their CCDs. The company commanders and XOs can send digital reports on the company command net, the battalion command net, or both simultaneously. Default nets based on type and logical routing direction (upward/adjacent or downward) exist for each report type. Of the eight types which can be created on a CCD, only one, an INTEL report, defaults downward. The other report types default to the upward/adjacent net. The unit or vehicle commander may override the default before pressing the SEND key. Once the report has been transmitted, a copy is kept in the creator's "old" file for later retrieval and review. Also, the message display in the Information Center shows "Message Sent" to reassure the creator that the report was sent. However, the CCD provides no feedback to the sender as to whether the recipients have opened, read, or will act in accordance with the report.

When a unit or vehicle commander receives a transmitted report, three cues signal its arrival: the RECEIVE key highlights, an audible tone sounds in his headset (three beeps for high priority reports, one beep for low priority), and its report icon appears on the tactical map, blinking for the first five seconds. High priority reports go to the top of the Receive queue with low priority reports beneath them. Report priority is based on immediacy of information. High priority reports which can be received include CONTACT, CALL FOR FIRE, ADJUST FIRE, FRAGO, FREE TEXT, INTELLIGENCE, and NBC reports. (FRAGO and FREE TEXT messages cannot be created using the CCD, but they can be received and relayed.) Routes and overlays are also received like high priority reports. Once received, reports remain in the Receive queue for five minutes. Meanwhile, the icon accompanying the report remains on the map. The Receive queue lists the report type, originator, time the report was created, status (i.e., whether the report has been previously opened or relayed), and an asterisk indicating that the report icon is posted to the tactical map. The Receive queue will display up to nine items at a time. A paging function is available for viewing multi-page listings.

Once the commander selects and reads a report, he cannot modify it. He may post the report icon to the tactical map if he desires and then either exit the report, relay the report, or delete the report. If he reaches the Report Action page in the report, a copy automatically is placed in his "old" files for future reference. The default routing options are different when relaying a received report than when sending a report. When relaying a report, the default net is based not on report type but on routing nets. The CCD system defaults to the net the report was not received on. This default was designed to prevent copies of a report from being rerouted on the same net.

Features for reducing duplicate reports. A duplicate report is a copy of a report received previously during an exercise. Before a report is shown in the Receive queue, the CCD checks to see if it already has a copy in the Receive queue. If so, the CCD will not admit the new copy. However, if a report is in the "old" file, a copy can enter the Receive queue. Once the report is in the Receive queue, the CCD provides other cues to the user that the report received is a duplicate. The call signs of the report's creator and sender at the highest echelon are given on the routing page to help the receiver decide whether he needs to relay the report. For example, if the battalion commander receives a CONTACT report relayed by the A Company commander, the battalion commander knows that the report was sent to him on the battalion command net. Because the S2 is on CCD battalion command net, too, the battalion commander should not relay the report using the CCD. He could, however, relay the report via voice radio on the brigade command net.

Another CCD feature which helps reduce the number of duplicate reports is the use of status symbols in the report queues. The symbols indicate whether a copy of the report has been opened or routed. If a copy of the report is available in the "old" files, the new report in the Receive queue will duplicate the status symbol of the copy in the "old" file. Thus, if a report appears in the RECEIVE queue with an arrow (-->), the receiver knows that he relayed the earlier copy. He can delete the new copy immediately. Likewise, if a report enters with the symbol "O," the receiver knows that he has reviewed the copy but did not relay it. He can choose to relay the report this time or can delete it from his Receive queue.

Other CCD functions. The first of the remaining CCD functions is the Unpost Icons function. When numerous reports are received during an exercise, the tactical map may become cluttered with report icons. To declutter the tactical map, a commander can delete icons one at a time or he can select a menu option to delete all icons posted longer than the times shown (e.g., posted longer than five minutes). Another CCD function is the overlays function. The overlays function provides the capability to receive and post mission overlays transmitted from the TOC workstations. These overlays are received like high priority messages in the Receive queue and may be posted to the tactical map and relayed if desired. Friendly operations overlays are black, enemy operations overlays are red, and barrier overlays are green.

An additional CCD map-related capability is aggregation and deaggregation of friendly vehicle icons. Users can aggregate friendly vehicle icons to the following levels: battalion, company, platoon, section, and vehicle level. The default aggregation levels are platoon level at 1:25,000 and 1:50,000 and company level at 1:125,000 and 1:250,000.

One of the newer CCD functions is the LOGISTICS report. The LOGISTICS report is unique in that it allows the TOC workstations to automatically receive status information on ammunition, fuel, equipment, and personnel from each vehicle with a CCD; no action is required by any commander. Furthermore, the LOGISTICS report allows the commander to check his own vehicle's ammunition, equipment, personnel, and fuel status. He can also check the ammunition, equipment, personnel, and fuel status of his unit and of other units in the battalion. The equipment status will show losses with any kind of equipment destruction (e.g., mobility kill, main gun damage, or catastrophic kill). The fuel and ammunition status are based on the number of units currently capable of using the supplies (i.e., dead vehicles are not included in the calculations). Personnel status decreases by four crewmembers every time a vehicle is catastrophically killed. The LOGISTICS report updates within ten seconds of a change in status.

POSNAV. The POSNAV component provides unit and vehicle commanders with automated, accurate updates of critical positioning and navigation information, such as own-vehicle and other friendly vehicle locations presented on a tailorable, digitized map as well as grid locations and vehicle headings. POSNAV also provides commanders with the means to create routes and to send navigational information to the driver. The driver uses this navigational information to steer to the next control point. The POSNAV configuration used in this experiment has been upgraded from previous versions evaluated in the battalion TOC evaluation (O'Brien et al., 1992), the company evaluation (Leibrecht et al., 1992), the platoon evaluation (Du Bois & Smith, 1991), and the crew evaluation (Du Bois & Smith, 1989).

Map functions. The basic tactical map is a Universal Transverse Mercator (UTM) grid representation of the terrain. Digital data in the SIMNET terrain database constitute the basis for all resident map graphics. The digital map may be tailored to show color-coded contour lines, rivers, roads, vegetation, and UTM grid lines.

Map rescaling and scrolling functions are available as well. The four map scales available are 1:25,000, 1:50,000, 1:125,000, and 1:250,000. There are three map scrolling functions available so that a commander can keep his map at the same scale but shift the map section displayed to see different terrain. The Move Vehicle function allows the user to position his tank icon anywhere on the screen. The map shifts as the icon repositions so that the own vehicle location remains accurate. Move Vehicle's counterpart, Follow, allows the vehicle icon to remain stationary on the display while the map scrolls beneath the icon as the vehicle itself moves. A third scrolling option, Jump, allows the use of blue "jump spots" on the corners and sides of the map to move the map one-half the map screen height/width per "jump." If a "jump spot" is not touched, the map remains stationary. When the vehicle moves, the own-vehicle icon will move across the stationary map terrain. Jump mode allows the map to be quickly shifted for inspection of off-screen icons or to place waypoints off the currently shown map display. The commander can quickly return the map to its original position by going back to Follow mode.

Own-vehicle and friendly vehicle icons. A directional, all-parts-moving own vehicle icon is displayed at the correct grid location on the tactical map. The own-vehicle icon has features representing the gun tube, the CITV line-of-sight (LOS), the front slope of the vehicle, and the hull. The digital map also displays blue tank icons which represent the friendly vehicles in the battalion. These tank icons move as the actual vehicles move, providing information on friendly mission execution to aid C3.

The Information Center augments the vehicle status information shown graphically by the POSNAV own vehicle icon. The center shows the date, time of day, vehicle call sign, own vehicle heading in degrees, and the six-digit own vehicle UTM grid location. The status information, like the POSNAV own-vehicle icon, will update as the vehicle moves along the database or at a rate of approximately every ten seconds.

Commander's station navigation functions. POSNAV enables the unit or vehicle commander to create and modify routes for navigation and to send route information to his driver and to other vehicles in his battalion. Using the Navigation function, routes are created when locations for up to six control points, called waypoints, are selected on the digital map. An icon for each waypoint appears on the tactical map. The waypoints are connected by lines to form a route. The commander can send waypoints to his driver one at a time (manually) or automatically by means of an Autoadvance option. Autoadvance sends information on the next waypoint when the vehicle is within 100 meters of the current waypoint.

Driver's display. When the driver's display receives waypoint information from the vehicle commander, the relative direction to the selected waypoint is depicted graphically via the steer-to display, a directional "clock" which provides steering guidance to the driver to allow him to stay on course. To the right of the steer-to display is information on the waypoint number, the current vehicle heading (in degrees), the deviation in degrees from the selected waypoint, and the distance (in kilometers) to the selected waypoint. There is also an area at the top of the steer-to-display where the driver sees the message "Auto Advancing to WP XX" when the system autoadvances to the next waypoint.

CCD and POSNAV changes since the battalion TOC evaluation. A number of hardware and software changes have been made to the CCD and POSNAV systems following the battalion TOC evaluation. These modifications capitalize on findings and lessons learned from iterative CVCC research. The change most affecting the CCD and POSNAV has been upgrading the equipment platform from a Masscomp with 16-20 megabytes of memory to a SPARCstation IPX with 48 megabytes of memory. Besides making the CCD more compatible with the TOC workstations, the processing speed for all CCD and POSNAV functions has increased greatly. For example, rescaling the map now takes only a few seconds, compared with up to ten seconds previously. The memory increase brings several other beneficial changes. For the first time, the tactical map displays tree canopies instead of only tree lines, and vegetation can be viewed at scales of 1:125,000 and above. POSNAV icon locations update more consistently despite the variable load on the CCD nets. Previously, stacked overlays and report screens had tied up so much available memory that the slowed processes sometimes caused menus to be drawn top to bottom before the commander's eyes. With the additional memory and new platform, the incidence of slow processing is substantially less. A summary listing of CCD and POSNAV changes, along with brief rationale statements, may be seen in Table 8.

Table 8

Changes to the CCD and POSNAV Since the Battalion TOC Evaluation

Change	Reason
<u>Hardware</u>	
• Platform upgraded from Masscomps to SPARCstation IPXs	Provides greater compatibility with TOC workstations.
• Memory increased from 16-20 megabytes to 48 megabytes.	Increases processing speed and provides more detailed map terrain.
<u>Software</u>	
• Soft numeric keypads added to INTEL, SHELL, and SPOT reports.	Provides greater precision in reporting numbers of vehicles and shell impacts.
• Text incorporated in overlays.	Allows overlays and text to be linked for sending and reviewing.
• Obstacle icons represented by green NATO symbols.	Provides doctrinally correct, standardized symbols.
• Overlays made deletable from overlay file list.	Gives commander flexibility in managing overlays.
• Paging up and down added to report queues and FREE TEXT reports.	Provides more precise means of scrolling than scroll bars and arrows.
• Posted icons indicated by asterisk in report queues.	Allows commanders to quickly assess which reports are already posted.
• Ammo status report replaced by automated Logistics status reporting.	Provides automatic and accurate fuel, ammo, equipment, and personnel status for own vehicle, own unit, and other units.

(table continues)

Table 8

Changes to the CCD and POSNAV Since the Battalion TOC Evaluation (Cont'd)

Change	Reason
• "Hot" icons added to allow viewing of reports when map icons touched.	Allows commanders to open reports based on icon type and location.
• Observer/Target (O/T) Line and Coordination Line added to CFF.	Permits more accurate adjustment of fires and quicker calls for fire using overlay TRPs.
• Summary key allows return to summary page after editing a field.	Enables faster return to report summary page.
• Numbers added to map icons for INTEL, SHELL, and SPOT reports.	Augments the visual "what" and "where" with "how many."
• Highest echelon sender shown on report action page and within report.	Increases commander awareness of who had already received a report copy to reduce re-routing on the same net.
• Default net for relayed reports modified to select net previously unused for that report.	Decreases chance of re-routing reports on same net.
• Duplicate copy of report gets same status symbol as copy in "Old" file.	Signals to commander that he had already processed a previous copy.
• "Section" added to aggregation level.	Allows platoons to be deaggregated into sections.

Commander's Independent Thermal Viewer (CITV). The CITV affords the unit and vehicle commander an independent battlefield viewing capability and an independent laser range finder (LRF). The CITV's capabilities assist him in performing navigation, battlefield surveillance, target acquisition (including identification), and fire control tasks. Table 9 lists the functional capabilities of the CITV configuration, described by Quinkert (1988). The SIMNET Combat Vehicle Command and Control User's Guide (Smith, 1990) explains the operating features of the

CITV. The following paragraphs (adapted from Leibrecht et al., 1992) summarize the functional features of the CITV.

Table 9

Capabilities of the CVCC CITV Configuration

Independent thermal search
3X and 10X magnification
White-hot and black-hot polarity
Gun Line of Sight (GLOS) lock-on
Manual search
Autoscan
Independent LRF
Identification Friend or Foe (IFF)
Target Designate
Own vehicle icon (directional, all parts moving)

Mounted directly in front of the vehicle commander, the CITV display includes control switches around three sides of a central display screen (Figure 7). Control of CITV operation occurs via inputs from the functional switches and from push buttons on the commander's control handle. The control handle is also used to manually control movement of the CITV sensor. The interface components consist of: (a) rectangular (6.5 X 5.88 inches) monochrome CRT display screen with own vehicle icon and sighting reticle; (b) three-position toggle switch for power (OFF, STANDBY, and ON); (c) push-button selector switch for basic mode (CITV, GPS); (d) push-button selector switches for operational mode (AUTOSCAN, MANUAL SEARCH, GLOS [Gun Line of Sight]); (e) two-position push-button switch for polarity (WHITE-HOT, BLACK-HOT); (f) Autoscan control switches for setting sector limits and adjusting scan rate; (g) control handle push buttons for switching magnification (3X, 10X), operating the laser, and designating targets; (h) control knobs for adjusting brightness and contrast. The interface also includes several target stack push-buttons along the bottom; as in the battalion TOC evaluation (O'Brien et al., 1992), the target stack function was inoperative in this evaluation.

Basic modes. In the GPS mode, the CITV is functionally inactivated, with the last active scene from the sensor remaining static on the screen. This mode requires the commander to use his GPSE for viewing and enables him to override the gunner in moving the turret/gun tube and firing. The CITV mode permits the commander to select three modes of surveillance--GLOS, Manual Search, and Autoscan. The GLOS mode slaves the CITV line of sight to the main gun alignment, except when the commander depresses his palm switch to activate Manual Search. The slaved alignment provides a view overlapping the gunner's view while enabling the commander to operate his own LRF and change magnification and polarity. The Manual Search and Autoscan capabilities, both providing independent surveillance, are discussed later. The commander cannot fire the main gun with his CITV activated.

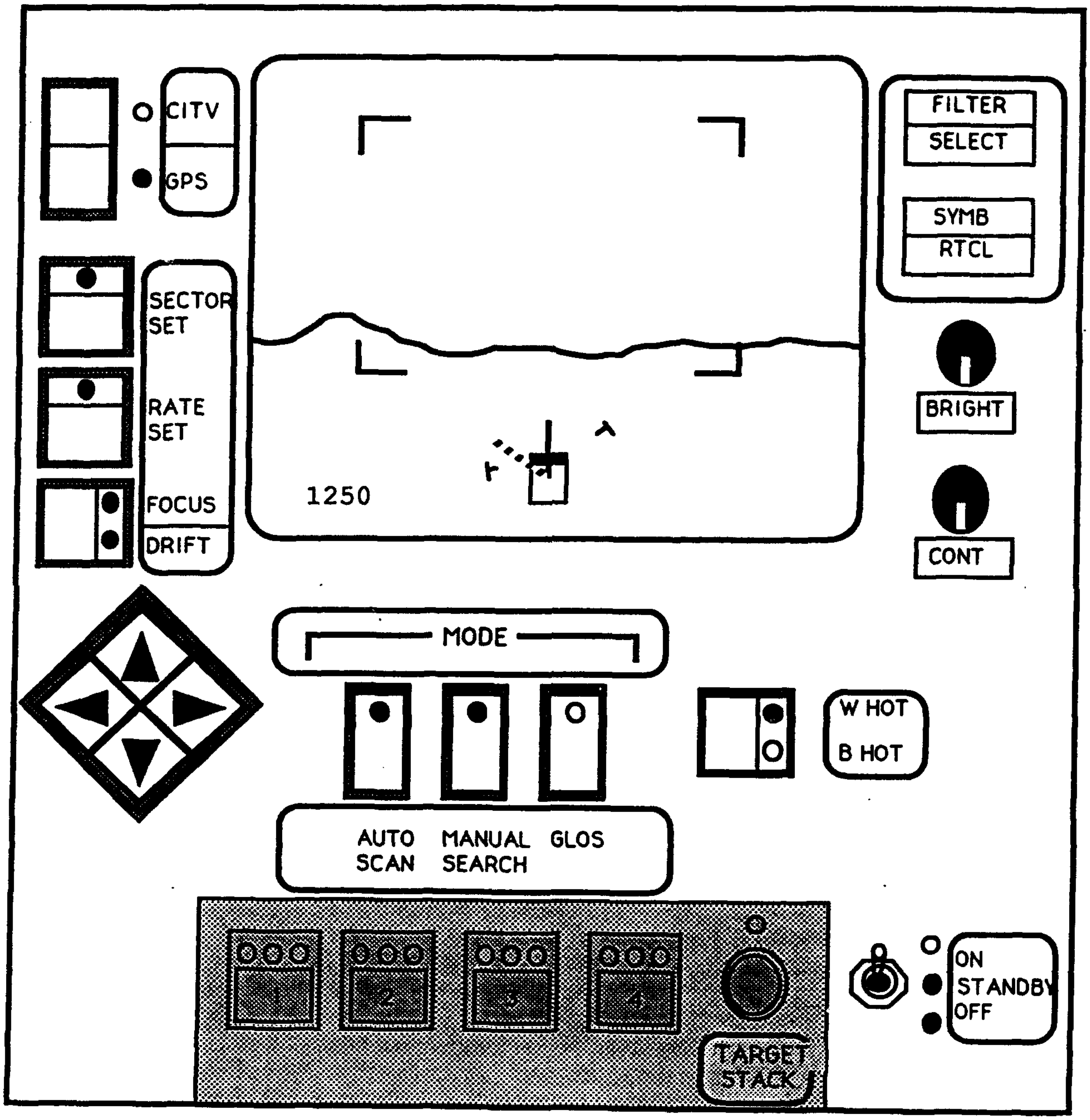

Figure 7. Commander's Independent Thermal Viewer (CITV) interface. See text for description. (Target stack functions, in the bottom shaded area, were inoperative.)

In all CITV modes the display screen presents two optional fields of view: wide field (3X magnification, 7.5 X 10 degrees) and narrow field (10X magnification, 2.5 X 3.3 degrees). In providing uninterrupted horizontal sweep capability, the system grants a 360 degree field of regard, with a vertical range from 20 degrees elevation to 12 degrees depression. According to his preference, the commander can select White-Hot or Black-Hot display options. In White-Hot mode, warmer objects within the field of view appear "white" against a darker background. In Black-Hot mode, warmer objects appear black against a lighter background.

The own tank icon present on the display screen is fully consistent with the own tank icon appearing on the CCD tactical map. The tank hull portion of the icon rotates to represent the tank's grid azimuth heading. The main gun indicator depicts the true direction of the turret/gun. The CITV indicators include the CITV's line of sight direction as well as the Autoscan sector limit markers.

Manual Search. In selecting Manual Search, the commander can control the CITV's line of sight by manipulating his control handle. Both direction (horizontal, vertical, and oblique) and speed of movement can be controlled simultaneously. This mode allows the pace and pattern to be varied as the commander searches for targets. It preserves access to other control options such as magnification, polarity, and Target Designation.

Autoscan. Autoscan permits the commander to automatically sweep the CITV's line of sight across a specified sector at a selected rate of speed. The search pattern requires no input from the commander once initial parameters are set. Setting or resetting left and right sector limit markers defines the portion of the field of regard to be scanned. To adjust scan rate, the commander can increase or decrease the current rate, which begins at a default value upon initialization. The entire 360 degree field of regard can be selected as the scanning sector, if desired. As with Manual Search, Autoscan maintains availability of secondary control options such as polarity, magnification, and Target Designation. The latter function requires activation of a temporary Manual Search option by depressing the palm switch.

Independent LRF. The CITV system includes a laser capability independent of the standard (GPS) LRF. The commander can exercise this capability in GLOS, Manual Search, and Autoscan modes; lasing in the latter mode requires interruption of scanning to stabilize the sight picture. Each lase produces a range-to-target reading in meters, displayed in the lower left corner of the display screen; this reading can indicate flawed determinations and double returns. Lasing also supports the IFF function, generating symbology characterizing the target as friendly, enemy, or unknown. This symbology appears in the upper left portion of the display. The IFF function models an 80 percent accuracy rate.

Target Designation. In the Manual Search and Autoscan modes, the commander can use the Designate function to quickly hand off a target to his gunner. Having identified an enemy target for immediate engagement, he presses the Designate button on his control handle. This rapidly slews the main gun to the CITV's line of sight, overriding the gunner's controls. The commander can then hand off the target to the gunner.

Battalion TOC. In addition to the vehicle simulators, a battalion TOC supported tactical operations in both the Baseline and CVCC conditions. The battalion TOC is located in a Standard Integrated Command Post System (SICPS) tent, the same type of tent used for a field-deployed TOC. The automated TOC (CVCC condition) provides an extension of the CVCC technologies available in the vehicle simulators. The following paragraphs describe the battalion TOC configuration for each condition.

Baseline battalion TOC. Battle reports, unit locations and status, and other pertinent information are maintained on wall charts and maps. The TOC staff updates staff journals manually. The radio configuration in the battalion TOC permits voice communications using the brigade command net, brigade operations and intelligence (O&I) net, the battalion command net and the battalion O&I net.

CVCC battalion TOC. The automated TOC (Figure 8) is comprised of four automated workstations and a large-screen Situation Display (SitDisplay). The four workstations support the tasks and responsibilities of the battalion commander/XO, the assistant S3, the S2, and the FSO. A fifth workstation, called the SitDisplay workstation, is located just outside the TOC. It controls the view shown on the SitDisplay screen as well as serving as a technical "troubleshooting" station. The SitDisplay provides a centralized location for individual workstations to post various mission overlays to gain a composite tactical picture. A sixth workstation is located in the ECR and is used to coordinate combat service support (CSS) and to emulate higher and adjacent headquarters. The workstations exchange data on a TOC local area network, which in turn connects to the CVCC network. This linkage provides the means of implementing command and control procedures and coordination and exchanging information with the unit and vehicle commanders in the manned simulators.

The battalion TOC workstations each consist of a central processing unit, two 19-inch color monitors, a keyboard, and a mouse (Figure 9). The left-hand monitor is a Map Display, which portrays a digital military topographical map and can be manipulated through the keyboard and mouse. The right-hand monitor, called the Communication and Planning Display, presents textual information received from other sources and enables the user to create, edit, store, and transmit overlays and reports generated from his workstation.

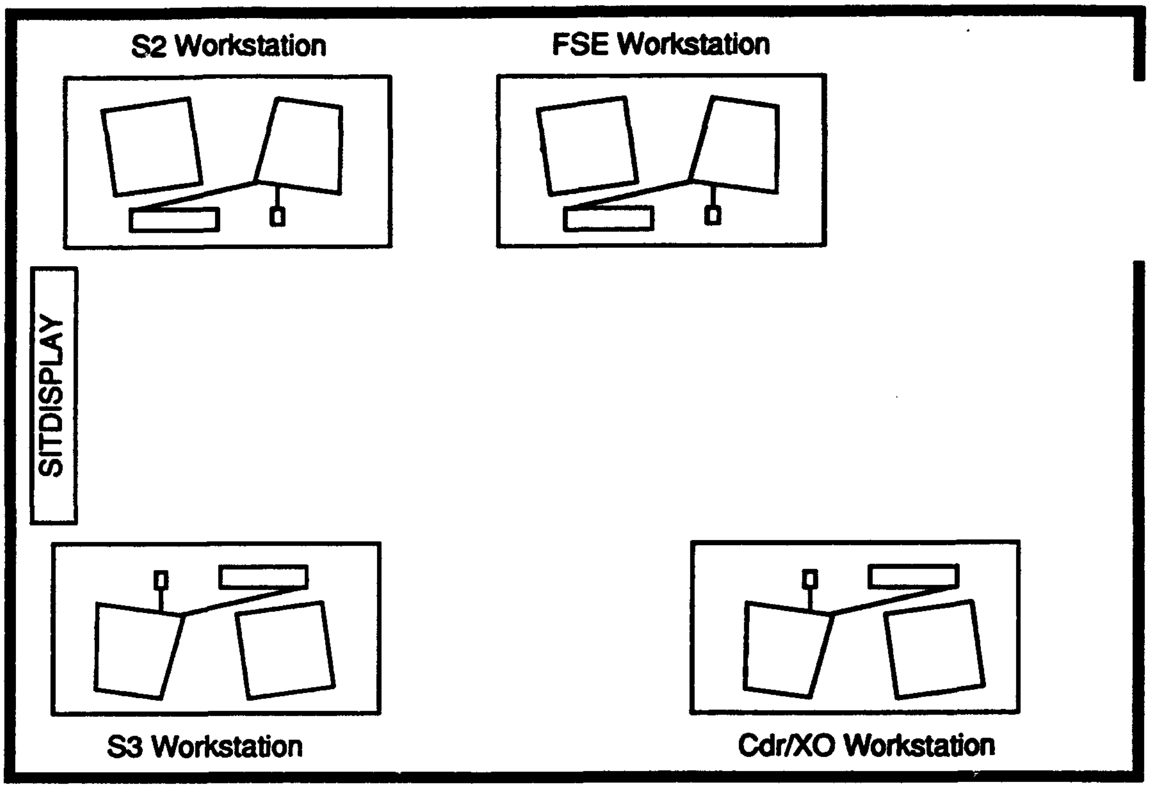

Figure 8. Floor plan of the battalion Tactical Operations Center used in the CVCC condition.

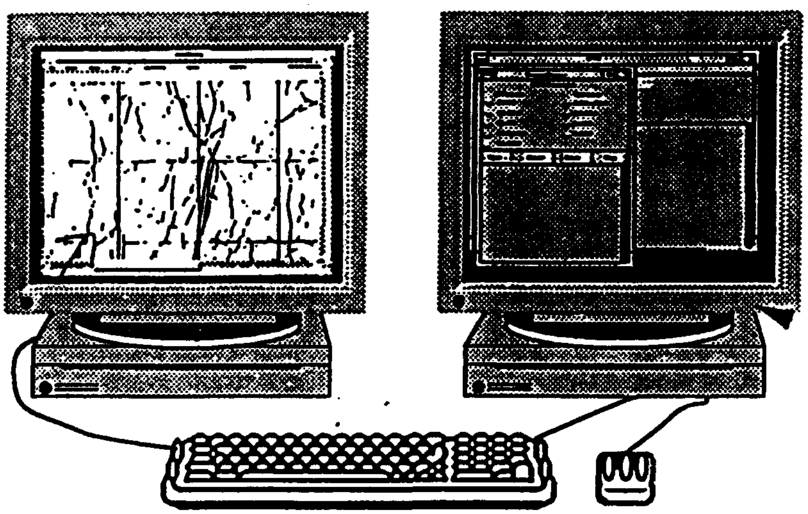

Figure 9. Automated workstation used in the battalion Tactical Operations Center for the CVCC condition.

The TOC workstations permit TOC personnel to perform key command and control functions such as receiving combat information, generating combat orders and overlays, and communicating information within the TOC and throughout the battalion. All TOC workstations have common hardware and functional features described in the following paragraphs. A complete guide to the functionality and operation of the TOC workstations may be found in the Battalion Tactical Operations Center (TOC) Job Aid (BDM Federal, Inc., 1992).

The workstation software consists of two major components: the Map Module and Message Module. Map Module functions provide the means to create and edit overlays, manipulate map objects, and adjust features (e.g., map scale, contour lines, terrain features) of the tactical map. The Map Module can display three classes of objects. These objects include (a) graphic overlays, (b) friendly vehicle icons (POSNAV-generated), and (c) message icons.

Overlays are created by workstation operators to represent overlays commonly associated with tactical combat operations (e.g., operations, intelligence, fire support, barrier). The staff can create these overlays by selecting objects such as unit symbols and points of military interest (e.g., checkpoints, target reference points, coordinating points) and by constructing routes, boundaries, and other graphic control measures using drawing tools. Although graphic symbols are available to support the individual types of overlays drawn (e.g., fire support), all workstations have the same library of overlay features from which to choose. For example, the current version of the battalion TOC software has been updated since the battalion TOC evaluation, to include those fire support graphic control measures and points of interest which allow the FSO to plan fires based on incoming digital CFF and ADJUST FIRE reports. The visual richness of the display can be varied by changing the stacking order of overlapping objects and clustering unit symbols hierarchically. Hierarchically clustered symbols can be represented by their superordinate unit symbol. Once created, overlays can be edited, stored, retrieved, and transmitted by the battalion TOC staff on the battalion network to the simulators. They can also be posted to the SitDisplay to create an updated picture of the battlefield situation.

The Course of Action (COA) overlay is a unique type of overlay in that it has the ability to show via "animation" the projected movement of units across the battlefield. It is a new feature added to the TOC workstations since the battalion TOC evaluation. The COA overlay is a tool for the battalion commander, battalion XO, or battalion S3 to use as they wargame possible courses of action as well as a visual aid for briefing units on the upcoming mission. As each stage of the mission is planned, phase icons are placed on the overlay in the various anticipated locations. When the planning is complete, the COA can be activated to show the progression of the unit symbols from one phase/location to the next. Unlike other types of overlays, the COA cannot be sent to the simulators, so it plays a key role only in the pre-mission stage of the exercise.

Another feature added to the TOC workstations since the battalion TOC evaluation is the Task Organization/Operational Effectiveness (TO/OE) module. The TO/OE module allows the TOC workstations to receive the LOGISTICS report information from the CCDs. It uses this logistics information to display color-coded bar graphs which represent the color-coded level (green, amber, red, black--GARB) of the ammunition, fuel, equipment, and personnel for units with CCDs.

Friendly vehicle icons are also an element of the Map Module. Like the POSNAV icons on the CCD map displays, these icons indicate actual location information received from the POSNAV-equipped individual vehicles in the battalion. The icon locations are dynamically updated as the vehicles maneuver across the simulated battlefield. The workstation operator can aggregate the individual vehicle icons into higher level unit symbols (i.e., from a tank icon to a platoon, company, or battalion unit symbol) to reduce display clutter, or he can selectively deaggregate them as necessary (e.g., deaggregate B Company to the platoon level).

Message icons indicate information from digital combat reports (e.g., SPOT, CONTACT) that have been viewed or created. They may also represent information previously posted to the Map Display. Reports can be viewed by selecting their message icons. They can also be linked to the appropriate unit symbols within an overlay (e.g., linking a SPOT report to a threat icon placed on an INTEL overlay). In the event of multiple icons in the same location, the stacking order of message icons can be also be changed.

The Message Module functions enable the staff to receive digital combat reports from the CVCC network and store them in the workstation's database. The staff can also create digital messages and/or route them on the battalion command net to the simulators, other workstations, or to internal workstation folders. A complete description of the Message Module contents and functionality may be found in the <u>Battalion Tactical Operations Center (TOC) Job Aid</u> (BDM Federal, Inc., 1992).

The following operations can be performed on digital messages: (a) receive incoming messages, (b) create new or delete existing messages, (c) view a message; (d) route a message to another folder (e) post a message to the Map Display or SitDisplay; (f) send a message to another workstation or to a CCD. Messages are created using report formats containing several option fields that permit the user to input the contents of a standardized message. To read a message, a message header must be selected from a folder's message list, or a posted icon must be selected from the Map Display.

Folders provide the means for managing message traffic. All new messages appear in the InFolder. The Miscellaneous folder serves as a holding file, with unprocessed reports moving from the InFolder to the Miscellaneous folder five minutes after reception. Reports can be copied to the Journal folder, which provides a permanent, chronological record of events. There is no capacity to delete reports from the Journal. The Map Display folder stores the message contents associated with reports posted to the workstations' own map displays. Likewise, the SitDisplay folder stores the messages posted by each workstation to the independent SitDisplay. The operator can create additional folders as needed. Workstation operators can also view the contents of other workstations' folders.

Exercise control equipment. The stations that control the training events, the training exercises, and the training and test scenarios are located in the ECR. These stations consist of: (a) two Plan View Displays (PVD), (b) six SINCGARS simulators (stand-alone), (c) a CB radio, (d) a Management, Command, & Control terminal, (e) a SIMNET Control Console, (f) three semiautomated forces (SAFOR) workstations, (g) a combat service support battalion TOC workstation, and (h) a LISTEN station.

One PVD is used for brigade-level monitoring and one for battalion-level monitoring. The six table-top SINCGARS simulators and one CB unit provide tactical and administrative control radio communications. The Management, Command, and Control (MCC) system monitors and controls the status of the simulators, while a LISTEN station monitors the digital message traffic. The three SAFOR stations (two for friendly SAFOR and one for OPFOR) control and operate the simulation-generated forces. A Combat Service Support (CSS) workstation is used for digital communication (e.g., transmission of messages and overlays) between the TOC and ECR. The CSS workstation also accommodates the SEND utility for preparing, retrieving from storage, and transmitting electronic reports at the brigade staff level. Figure 10 depicts the configuration of the ECR during the battalion evaluations. The following sections describe each station in greater detail.

PVD. Two PVDs provide the primary monitoring capabilities during the execution of the training and test scenarios. The PVD screen provides the control staff with a real-time, "God's eye" view of the battlefield. All vehicles, aircraft, gunnery targets, impacting artillery, and mortar fires are displayed. In addition, graphic control measures, grid lines and coordinates, lasing, and direct fire engagements are available for viewing. Through a series of keyboard commands, the PVD operator can insert a "flag" or time marker into the data stream to denote a significant or critical event useful for later analysis. PVD capabilities include map manipulation, vehicle identification, intervisibility plotting, and a number of other functions.

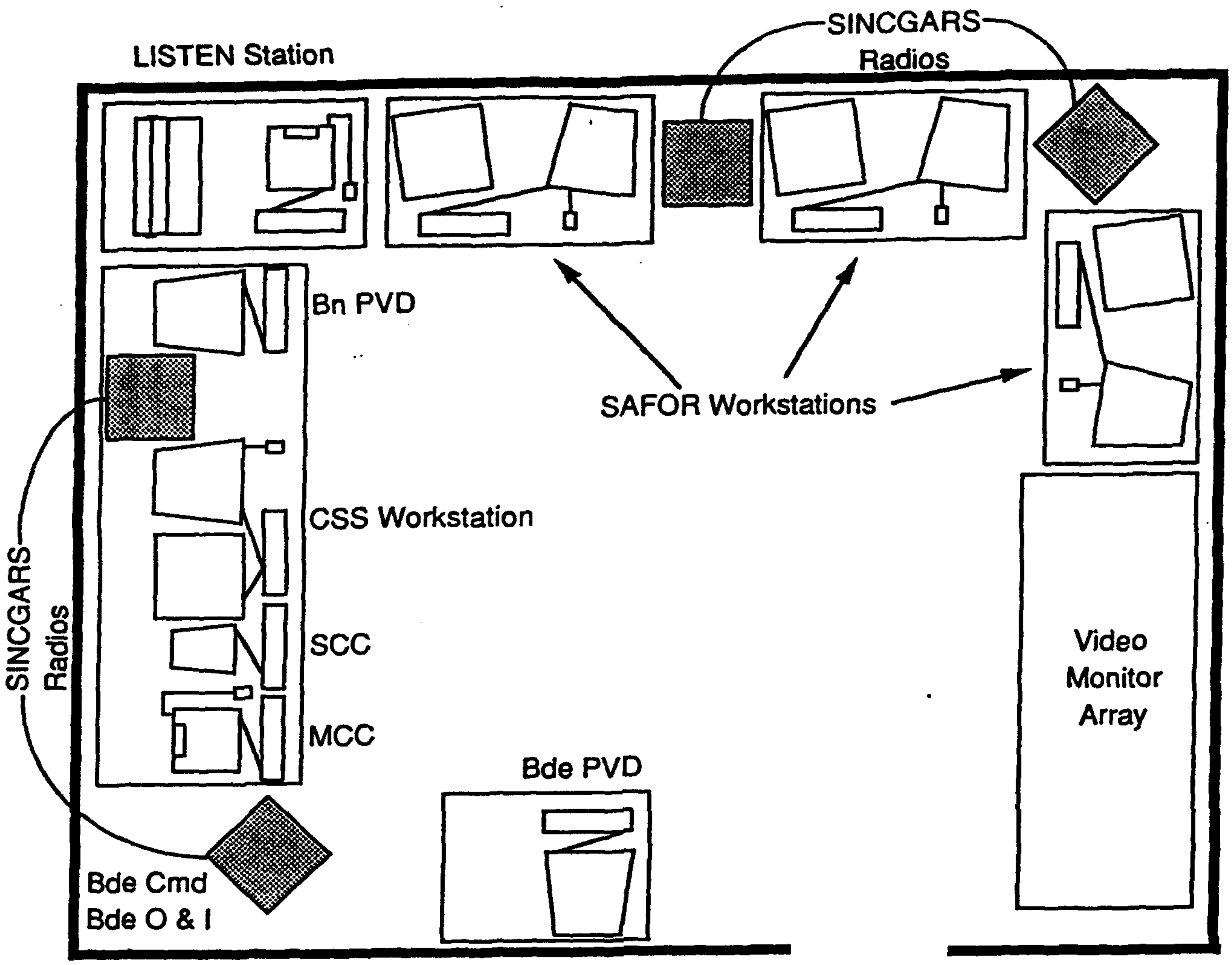

Figure 10. Floor plan of the Exercise Control Room (ECR), showing the layout of exercise control equipment.

Radio network. The simulated SINCGARS radio system services seven voice radio nets--brigade command, battalion command, battalion O&I, and four company command nets. Figure 11 shows the radio networks and configuration used in the Baseline and CVCC conditions. All nets except the battalion O&I net are available for digital burst transmission of reports and overlays. The company XOs, like the company commanders, have the battalion command net and the company command net routing options on their CCDs.

Seven send/receive stand-alone radios are used to monitor operational radio nets in the ECR. Six of these are stand-alone SINCGARS simulators. The brigade command net, located at the brigade PVD station, is used by the Battle Master (military SME who oversees scenario execution) to represent adjacent battalions. During training and the test scenarios, the battalion command net, located next to the battalion PVD, monitors voice messages (e.g., crossing phase lines [PLs], reporting SET).

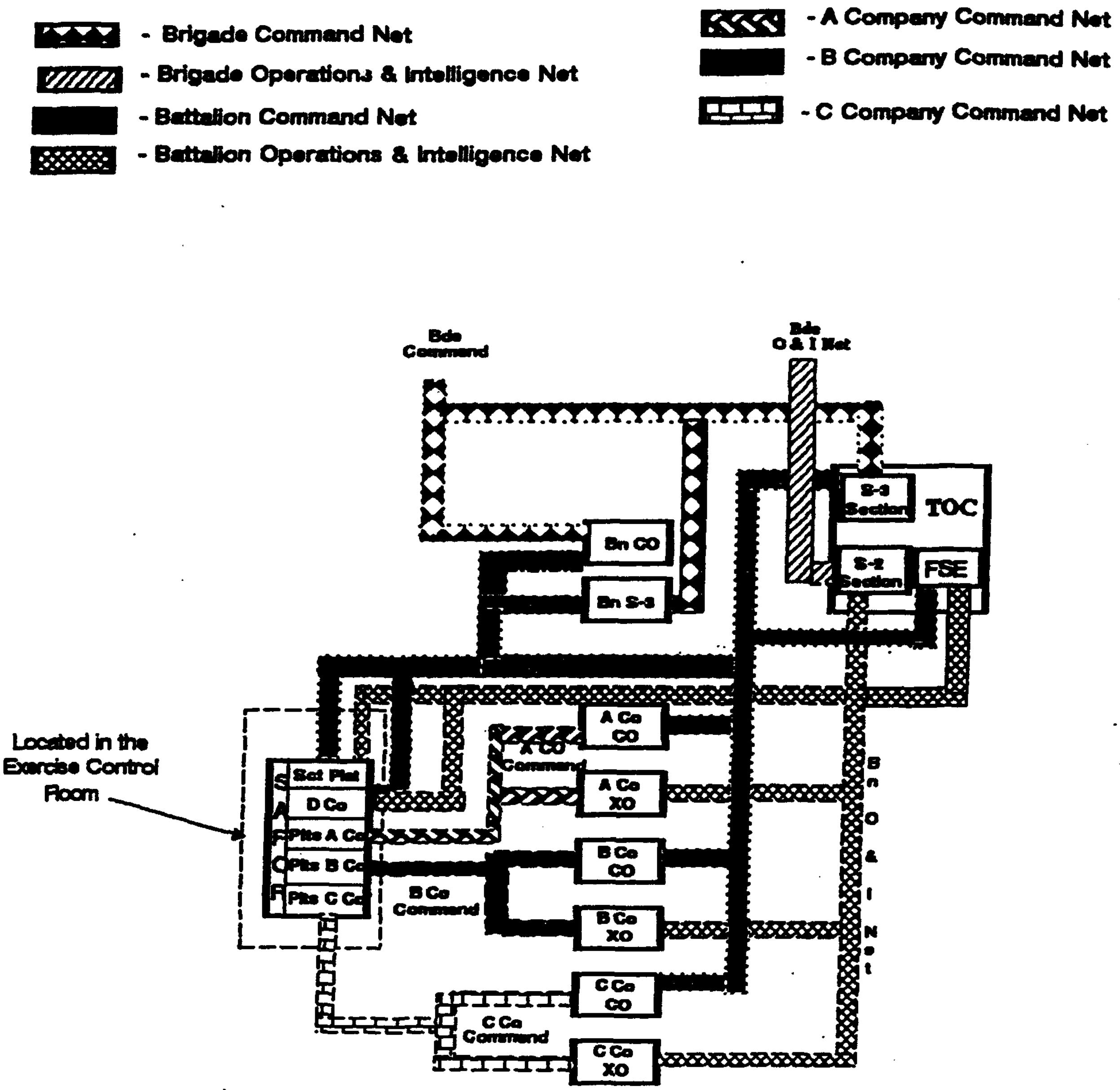

Figure 11. Diagram of the tactical radio networks (voice) implemented in the evaluation.

SAFOR operators monitor the nets appropriate to their roles. During training and the test scenarios, five nets are monitored: three company nets, the battalion command net, and the battalion O&I net. An additional CB radio (brigade O&I net) permits private radio communication between the battalion TOC and the ECR.

Management, Command, and Control system (MCC). The MCC system initializes and manages the simulation. Initialization selections define the terrain database, the exercise identifier, simulator parameters, and unit organizations. These initialization selections permit the control staff to repeatedly call up and execute scenarios in a standardized manner. Once initialized, the MCC provides easy access to status information about all operational manned simulators.

The SIMNET Control Console (SCC) is a component of the MCC system used to initiate the MCC's involvement in an exercise and to access most of the functions simulated by the MCC system. The SCC allows the control staff to place simulators and gunnery targets in specific locations on the terrain database. Standard files for each scenario and exercise permit all vehicles and targets to be placed on the terrain database with only a few key strokes. Thus, initialization and setup are both rapid and standardized. The SCC also provides the control staff with the ability to "reconstitute" or restore any elements that may have malfunctioned or "dropped off" the simulation network during the course of a scenario.

SAFOR workstations. The SAFOR workstations are used by the role-playing operators to monitor and control the automated friendly (BLUFOR) and enemy (OPFOR) units. BLUFOR operators respond to and implement the commands of unit and vehicle commanders located in the M1 simulators. Two SAFOR operators are responsible for directing the activities of the subordinate automated forces in accordance with the directives of the participant commanders. A single OPFOR workstation operator is responsible for directing the activities of the simulated threat forces in accordance with the training and test scenarios. With standardized operating procedures, events lists, and scripted OPFOR engagement timelines and axes of advance, the set-up and execution are standardized for both conditions and all rotations. Offensive and defensive scenario events lists can be found in the battalion-level preliminary evaluation (O'Brien et al., 1992); in addition, the RA and Battle Master logs in Appendix C contain scenario events.

Each SAFOR workstation provides a top-down color map display capable of depicting the current state of the battlefield. In the case of the battalion evaluation, however, this view is limited to the information reported by forces on the battlefield. The operator may zoom in or pan to any point on the map display. Features such as contour lines, UTM grids, roads, water, trees, bridges, railroad tracks, control measures, and buildings may all be displayed. Engagement and speed parameters for all SAFOR vehicles are entered using the workstation keyboard (e.g., engagement distance rules and cross-country rate of movement). Initialization files for each scenario and exercise permit both friendly BLUFOR and OPFOR units to be called up in their correct starting locations using a few keyboard commands.

SAFOR software routines automatically generate and send event-driven digital reports to the manned-simulator CCDs in the CVCC condition. During both conditions, RadioTelephone Operators (RTOs) role-play subordinate platoon leaders and the D company commander and XO. During Baseline, they relay the automated SAFOR reports and coordination items via voice radio. This automated information includes CONTACT reports, SPOT reports, and SITREPs. During the CVCC condition, the CCD-type reports are sent digitally, but coordination items not supported by the CCD (e.g., SET on BP 41) are still sent by voice.

Stealth vehicle. The Stealth station is a "ghost" simulator whose appearance cannot be detected by other combat simulators. The Stealth can move about the battlefield, undetected by manned simulators, and observe vehicles, fires, maneuver, and virtually all combat activities. The Stealth station consists of three 25-inch monitors, a PVD, and a SpaceBall control integrated into a single simulated vehicle. The SpaceBall provides control input to move the vehicle around on the battlefield. The PVD is used to determine the observer location on the simulated battlefield or to attach the Stealth to other combat vehicles in the simulation. Once attached, the Stealth moves around the battlefield with the vehicle to which it was linked.

CSS workstation (CVCC condition only). The CSS workstation facilitates the transmission and reception of digital reports between the ECR and the TOC workstations. It is used to transmit brigade-generated digital information to the battalion commander and the S3. To send reports to other battalion TOC workstations only, the CSS workstation operator selects "Staff" from the individual report's routing menu. The CSS workstation may also be used to store, copy, and post other workstations' scenario overlays. The CSS workstation is a part of the digital battalion command net as well. The CSS workstation is used as a coordinator (addressed in more detail later) to transmit scenario-building messages that provided context and situation development for the evaluation participants.

CVCC utilities. Several CVCC utilities are available to the ECR staff. These include the CVCC-SEND and CVCC-LISTEN programs, and a special workstation coordinator option (usually running on the CSS workstation). The coordinator option permits the CSS workstation controller to checkpoint or "snapshot" the current state of all TOC workstations and CCDs. All overlays, messages, folders, and other information on each workstation and CCD are stored to files when the checkpoint was initiated. The coordinator workstation also restores these checkpoint files. The use of checkpoint files initiates the start of each scenario stage. This capability permits a complex series of overlays and initial message traffic to be quickly and accurately called up for each stage.

The CVCC-SEND utility permits the Battle Master to send digital combat messages to the battalion TOC workstations and CCDs. The SEND utility can send digital reports over any communication network, with any unit designation. In addition, messages can be saved in files on the coordinator workstation. Saving these files permits the Battle Master to send preformatted messages quickly and accurately to participants in the exercises.

The CVCC-LISTEN utility provides real-time display of all digital messages transmitted over any communication network, unlike a CCD or workstation that is limited to one or two networks. The LISTEN utility provides a printed copy of all digital messages transmitted during an exercise.

Remote communication devices. Each vehicle trainer wears a Maxon 49-HX communicator. These communicators operate as single-channel two-way communication devices, permitting each vehicle trainer to communicate with the floor monitor. The Floor Monitor may pass administrative information such as the status of a breakdown to the vehicle trainers using the walkie-talkies in order to minimize disruptions and sustain operations.

Video recording capabilities. Audiovisual recordings provide a supplemental mechanism for examining the performance of selected unit and vehicle commanders as well as the TOC staff. Miniature cameras, approximately three inches in length, are installed in unobtrusive locations in the simulators and in the battalion TOC. All the audiovisual recordings are time-stamped with current clock time. Verbal communications in the TOC are recorded via a microphone.

Automated data collection and analysis (DCA) system. The DCA system provides automated data recording, reduction, management, and analysis capabilities. O'Brien et al. (1992) provide a detailed description of the data collection, reduction, and analysis procedures developed for this evaluation. DataLogger, one of the elements of the DCA system, records all simulation network data traffic transmitted over the Ethernet in the form of data packets. A variety of data packets is generated by operator-initiated events (e.g., a CCD soft-switch press) or by timed cycles (e.g., periodic vehicle appearance packets conveying location and orientation). DataLogger permits real-time digital data recording by storing on magnetic tape all data packets broadcast by every simulation element. These recordings are then available for later reduction and analysis. The two PVD stations in the control room are used to embed event flags in the DataLogger recordings. These flags indicate key events such as the start of an exercise, a radio transmission, or crossing of a phase line. CCD report contents as well as voice radio transmissions broadcast over the simulation network are available for subsequent analysis.

Two DCA subsystems process off-line reduction and analysis of DataLogger recordings. DataProbe™ (a registered trademark of Bolt, Beranek, and Newman, Inc.), a data management and analysis software package, extracts data elements from the DataLogger recordings and structures them into intermediate files. DataProbe™ includes a SIMNET Data Dictionary to define and label the various data packets, enabling the accurate isolation of data elements of interest. RS/1™ (a registered trademark of Bolt, Beranek, and Newman, Inc.), an interactive, programmable advanced statistics software package, is used to analyze data from these intermediate files using software routines developed specifically for CVCC databases.

Training Materials

Participant training followed the "crawl-walk-run" approach, beginning with individual training on the use of the various systems and progressing through crew, company, and battalion exercises. The scope of this wide range of activities required a variety of training materials. These included detailed lecture materials for classroom training, outlines and performance-based skills tests for hands-on training, trainer checklists, unit SOP, navigation aids, and operational exercise-control specifications for unit exercises. Every effort was made to provide equivalent training for both conditions despite content differences.

The support package for the battalion evaluation (BDM Federal, Inc., unpublished) contains the actual materials (e.g., lesson plans, briefing charts, evaluation instruments) used in the course of this effort. The following paragraphs summarize the content of the training materials.

Classroom briefings. Briefing materials, including viewgraphs and scripts, were developed to support the different classroom briefings presented in this evaluation. The viewgraphs and scripts, available in the support package (BDM Federal, Inc., unpublished), supported the following classroom sessions: (a) a general introduction to the evaluation (b) an orientation comparing the M1 simulator to an actual M1 tank, (c) a SIMNET navigation briefing (Baseline only), (d) a CITV orientation (CVCC only), and (e) a SAFOR orientation.

Seat-specific orientation outlines. For the seat-specific orientation, training outlines were developed to standardize the presentation given to all participants. These presentations were tailored to the CVCC or Baseline conditions and provided orientation to specific crew positions (i.e., vehicle commander, gunner, or driver).

CCD demonstration (CVCC condition only). The CCD demonstration, utilizing the large-screen monitor and a "stand-alone" TOC workstation, was designed as an overview of the CCD functionality and operation. The instructor's demonstration outline, contained in the support package (BDM Federal, Inc., unpublished), provided a general orientation and described critical features and functions of the CCD. Specific contents included the CCD's information center, creating, receiving, and relaying reports, the tactical map functions, and vehicle icons (both own-vehicle and POSNAV-generated).

Hands-on training outlines (CVCC condition only). To structure hands-on training regarding the use of the CCD, POSNAV, and CITV, outlines were developed to standardize the explanation and demonstration of specific functions. These outlines provided a systematic, step-by-step walk-through of all features and functions.

SIMNET, CCD, and CITV Skills Tests. These tests helped determine if a unit or vehicle commander was prepared to continue training. All test items were scored by vehicle trainers on a pass-fail basis immediately after the participant made each response. The SIMNET skills test (Baseline condition) included eight questions regarding attaining proper vehicle heading, azimuth, and odometer readings. The CCD and CITV skills tests (CVCC condition) covered the major functional features of the CCD, POSNAV, and CITV components. Each test consisted of a series of tasks with instructions to be read by the trainer. The CCD test contained 19 items; the CITV test had 11. These materials were based on previous versions, which can be found in O'Brien et al (1992).

Unit SOP. The battalion SOP, provided in paper form to each unit and vehicle commander on the second day of training, included general guidelines to be followed by the participants in training and test exercises. Actually an SOP "extract" (see Appendix A for the CVCC version), the content and format followed current doctrine and guidelines. Both the Baseline and CVCC versions of the battalion SOP detailed the rules applying to maneuver, engagement, communication and reporting, combat support, combat service support, and command and control. The SOP for both conditions defined the format for each structured report as well. The only major difference between the SOPs was in the CVCC version, which stated crews should use digital instead of voice report transmission techniques.

Unit training checklists. During crew, company, and battalion training, a checklist (see BDM Federal, Inc., unpublished) served to remind the vehicle trainer of the M1, CITV, CCD, and POSNAV functions the crewmembers were expected to exercise. The checklists also required the vehicle trainers to make judgments on whether or not the equipment was being used correctly and provided vehicle trainers with opportunities to practice report tallying. For the Baseline condition, the checklist emphasized radio reporting, crew interaction, navigation, and operation of the M1 simulator only. For the CVCC condition, the checklist included additional items on CCD, POSNAV, and CITV usage.

Navigation aids. Each unit and vehicle commander was provided a standard set of materials to help him navigate during training scenarios. These included: SIMNET terrain maps encased in clear plastic map covers, operational overlays drawn on clear acetate sheets, erasable markers for drawing on overlays and maps, duct tape for securing overlays to the map cases, and map protractors for plotting azimuths.

Tactical Training Exercises

The tactical training exercises provided the participants with opportunities to practice using the equipment to accomplish critical C3 tasks during a tactical mission. Four training exercises were used in this evaluation: tank crew training, the company situational training exercise (STX) (concurrent with battalion staff situational training), the battalion STX, and the battalion training scenario. All of these exercises are described in detail in the battalion evaluation support package (BDM Federal, Inc., unpublished). Two of the exercises (company STX and battalion training scenario) were adapted from materials developed by Microanalysis and Design, Inc. (Smart & Williams, unpublished).

Detailed descriptions were developed for each training exercise which described the tasks to be trained during the exercise, as well as the conditions, standards, instructions (for the test personnel), and all supporting materials used to conduct the exercise. The company STX, battalion STX, and battalion training scenarios were based on current doctrine and combined typical elements of realistic offensive and defensive combat operations staged on the terrain surrounding Fort Knox, Kentucky. For these exercises detailed overlays, brigade and battalion-level operations orders (OPORDs), Baseline and CVCC scenario event lists, SAFOR exercise files, and battalion TOC checkpoint files (CVCC only) were prepared. These materials helped the support staff initialize and execute the exercises in a standardized manner.

Test Materials

Battalion defense scenario. The defense test scenario was developed with the assistance of and approved for use by the Directorate of Combat Developments (DCD), U.S. Army Armor School, Fort Knox, Kentucky. This scenario was based largely on an earlier version developed by Microanalysis and Design, Inc. (Smart & Williams, unpublished). Executed in three stages, the test scenario involved the following missions: delay, counterattack, and delay. The test scenario began with a brigade OPORD briefing followed by the battalion OPORD. Appendix A presents the battalion-level OPORDs only; (the brigade version differs only in level of echelon). During the mission planning period, a leaders' reconnaissance was presented for the battalion commander, the S3, and the three company commanders assigned to the manned simulators. The leaders' reconnaissance was conducted over a pre-determined route using the Stealth station mimicking a SAFOR tank. Table 10 presents an overview of the tactical structure of this scenario.

Table 10

Tactical Structure of the Battalion Defensive Scenario

Stage	Major Activities
Initial Planning	Mission briefing, planning, leader's recon
1. Delay to Phase II [a]BPs	
A. Pre-engagement	Set up defense
B. Enemy engagement	Fight two [b]MRBs(+)
C. Displacement	Move to Phase II BPs
2. Counterattack to [c]OBJ	
A. Pre-engagement	Receive FRAGO, plan, move to OBJ
B. Enemy Engagement	Fight MRB(+)
C. Prepare FRAGO 2	Receive FRAGO, plan
3. Delay to [d]PL	
A. Pre-engagement	Receive FRAGO, plan, move to BPs
B. Enemy Engagement	Fight two MRBs
C. Chemical Attack	Delay to subsequent BPs

[a]Battle positions. [b]Motorized Rifle Battalion. [c]Objective.
[d]Phase line.

Manual data collection instruments. In addition to the DCA's automated data collection capability and the audiovisual recordings, a variety of manual data collection instruments was used. The following paragraphs detail the manual data collection instruments.

Behavioral observation. Data collection logs were completed by ECR and TOC personnel and the vehicle monitors. In this study, Battle Master, PVD, TOC, and Vehicle Logs were used. (See O'Brien et al., 1992 for early versions of the PVD and Baseline Vehicle Logs). Test personnel in the control room sent flags (electronic event markers) using the PVD to identify key events in the scenarios. These flags defined starting or ending points for time-based measures (e.g., delay in reporting SET on a BP) or defined the conditions under which the performance measures were collected. Test personnel in the TOC recorded times for milestone events in the scenario such as the first CONTACT report sent. Flags and times from the Battle Master, PVD, and TOC Logs were used to support DCA data reduction. The PVD and Vehicle Logs were also used to note any equipment breakdowns that interfered with established test procedures.

Baseline vehicle monitors in the battalion commander, S3, B Company commander, and B Company XO vehicles manually recorded data for selected performance measures such as the number of reports sent over the radio by their unit or vehicle commander. Information selected from these logs was used to provide data that the DCA system could not collect (e.g., information on vision block versus GPSE usage). Vehicle monitors also recorded any observations that they felt might help explain any unusual performance by a crewmember (e.g., a unit or vehicle commander who complained about lack of sleep after pulling night duty).

The CVCC version of the Vehicle Log (Appendix C) required the same information as the Baseline version with the addition of the number of CCD-type reports sent and CCD tactical map versus lap map usage by the commander.

Report transcription. Test personnel used playback of radio communications during the Baseline and CVCC test scenarios to transcribe key elements of the reports sent over the radio. Playback sessions consisted of reviewing the exercise as it was replayed on the PVD and listening to the voice radio traffic synchronized with the battlefield activities. Prior to playback, PVD logs were reviewed for missing data. If possible, the missing data were collected during playback. Each radio transmission was categorized first as to whether it was a CCD-type report (i.e., a report type that the CCD supports such as a CONTACT report or INTEL report). Special attention was paid to CCD-type reports which were sent via the radio in either the Baseline or CVCC conditions so that the accuracy of the voice reports could be scored against the same types of reports sent digitally. Once playback of radio traffic was complete, test personnel reduced the data using manual data reduction forms before the data were entered into a database for later analysis.

SMI assessment questionnaires. Two SMI questionnaires were administered, one covering the CCD and POSNAV, and one pertaining to the CITV. Questionnaires were administered to all unit and vehicle commanders after the debriefing for the test scenario. A member of the research staff administered these questionnaires. Instructions were read aloud and provided in writing. The questionnaires were self-paced. These SMI questionnaires were based on previous versions which can be found in O'Brien et al. (1992).

The CCD questionnaire contained 47 items with which participants used a seven-point scale (1 represented "Totally Unacceptable, 7 represented "Totally Acceptable") to rate the level of acceptability of 32 items regarding individual CCD and POSNAV functions, as well as four items regarding CCD components as a whole. In addition, 11 open-ended questions solicited participants' suggested changes, preferences, and problems concerning the CCD, with space for additional comments.

The CITV questionnaire contained a total of 20 items, 16 of which concerned individual CITV functions and the CITV as a whole. Participants used the same rating scale used for the CCD and POSNAV questionnaire. In addition, four open-ended questions asked for participant's opinions concerning the CITV, including any additional comments on its training.

Training assessment questionnaires. All participants rated the training they received during the first three days of the evaluation via training assessment questionnaires. There were Baseline and CVCC versions tailored to the commander, gunner, and driver positions, focusing on each training module, with space for participants' recommendations on improving each of the training modules. Questionnaires were administered to participants at the conclusion of the test scenario. Earlier versions of these questionnaires can be found in O'Brien et al. (1992).

Baseline vehicle commanders rated 17 items regarding classroom training, hands-on training, tactical training exercises, their own level of preparation, debriefs, and SAFOR using a five-point rating scale, with 1 representing "Poor" and 5 representing "Excellent". Participants used another five-point scale (1 representing "Very Unclear", 5 representing "Very Clear") to rate three items pertaining to the training program as a whole. Included with both sets of ratings were questions asking participants to explain any responses on the extreme negative end of the scales. In addition, five open-ended questions pertained to participants' suggestions, preferences, and problems with the training program.

The CVCC version of the vehicle commander's training evaluation included the same topics as the Baseline version, plus additional items to cover the training of the CCD and CITV.

The Baseline gunner's evaluation had participants rate three items pertaining to the adequacy of training using the same "Poor" to "Excellent" scale as with the vehicle commander's questionnaire. In addition, one open-ended question asked for comments on the quality of training and equipment.

The CVCC version included the same three Baseline rating questions concerning training adequacy. In addition, seven questions regarding participant's opinions on the target designation feature were presented for rating on a five-point scale with 1 representing "Strongly Agree" and 5 representing "Strongly Disagree." There were also three open-ended questions pertaining to gunners' opinions about the CITV equipment.

The Baseline driver's training evaluation was identical to that of the gunner's baseline evaluation. The CVCC version contained three training questions rated on the same five-point scale the vehicle commanders and gunners used. In addition, 11 questions obtained drivers' opinions of the Steer-To-Indicator (STI) through ratings on a five-point scale of "Strongly Disagree" to "Strongly Agree." Four open-ended questions asked for participants' overall opinions about the STI.

Biographical questionnaire. The biographical questionnaire was used to obtain background information on participants and was administered during the General Introduction. This questionnaire was designed to obtain selected information on demographic variables and military experience from each participant. This information provided a profile of participants and helped determine group comparability. Officers and enlisted personnel completed the same questionnaire, which requested basic information such as age, rank, military specialty, and time in service. Additional items recorded experience with various armored vehicles, experience in each tank duty position, military courses completed, National Training Center (NTC) or Combat Maneuver Training Center (CMTC) experience, and combat maneuver unit experience. Participants were asked about previous experience with both the Combined Arms Tactical Training Center (CATTC) and MWTB. Information regarding educational background and familiarity with computers was also collected.

One biographical questionnaire item was aimed at measuring the degree to which participants are comfortable with computers. This item was expected to provide unique information regarding individual differences and supplement the information concerning participants' computer experience.

Situational Assessment questionnaire. The Situational Assessment questionnaire was designed to measure a unit or vehicle commander's awareness of his unit's performance as it relates to target damage and other battlefield events. The information from this questionnaire provided insight into the degree to which CVCC might affect this awareness.

All of these participants assessed the number of tanks and BMPs that their unit (for the battalion commander and the S3, the unit is defined as the battalion) destroyed, and whether any enemy vehicles were destroyed after a certain point in the stage. They also assessed the number of casualties suffered by their unit. A final question dealt with the location of a given phase line (PL) in relation to another PL.

Control staff operating rules. Two types of documents specified the rules to be followed by the control personnel to ensure consistent implementation of training and testing exercises. The first type included operating guidelines for the ECR and TOC staff (Appendix B). Especially important in the ECR were the SAFOR operating guidelines, including voice radio protocols. The activities of the ECR staff were supervised by the Battle Master, who monitored execution of exercises for compliance with the operating rules. In the TOC, the SME who role-played the battalion XO supervised the TOC staff activities, monitoring and directing the staff to ensure consistent application of the rules. The operating rules were practiced during staff training sessions and carefully followed during all test week training and testing activities.

The second type of exercise control document specified the decision process and options for handling contingencies related to technical and personnel problems. The contingency rules document (see Appendix B) addressed cases involving participant absences, research staff absences, interaction between participants and research staff, equipment breakdowns, and schedule delays. Research staff absences were handled by substituting trained backup personnel. Participant absences and equipment breakdowns could be resolved by moderate delays, moving individual crewmembers to protect more critical crews, reallocating entire crews to protect company commander positions, or dismissing an entire crew. Significant schedule delays could lead to rescheduling of major events, usually with a consequent cancellation of data collection normally scheduled for the last day. The contingency rules helped to ensure that personnel and technical problems were handled in a consistent manner across test weeks.

Any significant departures from established control procedures (as might be necessitated by equipment problems) or contingency rules were noted in writing and later reviewed by the research staff for impact on the data collected. Where necessary, data reduction or analysis was adjusted to account for departures from planned procedures.

Procedures

A complete description of the training and test procedures is provided in the battalion evaluation support package (BDM Federal, Inc., unpublished). Highlights of the procedures follow.

General Instructions to Participants

Instructions at the start of the evaluation. Upon reporting to the MWTB, participants were escorted to the classroom where they received the general introduction, which gave them an overview of the evaluation. A schedule for the week was provided to each participant and the general requirements regarding participant support were discussed. The importance of being present for all scheduled activities was emphasized strongly and the group was queried to determine if any participants had appointments, duties, or other conflicts which would interfere with full participation. If conflicts were identified, they were resolved with the aid of the battalion commander and his staff. All participants were given a point of contact and telephone number in case conflicts should arise later.

Instructions during training exercises. Prior to each training exercise the battalion received a briefing by the Battle Master. This briefing included the training objectives for the session and key milestones (in-simulator time, readiness condition [REDCON] 1 time, mission start time). The Battle Master also provided special instructions for the exercise at hand, such as exercise-specific communication or coordination provisions.

Instructions for scenarios. Each battalion received a brigade OPORD briefing by the Battle Master followed by a battalion OPORD briefing by the battalion XO. The OPORD briefings were presented to all participants using the actual OPORD as a script guide to ensure standardization across rotations. These briefings were supported by visual graphic training aids presenting the unit's task organization, enemy composition and disposition, operational graphics on map displays, and reporting requirements.

Evaluation Week Schedule

Each evaluation week consisted of a standard sequence of training and testing events. Figure 12 provides an overview of the schedule for the CVCC condition, listing each event. The following sections describe each event in greater detail. A complete description and copies of all lesson materials for the below listed classes/events are available in the support package for this evaluation (BDM Federal, Inc., unpublished).

Day 1 events

1a: General introduction. The objectives of the general introduction were to (a) provide an overview of the battalion evaluation program and schedule, (b) describe the importance of the battalion evaluation to the Army's long range goals for improving battlefield performance, (c) describe the test facilities and general procedures that were to be followed throughout the evaluation. All participants received the general introduction as a group. At the end of the session, each participant completed a Privacy Act statement and the Biographical Questionnaire.

1b: M1 tank versus M1 simulator. This classroom presentation highlighted major differences between the M1 simulator and the M1 tank. All personnel participated.

1c: CCD demonstration (CVCC condition only). This lecture demonstrated the functionality and operation of the CCD. Only unit and vehicle commanders participated. Procedures were designed to configure a TOC workstation as a stand-alone CCD with a functional CCD screen (mouse-controlled cursor) and the overlays needed for the demonstration. Through an electronic interface, the large-screen monitor mimicked the display of the stand-alone workstation, allowing a group to comfortably view the CCD during the demonstration. An instructor's assistant manipulated the CCD workstation in accordance with the demonstration outline and instructor cues. CVCC-SEND message files were prepared ahead of time to transmit messages to the standalone CCD.

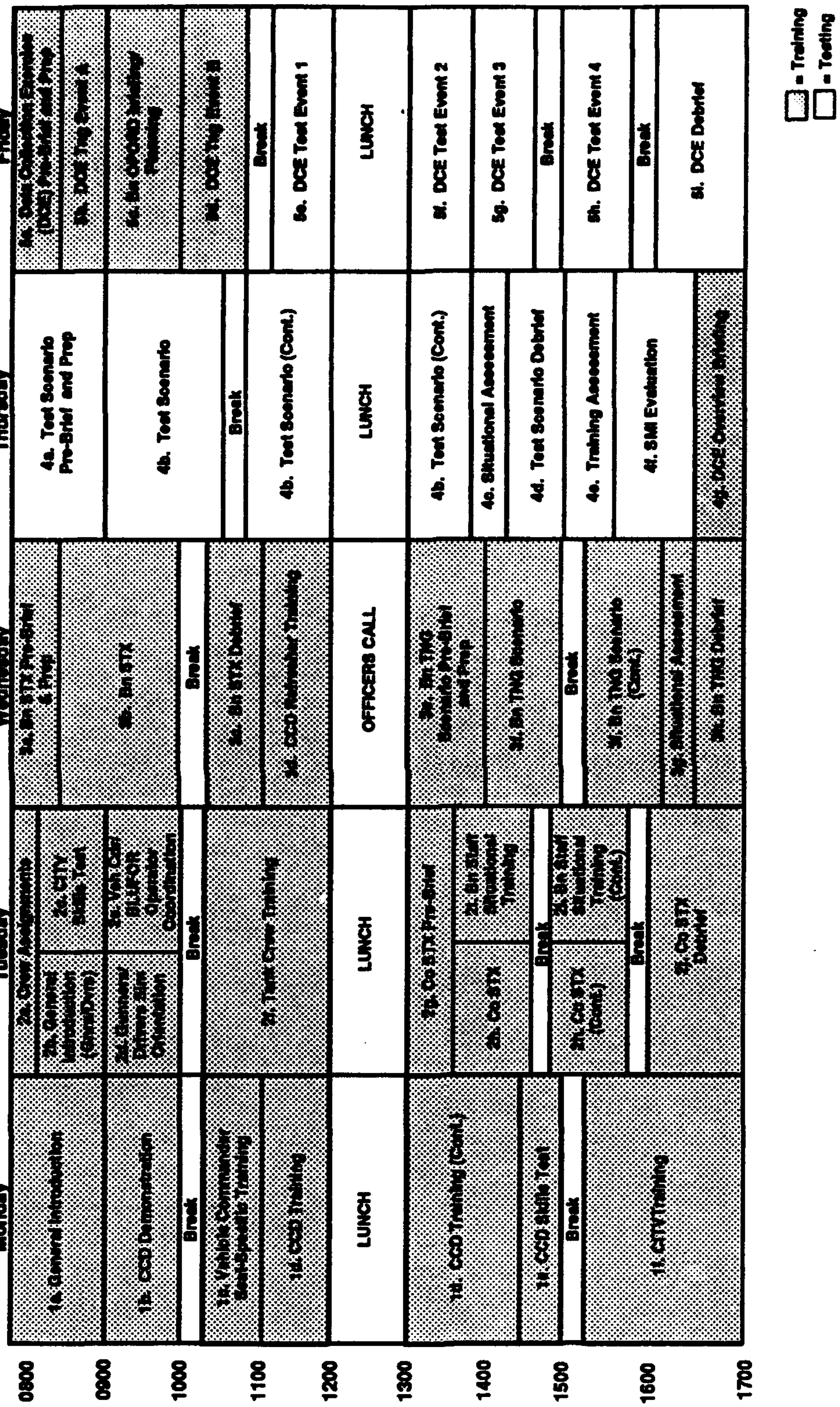

Figure 12. Weekly training and testing schedule for the CVCC condition. Data Collection Events (DCEs) are addressed in a separate report (Lickteig, in preparation).

1d: Vehicle commander seat-specific training. This lesson trained unit and vehicle commanders on M1 simulator unique features. While the vehicle trainers gave a global orientation on most of the features of the simulator, they focused on those features that were different from an actual M1 (e.g., the turret-to-hull reference display and the grid azimuth indicator).

1e: CCD training (CVCC condition only). This equipment training provided detailed instruction and hands-on practice in the operation of the CCD and POSNAV. Only unit and vehicle commanders participated. A uniform sequence was followed for each function: explanation of the function's purpose, followed by a step-by-step explanation and demonstration, and ending with practice by the participant.

1f: CCD Skills Test (CVCC condition only). This test evaluated unit and vehicle commander proficiency on CCD operation. The vehicle trainer first ensured the CCD was set up properly (e.g., a route was in the system, reports were in the queue) before beginning. Each task was then read to the commander; a response was required within 90 seconds. Each performance was observed and recorded as a "Go" or "No-go" on the form. If necessary, upon completion of the test, the vehicle trainer conducted remedial training until the participant could perform each task.

1g: CITV training (CVCC condition only). This training provided detailed instruction and hands-on practice in the operation of the CITV for unit and vehicle commanders. As with CCD hands-on training, a uniform sequence was followed for each function: explanation of the function's purpose, followed by a step-by-step explanation and demonstration, and ending with practice.

SIMNET navigation training (Baseline only). Following the M1 tank versus M1 simulator lecture, the Baseline unit and vehicle commanders received training on navigating in the SIMNET environment. This session began with a classroom presentation reviewing conventional navigation procedures (e.g., polar plotting, resection) plus the special tools available in the M1 simulators (e.g., LRF, grid azimuth indicator). Hands-on training in simulators followed, with participants paired so that one drove while the other navigated. Each participant navigated to at least three checkpoints, responding to control staff queries requiring determination of current location or identification of prominent terrain features along the way. This session concluded with administration of the SIMNET Skills Test.

This test assessed participants' ability to navigate in the SIMNET environment. Vehicle trainers read the questions aloud; responses were required within 90 seconds. Participants were provided with protractors, paper, and pencils to use as they needed.

Day 2 events

2a: CITV Skills Test (CVCC condition only). Used only with unit and vehicle commanders, this test evaluated proficiency on CITV operation. The vehicle trainer ensured proper configuration of the CITV for the test (e.g., ensuring enemy targets were present) then conducted this session in the same manner as the CCD Skills Test. Following administration of the test, the vehicle trainer conducted remedial training, as needed, until the participant could perform each task.

2b: Gunners/drivers simulator orientation. This lesson oriented the gunners and drivers on the features and functions of their respective simulator crew stations. The instruction took place in the simulators.

2c: Vehicle commander/BLUFOR operator coordination. This module consisted of a classroom briefing and orientation to BLUFOR (SAFOR) operation, for unit and vehicle commanders only. The lecture explained the coordination required between the commanders and the BLUFOR operators who would, in accordance with the mission, intent, and specific directives, control their subordinate forces during tactical execution. Instruction emphasized that command was exercised by the unit commanders in the manned simulators through immediate intervention or FRAGOs. The capabilities and operating characteristics of the SAFOR were addressed in detail, to include formations, speed (both rate of movement and response time), coordination of fires, and engagement criterion. Limitations such as lack of platoon fire commands and inability to split sections were also addressed.

2d: Tank crew training. All participants were trained in collective crew tasks and skills. The focus of this training was on crew coordination, navigation, and terrain negotiation. Opportunities for initial practice of target engagement and combat reporting tasks were provided. Each crew navigated a six-waypoint route laid out in a 4-5 km by 4-5 km terrain square or "sandbox." Stationary gunnery targets provided the engagement and reporting opportunities. Unit and vehicle commanders were instructed to send reports based on events encountered during the exercise. When a crew completed its route, its simulator was re-initialized in a new sandbox, and another route negotiated. This process continued until the time allotted for the module had expired. All personnel participated in this and all following training and testing events.

2e: Company STX pre-brief. Pre-mission activities for the company STX included an overview briefing by the Exercise Director, an OPORD briefing by the Battle Master, mission preplanning by participants, and a battalion command group briefing conducted by the Exercise Director and battalion XO.

2f: Company STX. Company commanders and XOs and their crews executed the company level scenario with minimal involvement of the TOC. The scenario was designed to provide these participants practice in working with SAFOR platoons.

2g: Battalion staff situational training. Concurrent with the company STX, the command group (i.e., battalion commander and S3) and the TOC staff (i.e., battalion XO, S2, Assistant S3, and FSO) practiced working together in parallel with the company STX battlefield activities. The objectives of this training were to orient the command group on TOC capabilities and limitations, to provide the TOC staff an opportunity to understand the operating "style" of the commander and S3, and to practice providing TOC support to the maneuvering tank companies. In this two-stage exercise, the command group operated "off-line" (i.e., only interacted with the TOC while the Battle Master role played the commander/S3), becoming familiar with the capabilities and procedures of TOC operations. During stage one, the command group could rotate at will between their simulator and the TOC, observing activities and listening to communications as the STX unfolded. During stage two, the commander and the S3 were restricted to their respective simulator, but remained in an observer role.

2h: Company STX debrief. Participants were briefed on the overall performance of the unit during the company STX. The Battle Master pointed out instances in which the participants did not act in accordance with the battalion SOP or scenario instructions and described procedures for correcting these discrepancies. This debriefing also included feedback from the test support staff and participants regarding issues such as reporting performance.

Day 3 events

3a: Battalion STX pre-brief. Pre-mission activities for the battalion STX followed the same general structure as for other training and test scenarios. The battalion XO briefed the battalion OPORD, and participants conducted mission planning and preparation. The TOC staff was available and participated in coordination and preparation. As part of the mission preparation for the Baseline condition, an execution matrix was provided to the battalion commander and the S3. This matrix depicted the phases of the operation and indicated sequence of activities for each subordinate unit. For the CVCC condition, the COA overlay was activated on the large-screen monitor in the TOC where the battalion XO "walked through" the operation for the commanders and S3 using sequenced phasing techniques of the COA module.

3b: Battalion STX. The battalion training exercise included two phases. Phase one required the participants to execute a delay operation, while phase two required them to execute a counterattack. The battalion commander was given options from which to choose in conducting the counterattack. All elements in the battalion, including the battalion TOC staff, participated in the exercise.

3c: Battalion STX debrief. The battalion STX debrief was conducted in the same manner as the company STX debrief.

3d: CCD refresher training (CVCC condition only). To reinforce CCD operating procedures, a refresher training session (for unit and vehicle commanders only) followed the battalion STX debriefing. This session began with an abbreviated CCD demonstration highlighting common problems, and concluded with a message processing exercise.

Officers call. A mid-week officers call was held for all unit and vehicle commanders. The purpose of this session was to clarify role-playing responsibilities, with special reference to key issues, and to allow research staff members to answer participants' questions. The key issues addressed were: (a) the protection of manned simulators from being killed; (b) the possibility of unrealistically aggressive behavior (dubbed "Rambo" behavior); and (c) the potential for crews to follow SAFOR instead of navigating on their own. For each of these issues, the basic research concerns were explained, the potential impacts on the evaluation's findings were discussed, and guidelines for role-playing behavior were provided. This session was conducted in an informal manner, with the research staff exercising an "honest-broker" role.

3e: Battalion training scenario pre-brief. Pre-mission activities for the battalion training scenario followed the same general structure as for the other training and test scenarios. The brigade OPORD was briefed by the Battle Master, the battalion OPORD was briefed by the battalion XO, and participants conducted mission planning and preparation. The TOC staff was available and participated in coordination and planning.

Pre-mission preparation included a leader's reconnaissance conducted for the battalion commander, the S3, and the three company commanders. In this activity, the battalion XO attached the Stealth sensor to a vehicle simulator which moved according to a previously recorded exercise. As the vehicle maneuvered on the battlefield, the Stealth followed. This permitted the battalion XO to lead the commanders and staff on a standardized reconnaissance over the simulated terrain, highlighting friendly positions, engagement areas, enemy avenues of approach (no OPFOR vehicles were visible) and areas of terrain masking. The S2 was available at the Stealth to respond to queries about the enemy or terrain. This reconnaissance technique immediately followed the battalion OPORD briefing.

3f: Battalion training scenario. The battalion training scenario was executed in two stages. During stage one, the battalion executed a delay operation. In stage two, they executed a brigade-directed counterattack. During stage one, the brigade issued a warning order followed by the counterattack FRAGO, which initiated the battalion planning process. Stage two was initiated with the issuance of the battalion counterattack FRAGO. To ensure consistency and standardization of the starting conditions at each stage for all rotations, a previously prepared FRAGO was issued in lieu of the one developed by the commander and staff. The participants were given a brief re-orientation (if required) prior to beginning stage two.

3g: Situational assessment. At the end of the battalion training scenario, the unit and vehicle commanders received a short orientation to the Situational Assessment questionnaire. Details of the questionnaire were addressed earlier.

3h: Battalion training scenario debrief. The battalion training scenario debrief was conducted in the same manner as the company STX and battalion STX debriefs.

Day 4 events

4a: Battalion test scenario pre-brief. Pre-mission procedures for the battalion test scenario followed the same structure as for the training scenarios.

4b: Battalion test scenario. The battalion executed a defensive scenario with three stages: delay, counterattack, delay. Stages one and two were similar to their counterpart stages in the battalion training scenario (force orientation was different). Stage three was a continuation of the delay after completion of the brigade-directed counterattack. The same sequence of events which linked stages one and two (i.e., brigade warning order/FRAGO, battalion planning/FRAGO) was used also to accomplish the transition from stage two to stage three.

4c: Situational assessment. At the end of the test scenario, each unit and vehicle commander completed a Situational Assessment questionnaire outside his simulator. This questionnaire was similar to that presented in the orientation at the conclusion of the battalion training scenario.

4d: Battalion test scenario debrief. The battalion test scenario debrief was conducted in the same manner as the debrief at the conclusion of the battalion training scenario. In addition, participants were queried as to techniques used to accomplish certain tasks (e.g., target detection and identification, IFF, navigation methods).

4e: Training assessment. A detailed questionnaire asking all participants to rate the quality and effectiveness of the training they received during the first three days of the evaluation was administered. This self-paced questionnaire also solicited opinions for improving each of the training modules.

4f: SMI evaluation (CVCC unit and vehicle commanders only). In the CVCC condition, a detailed questionnaire was administered to the unit and vehicle commanders to obtain their opinions and insights about the design and operation of the CCD and CITV interfaces. Completion of this questionnaire was self-paced.

Data Collection Exercise events on Day 4 and Day 5. Participants in this study also participated in a series of special Data Collection Exercises (DCEs). These exercises are described in detail elsewhere (see Lickteig, in preparation).

Participant Training Procedures

Separate training programs were developed for two categories of participants--unit and vehicle commanders in one group, and tank gunners and drivers in another. Both groups began their training with the general introduction. The training paths for these two groups diverged for the individual position-specific portion of the training program. The two groups came together again for the tank crew training module that started their collective training.

On Day 1, all participants began with the general introduction. Baseline commanders then received the M1 tank versus M1 simulator presentation, seat-specific orientation, navigation training, and the SIMNET Skills test. CVCC commanders received the CCD demonstration, seat-specific orientation, CCD hands-on training, CCD Skills Test, and CITV hands-on training on Day 1. On Day 2, CVCC commanders began with the CITV Skills Test. Gunners and drivers for both conditions received separate gunner and driver seat-specific orientations, while the commanders participated in a SAFOR orientation session with the senior BLUFOR operator. This session addressed rules and procedures for executing scenarios. Before lunch on Day 2, the unit and vehicle commanders, gunners, and drivers participated in tank crew training as functional crews.

After completing tank crew training, the company commanders and XOs began integrated collective training with the company STX and battalion STX. During this session, the company commanders practiced working with their SAFOR components. At the same time, the battalion command group and contractor-furnished TOC personnel practiced working together in battalion staff situational training, conducted in parallel with the company STX. This collective training was concluded on Day 3, when the entire battalion participated in the battalion STX and battalion training scenario.

Professional Role Playing

A key factor in the successful simulation of the battlefield environment, professional role playing was mandated to ensure realistic command and control and combat performance. Unrealistic behavior had a strong potential to compromise test integrity and skew test results (e.g., unrealistic force attrition or tactical maneuvers). As a result, the test support staff monitored participants and implemented corrective action when unrealistic behavior was observed. Feedback to the participants included individual counseling, use of the chain-of-command, and non-attributed examples at the debriefings.

Past CVCC research efforts (O'Brien et al., 1992) indicated that some test participants exhibit unrealistic risk-taking behavior during evaluations. This evaluation utilized a kill-suppress option to protect manned vehicles, which is suspected to contribute to that risk-taking behavior (i.e., attitude of invincibility). This behavior is commonly referred to as "Rambo" behavior. The officers call, addressed earlier, specifically emphasized the importance of professional role playing and the potential impact on the test results. Special emphasis was placed on the "Rambo" factor to discourage unrealistic risk-taking.

Scenario Execution Procedures

Each scenario was executed according to established control procedures to maintain consistency between conditions and rotations. The battalion TOC staff, role-played by members of the support staff, assisted the battalion commander by preparing tactical overlays, synthesizing critical battlefield information, and maintaining a broad picture of the entire battlefield. While exercise participants could conduct pre-mission planning and coordination in the TOC, they were not permitted to enter the TOC during the exercises. The Battle Master advised the battalion commander that the pace of battlefield activities realistically did not accommodate battalion commander or S3 visits to the TOC. The specific scenario execution procedures, which guided scenario set-up and execution, are detailed in Appendix B.

Data Collection Procedures

The DCA system was the primary means of data collection. A list of sample measures for each BOS appears in Appendix D. Refer to O'Brien et al. (1992) for a complete set of measures definitions.

Standard DataLogger procedures were employed in collecting automated data. All test exercises were recorded on magnetic tape for subsequent reduction and analysis. PVD operators entered flags corresponding to key tactical and administrative events. Examples of these events included the start and end points of the scenario, scheduled breaks, significant equipment breakdowns, significant vehicle/unit movement events (e.g., crossing the Line of Departure (LD)), and selected data elements. The PVD operator also kept a log which provided additional information related to the flags. The flags and logs were used to break scenario recordings into discrete mission stages, and to adjust performance measures for unscheduled breaks. PVD logs also served as important sources of data during manual data reduction.

In addition, simulator logs were completed for selected vehicles (battalion commander, S3, B Company commander, B Company XO) in the test scenario. Data collectors recorded observations of various aspects of the participant's behavior such as equipment operation, radio communications, use of paper map and visual display devices, and interactions among crewmembers.

Test support personnel administered the previously-described questionnaires to participants at designated points during the test week. During the debriefs following the training and test scenarios, participants' comments and suggestions were transcribed by support personnel.

Following each test week, playback sessions were conducted. These sessions focused on voice radio messages, and complete transcriptions of combat reports (see the CVCC Battalion SOP in Appendix A for a listing of combat reports used) as well as other messages were generated. A complete listing of voice message-based measures is provided under the Command and Control BOS heading in the Results and Discussion section of this report. Prior to the playback, PVD and Battle Master logs were reviewed for missing data. In cases where missing data were identified, attempts were made to capture the information in the playback.

Data Reduction and Analysis Procedures

To protect the privacy of individual soldiers, each participant was assigned a unique number at the start of the evaluation. This number was used in place of the individual's name on all data collection instruments, except for the Biographical Questionnaire. This numbering system identified individual cases in all database activities.

Reduction and analysis of data proceeded through three steps: database management (data entry and quality control), data reduction, and descriptive analyses. The first two steps of this sequence were tailored for automated and manual data, respectively. Each step is summarized below.

Database management. To organize the manually collected data, a set of database management system (DBMS) files was created. Individual files were created for each manual data collection instrument (e.g., Biographical Questionnaire). Test support personnel entered data into these files using dBASE III+™ (a registered trademark of Ashton-Tate) customized data entry screens on a personal computer. Quality control procedures were implemented to verify the accuracy of data entry, using 100% review of print-outs.

In the case of automated data collected by DataLogger, DataProbe™ extracted raw data from magnetic tapes recorded during the test scenario and RS/1™ organized the resulting data into files. Research team members reviewed printouts of these files, checking for out-of-range or inconsistent data. These files provided intermediate data for the reduction process described in the following section.

Data reduction. A number of measures required hands-on processing of manually collected data (e.g., counts of voice radio messages). For each measure in this category, data reduction forms were developed to guide the data reducer carefully through each step. Test personnel received training in administering these forms. Data reduction forms were also spot-checked by experienced behavioral scientists on the test support team. When the data reduction forms were complete, the data were directly entered into DBMS files.

To reduce the automated data, data packets from the DataLogger-recorded files established during creation of the automated database were combined by RS/1™ to produce specified measures. This lengthy process resulted in a set of American Standard Code for Information Interchange (ASCII) files containing DataLogger-based data for all test weeks.

Descriptive analyses. Prior to analyzing manual and automated data, procedures for accommodating missing and contaminated data were applied. Missing data may have resulted from a unit's failure to complete the test scenario due to equipment failures or participant absences. Also, participants occasionally skipped a question on a questionnaire. Contaminated data could be produced by equipment malfunctions or crew adjustments due to participant absences. The general rule for handling both missing and contaminated data was to omit the affected measures from analyses. Only those measures/values influenced by the unplanned event were omitted. This strategy reduced sample size across cells and across measures.

The Statistical Package for the Social Sciences for the IBM Personal Computer (SPSS/PC+™,V2.0) was used for all data analyses (SPSS/PC+ is a trademark of SPSS Inc). The REPORT procedure computed means, medians, and standard deviations. The CROSSTABS procedure generated frequency distributions, including percent response breakouts for questionnaire items. Other procedures included MEANS and COMPUTE.

Support Staff

The test support staff was responsible for training exercise participants, controlling all scenarios and exercises, operating the ECR stations, and operating the surrogate battalion TOC. This staff also administered manual data collection instruments.

Scenario Roles and Responsibilities

Table 11 summarizes the primary responsibilities assigned to each member of the support staff during the training and testing scenarios.

The Exercise Director retained overall decision-making authority for all matters regarding the conduct of training and testing. The Event Coordinator, Battle Master, Floor Monitor, and others assisted the Exercise Director in ensuring proper execution of events. This permitted decentralized execution consistent with the research plan.

Table 11

Roles and Responsibilities of the Exercise Control Staff During Scenarios

<u>Exercise Director</u>
- Oversee overall scenario execution
- Implement procedures for accommodating unplanned events
- Serve as Assistant Battle Master
- Monitor and operate CSS workstation (CVCC condition)
- Operate CVCC-SEND program
- Administer questionnaires to gunners and drivers

<u>Event Coordinator</u>
- Inform Exercise Director and ECR staff of simulator and TOC status
- Troubleshoot and coordinate site support in the event of equipment malfunctions
- Document equipment problems
- Oversee VCR operation
- Administer questionnaires to unit and vehicle commanders
- Coordinate automated data collection

<u>Battle Master</u>
- Initialize MCC and CSS workstation
- Supervise scenario execution within control room
- Supervise control room staff
- Conduct brigade orders briefing for participants
- Maintain Battle Master log
- Assume roles of brigade commander, adjacent unit commanders, brigade staff
- Conduct post-scenario debriefings
- Maintain contact with TOC to coordinate scenario execution

<u>OPFOR Operator (SAFOR)</u>
- Initialize OPFOR workstation prior to execution
- Control actions of OPFOR
- Coordinate OPFOR activities with Battle Master

<u>BLUFOR Operators (SAFOR)</u>
- Initialize BLUFOR workstation prior to execution
- Implement company commanders' orders/directives to platoons in A, B, and C Companies
- Implement battalion commander's orders/directives to D Company and scouts
- Coordinate BLUFOR activities with Battle Master
- Coordinate radio messages with Radio Operator

(Table continues)

Table 11

Roles and Responsibilities of the Exercise Control Staff During Scenarios (Cont'd)

<u>Radio Operators</u>
- Role-play platoon leaders, company commanders, and XOs
- Coordinate radio communication between BLUFOR elements and M1 simulators

<u>PVD Monitor</u>
- Record significant events using log and PVD flags
- Record breakdowns and other contingencies on PVD Log
- Maintain PVD Log

<u>Floor Monitor</u>
- Supervise RAs during scenarios
- Coordinate with Ras and simulator technicians to help resolve equipment problems

<u>Research Assistants (In simulators)</u>
- Train crews and answer questions
- Record key performance events on log
- Notify Floor Monitor of system malfunctions and troop problems
- Record equipment problems on maintenance log
- Administer Situational Assessment questionnaire

Based in the ECR, the Exercise Director supervised the overall conduct of the scenarios and served as the Assistant Battle Master. The Battle Master, two BLUFOR operators, two radio operators, an OPFOR operator, and a PVD monitor also worked in the ECR. The Event Coordinator primarily coordinated activities between the ECR, battalion TOC, and the vehicle simulators throughout the training and test scenarios.

The Battle Master maintained primary responsibility for scenario execution. The Battle Master, assisted by the ECR staff, role-played the brigade commander and staff, adjacent and supporting unit personnel, and other tactical elements. He also presented the brigade OPORD (pre-mission briefing), and ensured that the ECR was set up prior to the start of each exercise. In addition, he supervised the ECR staff during execution to ensure strict adherence to the operating procedures and to the scenario events list. At the conclusion of each scenario, the Battle Master conducted the debriefing.

Eight Research Assistants (RAs) served as vehicle trainers/monitors. Their responsibilities included training participant crews on the operation of the simulators (Baseline and CVCC) and the CVCC equipment (CVCC only). During the test scenario, four vehicle monitors collected data on crew performance. The Floor Monitor supervised the trainers/monitors. The Floor Monitor also assisted the Event Coordinator by notifying site support staff (technicians) during equipment malfunctions, and tracking the status and resolution of these problems.

Methodological Limitations

A number of methodological limitations stemmed from the simulation technology itself, from certain design choices, and occasionally from implementing procedures. These limitations, which may impact the evaluation's results and their interpretation, are discussed in this subsection. Facility-based issues have been provided to the MWTB site manager for action, as appropriate.

Given the allocation of manned simulators, the lowest echelon manned within the battalion was the company level (company XO). In other words, only SAFOR elements were operative at the platoon level. Thus, battlefield information from the wingman and platoon leader levels originated from SAFOR algorithms or from BLUFOR operators. The working framework used by the company commanders and XOs to interpret SAFOR-generated reports may have varied across individuals. Further, there was no strong incentive for them to relay INTEL reports, FRAGOs, and other information to their SAFOR elements. These factors may have influenced the flow of information within the battalion. In combination with the lack of Fire Support Team (FIST) personnel within the companies, these factors also may have affected the battalion's command and control dynamics. One practical consequence was that the ability to study transmission of reports across echelons was very limited.

Radio net differences between the Baseline and CVCC conditions complicate the interpretation of communication-based performance. The voice radio nets were identical in both conditions: company command and battalion command nets for company commanders, company command and battalion O&I nets for company XOs. However, the CVCC equipped company XOs had the battalion command digital net instead of a digital O&I net. When the CVCC TOC transmitted digital reports and FRAGOs on the battalion command net, the company commanders and company XOs received them at the same time. But when the Baseline TOC transmitted voice reports and FRAGOs on the battalion command net, the company XOs did not receive them until the company commanders relayed them on the company command nets. This methodological difference would be expected to impact selected aspects of communications, such as time to transmit INTEL reports and FRAGOs.

Due to limited processing capacity of each simulator's computer image generator, the driver's vision blocks occasionally failed to display surrounding vehicles properly. Vehicle images could flash intermittently or disappear for extended periods, depriving the driver of important visual information. These problems degraded the driver's ability to maintain proper position within a tactical formation and to steer clear of neighboring vehicles. Occasional collisions resulted. Additionally, if a vehicle commander found it necessary to verbally guide his driver, the commander's ability to fight his unit or his vehicle may have suffered. Altogether, this limitation could somewhat compromise performance related to positioning and navigation, and perhaps reduce overall attention to C3 activities.

Constraints limiting SAFOR behavior compromised the realism of the simulated battlefield. SAFOR responsiveness was sometimes slowed by keyboard command requirements, especially given that one SAFOR operator controlled the actions of several platoons. Maneuver options for SAFOR units were limited; for example, OPFOR platoon vehicles did not disperse when artillery fell. Unrealistic movement of SAFOR elements occurred (e.g., failure to follow cover and concealment principles, circling around terrain canopies, scrambled patterns when two units intersect). In addition, SAFOR vehicles never committed fratricide, due to perfect IFF capabilities. As with other DIS evaluations, these and similar limitations require caution when attempting to apply findings to other environments, including actual combat.

Several factors posed special challenges to the crewmembers as they strove to role play professionally. The use of kill suppress to protect manned simulators may have encouraged unnecessary risk-taking when crews discovered they were "invincible." Crews occasionally appeared to be engaging in "Rambo" behavior. Compounding this was the lack of a clear, immediate signal telling the crewmembers that their vehicle had taken a killing hit. Combining manned and BLUFOR vehicles in the same unit meant that crews could follow BLUFOR elements instead of navigating for themselves. Also, minefields and obstacles were not implemented on the terrain database, so the crew might have discovered that ignoring them on the overlay carried no penalty. The mid-week officers call addressing these issues was designed to ensure that participants were clear about their role-playing responsibilities.

The simulation algorithms modelling ballistic performance, probability of hits, and probability of kills were based on out-of-date 105 mm service round data. In addition, the simulation implementation of target lead differed appreciably from the fielded tank, making it difficult for gunners to master firing at moving targets. Thus, target engagement performance in this evaluation cannot be considered representative of actual tank battalion gunnery performance.

The following section presents a comprehensive account of the quantitative measures used in the current evaluation, and the process followed in developing them.

Performance Measures

This section presents the hypotheses and performance measures developed to structure the analysis of data in the current evaluation. The process for developing the performance measures will be described first, followed by a review of hypotheses (organized by research issue); a summary of measures will conclude the section.

As discussed in the Design of the Evaluation section of this report, the research issues spanned tactical maneuver, fire support, command and control, and intelligence activities. The measures supporting this evaluation quantified a comprehensive cross-section of unit performance. The measurement categories encompassed tactical movement and navigation, target acquisition and engagement, control of terrain, gathering and processing of battlefield information (enemy and friendly), situational assessment, and usage of equipment.

Approach

The current set of performance measures was derived from the battalion TOC evaluation (O'Brien et al., 1992). In turn, the measures used in the battalion TOC evaluation were based on measures from earlier CVCC efforts (e.g., Du Bois & Smith, 1989; Du Bois & Smith, 1991; Leibrecht et al., 1992; Quinkert, 1990). Thus, this current set of performance measures was built on preceding CVCC efforts, based on the results of data analysis and lessons learned. Details on this process follow.

Develop Performance Hypotheses

The issues underpinning the evaluation have been presented in the Design of the Evaluation section of this report. Based on four BOSs from the Blueprint of the Battlefield (Department of the Army, 1991), these operational issues provided the foundation for developing hypotheses to describe the expected differences between the CVCC and Baseline configurations. The specific hypotheses appear in the following subsection.

Adapt List of Measures for Each Hypothesis

Measures used in past CVCC evaluations (cited above) were adapted for addressing each hypothesis. For the most part, multiple measures were identified for each hypothesis. Wherever possible, previously existing measures that fit into the BOS structure were employed. Certain new measures were developed, as necessary.

Revise Operational Definitions

Operational definitions from previous evaluations were revised where necessary; or definitions were developed for newly-defined measures.

Revise Data Reduction and Analysis Procedures

The specific data instruments required to provide the input variables for each measure were identified. The operations necessary to compute each performance measure were then defined.

Revise Data Collection Logs

Logs were inspected to ensure that they captured the necessary information. Revisions were made accordingly.

The performance hypotheses and measures that were developed by this process are listed in the subsections that follow. A list of sample measures and their operational definitions can be found in Appendix D. A more complete list can be found in O'Brien et al. (1992).

Operational Issues and Hypotheses

In the paragraphs that follow, the operational issues and hypotheses that supported the current research effort are presented.

Issue 1: Does the CVCC system enhance the Maneuver BOS? The CVCC system's CITV, steer-to display, and tactical map with POSNAV icons and overlays were expected to provide an overall advantage for a subset of Maneuver BOS tasks. Table 12 shows those Maneuver BOS tasks linked to CVCC hypotheses for Issue 1. A statement of each hypothesis for Issue 1 follows.

Table 12

The Maneuver BOS Linked to CVCC Hypotheses

TASKS	HYPOTHESIS
Move	
Move On or Under Surface	1.1
Navigate	1.2
Engage Enemy	
Employ Direct Fire	
Process Direct Fire Targets	1.3
Engage Direct Fire Targets	1.4
Control Terrain	1.5

Hypotheses 1.1 through 1.5, respectively, state the CVCC units' performance on the battlefield was expected to be better than the Baseline units' regarding the ability to: (a) move on the surface; (b) navigate; (c) process direct fire targets; (d) engage direct fire targets; and (e) control terrain.

Issue 2: Does the CVCC system enhance the Fire Support BOS? Table 13 shows the Fire Support BOS linked to the CVCC hypothesis for Issue 2. Only a very limited subset of the Fire Support BOS was addressed in this evaluation. The inputting of target location grids by lasing or touching the tactical map combined with the CCD's digital messaging capability was expected to provide an advantage for fire support tasks under the CVCC condition. A statement of the hypothesis for Issue 2 follows.

Table 13

The Fire Support BOS Linked to CVCC Hypothesis

TASKS	HYPOTHESIS
<u>Engage Ground Targets</u>	
Conduct Lethal Engagement	
Conduct Surface Attack	2.1

Hypothesis 2.1: The CVCC units' ability <u>to conduct surface attack</u> by indirect fire on the battlefield was expected to be better than the Baseline units.

Issue 3: Does the CVCC system enhance the Command and Control BOS? The CVCC's enhanced features, including the tactical map with digital overlays and digital report capabilities, were expected to positively impact command and control performance. Table 14 shows the Command and Control BOS linked to CVCC hypotheses for Issue 3. A statement of each hypothesis for Issue 3 follows.

Table 14

The Command and Control BOS Linked to CVCC Hypotheses

TASKS	HYPOTHESIS
<u>Acquire and Communicate Information and Maintain Status</u>	
Communicate Information	
Receive and Transmit Mission	3.1
Receive and Transmit Enemy Information	3.2
Receive and Transmit Friendly Troop Information	3.3
Manage Means of Communicating Information	3.4
<u>Assess Situation</u>	SA1
<u>Direct and Lead Subordinate Forces</u>	3.5

Hypotheses 3.1 through 3.3, respectively, state the CVCC units' performance on the battlefield was expected to be better than the Baseline units' regarding the ability to: (a) <u>receive</u>

and transmit the mission; (b) receive and transmit enemy information; and (c) receive and transmit friendly troop information.

Hypotheses 3.4 through 3.5, respectively, state the CVCC unit leaders' performance on the battlefield was expected to be better than the Baseline unit leaders' regarding the ability to: (a) manage means of communicating information; (b) direct and lead subordinate forces; (c) assess the battlefield situation; and (d) direct and lead subordinate forces.

Issue 4. Does the CVCC system enhance the Intelligence BOS? The advantages provided by the CVCC system for gathering enemy information using the tactical map (e.g., inputting enemy locations by lasing or touch) and digital reporting via the CCD were expected to allow CVCC groups to outperform Baseline groups in collecting threat information. Table 15 shows the Intelligence BOS linked to the CVCC hypothesis for Issue 4. A statement of the hypothesis for Issue 4 follows.

Table 15

The Intelligence BOS Linked to CVCC Hypothesis

TASKS	HYPOTHESIS
Collect Information	
Collect Information on Situation	
Collect Threat Information	4.1

Hypothesis 4.1: The CVCC units' ability to collect threat information on the battlefield was expected to be better than the Baseline units'.

Diagnostic Issues

SMI information augments the understanding of CVCC-Baseline differences addressed by the operational issues. The SMI issue stated in the Design of the Evaluation section (i.e., "What SMI factors critically affect utilization of the CVCC configuration and how do they impact CVCC design?") was translated into two diagnostic issues discussed below.

Diagnostic issues address various aspects of CVCC equipment utilization. Separate measures were developed to identify the frequency with which different features of the CCD (Issue D1) and the CITV (Issue D2) are utilized. The equipment utilization measures also provide valuable information to future CVCC designers and training developers. Because they generally applied only to the CVCC condition, hypotheses were not developed for this set of measures.

Issue D1: How frequently were the CCD features used?

Issue D2: How frequently were the CITV features used?

Training Issue

Information gained from training questionnaires and skills tests provide insight to the requisite skills for CVCC evaluations. Training data are used to identify required modifications to training exercises, materials, and schedules, ensuring adequate preparation of all participants. Because these data are not used for testing Baseline/CVCC differences, no hypotheses or specific measures geared toward hypothesis testing were developed.

Issue T1: What training considerations and implications are important in training unit commanders and crews to operate and utilize the CVCC?

Summary of Measures

Operational Measures

In the paragraphs that follow, operational measures are presented and organized by the hypotheses within each operational issue. Each hypothesis was stated in the Operational Issues and Hypotheses subsection of this section.

Table 16 presents the operational measures for Issue 1 which were developed to address the following Maneuver BOS functions: Move on Surface, Navigate, Process Direct Fire Targets, Engage Direct Fire Targets, and Control Terrain.

Table 16

Operational Measures by Maneuver BOS Function

MEASURE #	Title
	MOVE ON SURFACE
1.1.1	Distance between BLUFOR and OPFOR Center of Mass, average per battalion
1.1.2	Time to reach Line of Departure
1.1.3	Exposure Index
1.1.4	Range to OPFOR at displacement
1.1.5	Time for companies to reach objective (Stage 2)
	NAVIGATE
1.2.1	Distance travelled
1.2.2	Fuel used
1.2.3	Mean time out of sector/axis

(Table continues)

Table 16

Operational Measures by Maneuver BOS Function (Cont'd)

MEASURE #	Title
	NAVIGATE
1.2.4	Mean time misoriented
1.2.5	Time to complete exercise
	PROCESS DIRECT FIRE TARGETS
1.3.1	Time to acquire targets
1.3.2	Time between lases to different targets
1.3.3	Time from lase to first fire
1.3.4	Maximum lase range
1.3.5	Number of fratricide hits by manned vehicles
1.3.6	Number of fratricide kills by manned vehicles
	ENGAGE DIRECT FIRE TARGETS
1.4.1	Percent of OPFOR killed by end of stage
1.4.2	Percent of BLUFOR killed by end of stage
1.4.3	Losses/kill ratio
1.4.4	Mean target hit range
1.4.5	Mean target kill range
1.4.6	Percent OPFOR vehicles killed by all manned vehicles
	ENGAGE DIRECT FIRE TARGETS
1.4.7	Hits/round ratio, manned vehicles
1.4.8	Kills/hit ratio, manned vehicles
1.4.9	Kills/round ratio, manned vehicles
1.4.10	Number of manned vehicles sustaining a killing hit
1.4.11	Number of rounds fired by manned vehicles, by echelon
1.4.12	Number of OPFOR vehicles killed south of PL King
1.4.13	Number of OPFOR vehicles killed south of PL Club
1.4.14	Number of OPFOR vehicles killed south of PL Queen
1.4.15	Number of OPFOR vehicles killed south of PL ACE
	CONTROL TERRAIN
1.5.1	Number of OPFOR vehicles penetrating designated line (counterattack)
1.5.2	Was the battalion bypassed by the OPFOR?
1.5.3	Number of OPFOR vehicles penetrating designated line (delay)
1.5.4	Number of OPFOR vehicles that crossed PL Queen

Table 17 presents the operational measures for Issue 2 which were developed to address the Conduct Surface Attack function of the Fire Support BOS.

Table 17

Operational Measures by Fire Support BOS Function

MEASURE #	Title
	CONDUCT SURFACE ATTACK
2.1.1	Mean accuracy of CFF locations
2.1.2	Percent of CFFs with correct type

Table 18 presents the operational measures for Issue 3 which were developed to address the following functions of the Command and Control BOS: Receive and Transmit Mission, Receive and Transmit Enemy Information, Receive and Transmit Friendly Troop Information, Manage Means of Communicating Information, Assess Situation, and Direct and Lead Subordinate Forces.

Table 18

Operational Measures by Command and Control BOS Function

MEASURE #	Title
	RECEIVE AND TRANSMIT MISSION
3.1.1	Elapsed time from battalion transmission of FRAGO to receipt by company commander/XO
3.1.2	Duration of request by company commander to clarify FRAGO/overlay
3.1.3	Consistency of relayed FRAGO
	RECEIVE AND TRANSMIT ENEMY INFORMATION
3.2.1	Time to transmit INTEL report full net: battalion TOC to lowest manned net
3.2.2	Consistency of relayed INTEL
	RECEIVE AND TRANSMIT FRIENDLY TROOP INFORMATION
3.3.1	Mean time to transmit SITREP full net: lowest net to battalion TOC
3.3.2	Deviation of BLUFOR location reported in SITREP from actual location
3.3.3	Delay between observed phase line/line of departure/FCL crossing and reported crossing
3.3.4	Delay between observed battle position arrival and reporting SET at battle position
3.3.5	Elapsed time from request for fuel and/or ammunition report until received by battalion TOC (Baseline only)

(Table continues)

Table 18

Operational Measures by Command and Control BOS Function (Cont'd)

MEASURE #	Title
	MANAGE MEANS OF COMMUNICATING INFORMATION
3.4.1	Average length of voice radio transmissions, by echelon
3.4.2	Mean duration of voice transmissions between battalion TOC and battalion commander/S3, excluding named reports
	ASSESS SITUATION
SA1.1	During the last stage, how many OPFOR tanks did your company or battalion destroy? (Defensive stage 3)
SA1.2	During the last stage, how many BMPs did your company or battalion destroy? (Defensive stage 3)
SA1.3	During the last stage, did you company or battalion destroy any enemy vehicles after the order to delay was given? (Defensive stage 3)
SA1.4	During the last stage, how many tanks in your company or battalion were destroyed? (Defensive stage 3)
SA1.5	During the last stage, how far was your initial battle position from your subsequent battle position? (Defensive stage 3)
	DIRECT AND LEAD SUBORDINATE FORCES
3.5.1	Did Task Force prevent decisive engagement?
3.5.2	Did the battalion withdraw intact?
3.5.3	Number of counterattacking companies engaging OPFOR
3.5.4	To what extent did the battalion meet the brigade commander's intent?

Table 19 presents the operational measures for Issue 4 which were developed to address the collect threat information function of the Intelligence BOS.

Diagnostic Measures

In the paragraphs that follow, diagnostic measures are presented.

Issue D1: How frequently were the CCD features used? Table 20 shows the diagnostic measures for Issue D1.

Issue D2: How frequently were the CITV features used? Table 21 shows the diagnostic measures for Issue D2.

Table 19

Operational Measures by Intelligence BOS Function

MEASURE #	Title
	COLLECT THREAT INFORMATION
4.1.1	Accuracy of SPOT report locations
4.1.2	Correctness of SPOT report number and type
4.1.3	Accuracy of SHELL report locations
4.1.4	Accuracy of CONTACT report locations
4.1.5	Percent CONTACT reports with correct type

Table 20

Summary of Diagnostic Measures for Issue D1: How Frequently Were the CCD Features Used?

MEASURE #	Title
D1.1	Percent time each map scale in effect
D1.2	Percent time each map feature in effect
D1.3	Percent time each map scroll function in effect
D1.4	Percent control inputs by Touch Screen
D1.5	Percent grid inputs to reports by laser device, a) overall and b) by report type
D1.6	Number of reports received, by report type, a) total reports received and b) unique reports received
D1.7	Percent of reports received which were duplicates, a) overall and b) by report type
D1.8	Percent reports retrieved from receive queue, a) overall and b) by report type
D1.9	Percent reports retrieved, a) overall and b) by report type
D1.10	Average number of upward relays per report, a) overall and b) by report type
D1.11	Percent reports relayed upward--unique relays, a) overall and b) by report type
D1.12	Average number of downward relays per report, a) overall and b) by report type
D1.13	Percent reports relayed downward--unique relays, a) overall and b) by report type
D1.14	Percent reports posted to tactical map, a) overall and b) by report type
D1.15	Mean time to retrieve reports, a) overall and b) by report type

(Table continues)

Table 20

Summary of Diagnostic Measures for Issue D1: How Frequently Were the CCD Features Used? (Cont'd)

MEASURE #	Title
D1.16	Mean time to relay reports upward, a) overall and b) by report type
D1.17	Mean time to relay reports downward, a) overall and b) by report type
D1.18	Number of digital reports sent (originated), a) overall and b) by report type
D1.19	Percent time battalion commander and S3 used their Tactical Map (CCD) and paper lap map
D1.20	Percent time battalion commander and S3 used vision blocks, GPSE, CITV, CCD

Table 21

Summary of Diagnostic Measures for Issue D2: How Frequently Were the CITV Features Used?

MEASURE #	Title
D2.1	Percent time in each CITV mode
D2.2	Number of times CITV laser used
D2.3	Number of times Designate used

The next section begins with the presentation of the operational data, followed by SMI and training data. Operational data are organized by BOS and discussed within the context of each operational issue and hypothesis.

Table 21

Summary of Diagnostic Measures for Issue D2: How Frequently Were the CITV Features Used?

MEASURE #	Title
D2.1	Percent time in each CITV mode
D2.2	Number of times CITV laser used
D2.3	Number of times Designate used

The next section begins with the presentation of the operational data, followed by SMI and training data. Operational data are organized by BOS and discussed within the context of each operational issue and hypothesis.

Results and Discussion

The data presented in this report are strictly preliminary, representing the initial portion of a planned battalion-level database. The majority of this section presents and discusses operational data linked to either the Maneuver, Fire Support, Command and Control, or Intelligence BOS. This section also contains data and discussion related to SMI and training, concluding with a discussion of important methodological implications gleaned from the evaluation.

Data analysis for this evaluation was descriptive due to the limited cell size for most measures. An additional limitation to the data analysis was that no Baseline group completed Stage 3. Since this prevents the comparison of data from this stage, only data from Stages 1 and 2 (delay and counterattack) are discussed. Measures resulting in empty cells are noted at the beginning of each results subsection, as are measures considered developmental in nature and excluded from this report pending further refinement. A list of sample measures and their operational definitions is found in Appendix D (refer to O'Brien et al., 1992 for the complete list). Data tables are presented in Appendix E.

Based on only two battalions in each condition, these preliminary findings do not support generalizations regarding CVCC. However, these data will be integrated with additional data from the battalion effort to create a comprehensive database. This comprehensive database will be subjected to hypothesis testing and is expected to support more robust analysis than the current data set. In the meantime, the descriptive results in this report may indicate the trends to be expected of the comprehensive database.

Maneuver Battlefield Operating System

Issue 1: Does the CVCC system enhance the Maneuver BOS?

This subsection addresses the potential impact of CVCC on the Maneuver BOS. The measures that address Issue 1 are organized by the Move on Surface, Navigate, Process Direct Fire Targets, Engage Direct Fire Targets, and Control Terrain components of the Maneuver BOS and their associated hypotheses. Refer to the Performance Measures section for a listing of the Maneuver BOS components associated with this evaluation.

The results for several measures developed under the Maneuver BOS are not presented, due to the fact that the measures either produced all zeros or pertained to Stage 3 only (no Baseline battalion completed Stage 3). These measures include mean time out of sector/axis, mean time misoriented, number of fratricide kills by manned vehicles, and number of OPFOR vehicles penetrating designated line. A second subset of measures was considered developmental. These measures include range to OPFOR at displacement, time to acquire target, time between lases to different targets, and time from lase to first fire. These measures are not presented here because they need further refinement. Exposure Index is also considered in this category, but since its development is more advanced than the other measures, its data are included for review in Table E-3. All developmental measures are expected to be included in the analysis of the complete database.

Move on Surface

Hypothesis 1.1: The CVCC units' ability to move on the surface of the battlefield was expected to be better than the Baseline units'.

Distance between BLUFOR and OPFOR Center of Mass (CoM). BLUFOR was defined for this measure as all non-reserve companies and included all manned and SAFOR vehicles. CoM is defined as the arithmetic mean of the company's x,y plot, including dead OPFOR vehicles within 500 meters. In Stages 1 and 2, the average end-of-stage distance between BLUFOR and the OPFOR CoM appeared much greater for the CVCC companies relative to the Baseline companies (these data appear in Table E-1). For the CVCC companies, the distances ranged from 9,792 meters to 10,641 meters, at the end of the engagements. For the Baseline companies, the distances ranged from 1,978 meters to 9,819 meters. This result suggests that CVCC companies did a much better job holding off the enemy forces or preventing the enemy force from getting too close. From this limited set of data, there do not seem to be any differences between Stage 1 (delay) and Stage 2 (counterattack).

Time to reach line of departure (Stage 2 only). These data (see Table E-2) indicate that CVCC units were slightly faster and less variable than Baseline units in elapsed time to reach the line of departure (LD) during Stage 2 (counterattack). For the two CVCC units, time to LD were 11.50 and 20.70 minutes. For the Baseline units, the elapsed times were 4.68 to 22.03 minutes. These data do not exclude times at halt which might explain a portion of the Baseline/CVCC differences since past CVCC evaluations (e.g., Leibrecht et al., 1992) found that Baseline groups spent more time at halt than CVCC groups.

Time for companies to reach objective (Stage 2 only). Overall, CVCC companies were faster than Baseline companies in time required to execute the Stage 2 counterattack (see Table E-2). For the CVCC companies, the average time from the start of the stage until each company reported set on their respective objectives varied from 17.85 minutes to 26.38 minutes. For the Baseline companies, this average varied from 15.37 to 47.13 minutes. Again, time at halt was not excluded from the calculation of data for this measure and may account for a portion of these apparent Baseline/CVCC differences.

Navigate

Hypothesis 1.2: The CVCC unit's ability to navigate on the battlefield was expected to be better than the Baseline units.

Distance traveled. The average distances driven by manned vehicles during each stage do not appear to support any noteworthy differences between groups (Table E-4). Potential interpretations of these data are complicated by the fact that Baseline distance traveled may be low since Baseline commanders may have relied more on unmanned BLUFOR vehicles to navigate, particularly in Stage 1 (delay). Additionally, CVCC commanders can easily navigate to unit locations for direct observation, possibly resulting in artificially high travel distances.

Fuel used. Only negligible differences in average fuel used could be detected between condition and echelon across the two stages. These data appear in Table E-4.

Time to complete exercise. Congruent with the data for time to reach LD and time to reach objective, Baseline units took longer than the CVCC units to complete each stage. The elapsed time for the Baseline units to execute Stage 1 ranged from 75.10 to 87.28 minutes, while Stage 2 completion times ranged from 58.87 to 67.15 minutes. The elapsed time for CVCC units to execute Stage 1 ranged from 63.38 to 66.55 minutes, while Stage 2 completion times ranged from 40.53 to 40.88 minutes. These data can be found in Table E-5. This apparent trend replicates previous findings (e.g., Leibrecht et al., 1992).

Process Direct Fire Targets

Hypothesis 1.3: The CVCC units' ability to process direct fire targets on the battlefield was expected to be better than the Baseline units'.

Maximum lase range. This measure was operationalized as the maximum distance a manned vehicle lased to a potential target using the GPS or CITV laser. No appreciable differences between Baseline or CVCC groups, or stages are apparent in these data. These data are presented in Table E-6.

Number of fratricide hits by manned vehicles. There were only three incidents of manned vehicles firing at other BLUFOR vehicles throughout the experiment. Baseline battalions were responsible for two of these incidents during Stage 2. CVCC companies were responsible for the other fratricide hit which occurred during the Stage 1 delay. These data appear in Table E-6.

Engage Direct Fire Targets

Hypothesis 1.4: The CVCC units' ability to engage direct fire targets on the battlefield was expected to be better than the Baseline units'.

Percent of OPFOR killed by end of stage. No noteworthy difference in the percent of OPFOR vehicles killed by BLUFOR in the Baseline or CVCC units is apparent for Stage 1. In Stage 2, both CVCC units and one Baseline unit killed all OPFOR vehicles. The other Baseline unit killed 66% of the OPFOR in this stage. The data for this measure appear in Table E-7.

Percent of BLUFOR killed by end of stage. This measure was used to evaluate whether the battalion successfully "protected its forces." BLUFOR included manned and unmanned units and excluded mobility kills. There is some indication that CVCC units did a better job protecting their forces in Stages 1 and 2 than Baseline units. The greatest apparent differences occurred in Stage 2 with Baseline units sustaining a range of 11 to 16% casualties compared to CVCC units which sustained a range of 2 to 6% casualties. These data are presented in Table E-7.

Percent of OPFOR vehicles killed by all manned vehicles. There does appear to be some evidence that the manned vehicles in the CVCC groups killed a greater percent of the OPFOR than the Baseline groups in Stages 1 and 2. In Stage 1 (delay), the percentage of OPFOR killed by the manned vehicles in Baseline groups ranged from 7% to 13%. In the same stage, the percentage of OPFOR killed by manned vehicles in the CVCC groups ranged from 12% and 22%. In Stage 2, CVCC manned vehicle kills ranged from 7% to 11% of the OPFOR, while the Baseline groups killed between 3% and 8%. These data appear in Table E-7.

Number of manned vehicles sustaining a killing hit. CVCC manned simulators appeared to sustain fewer kills than Baseline simulators. In Stage 1, CVCC simulator kills varied from 12 to 24, while Baseline kills ranged from 22 to 26. In Stage 2, CVCC simulator kills ranged from 1 to 4, compared to a range of 7 to 10 for Baseline simulators. These data can be found in Table E-7.

Losses/kill ratio. The losses/kill ratio provides information about a units' combat effectiveness, and is calculated by dividing the total number of BLUFOR losses by the total number of OPFOR losses. In Stage 1, there was no noteworthy difference in the losses/kill ratios of Baseline and CVCC units. In Stage 2, the losses/kill ratio appeared to indicate greater combat effectiveness for CVCC units than for Baseline units. In this case, loss/kill ratio for CVCC units ranged from .02 to .06. For Baseline units, this ratio ranged from .11 to .25. These data appear in Table E-7.

Mean target hit range. This measure was operationalized as the distance from a firing manned vehicle to the OPFOR vehicle hit by the round fired. These limited data (presented in Table E-8) do not indicate any substantial differences between CVCC and Baseline groups in Stages 1 or 2.

Mean target kill range. There is some evidence that Baseline groups killed targets at longer ranges than CVCC groups.

However, it is important to note that this measure should be considered in conjunction with the data for percent of OPFOR killed (CVCC advantage), number of manned vehicles sustaining a killing hit (CVCC advantage), and losses/kill ratio (CVCC advantage). The limited data do not provide any reliable evidence of differences in mean target kill range between echelons (see Table E-8).

Hits/round ratio, for manned vehicles. During Stage 1 and Stage 2, there do not appear to be any noteworthy differences in the hits/round ratio between Baseline and CVCC companies. The data for this measure appear in Table E-8.

Kills/hit ratio, for manned vehicles. No noteworthy differences could be detected between Baseline and CVCC groups in the number of OPFOR vehicles killed per hit (See Table E-9).

Kills/round ratio, for manned vehicles. No notable differences between Baseline and CVCC groups could be detected for this ratio. These data are presented in Table E-9.

Number of rounds fired by manned vehicles. For this measure, no apparent differences occurred between CVCC and Baseline groups for Stage 2 (see Table E-9). For Stage 1 (delay), the Baseline data indicate that both battalion vehicles ($\bar{X}$ = 6.00, S.D. = 5.48) and company vehicles ($\bar{X}$ = 16.33, S.D. = 9.36) tended to fire fewer rounds per vehicle than CVCC groups. CVCC battalion vehicles averaged 18.25 rounds (S.D. = 12.04) and company vehicles averaged 17.58 rounds per vehicle (S.D. = 5.66). These possible trends differ slightly from past work (e.g., Leibrecht et al., 1992), and will be carefully examined when the comprehensive database is available.

Number of OPFOR vehicles killed south of a designated line. Two measures examined the total number of OPFOR vehicles killed by the battalion south of a designated phase line during Stage 1. The data for this measure appear in Table E-10. These measures (crossing PL King and PL Club) were designed as components of a later measure that addressed how well the battalion met the commander's intent (measure 3.5.4), discussed in the Command and Control BOS subsection. No differences were apparent between Baseline and CVCC units in either of these measures.

Control Terrain

Hypothesis 1.5: The CVCC units' ability to control terrain on the battlefield was expected to be better than the Baseline units'.

Measures developed to test this hypothesis failed to produce non-zero data for CVCC and Baseline units. No OPFOR vehicles passed the designated line.

Summary of Findings

Table 22 summarizes the major preliminary results discussed above. There is some indication that CVCC units were better able to move on the surface than their Baseline counterparts. The OPFOR companies maintained closer proximity to Baseline companies than to the CVCC companies, measured between company CoMs in Stages 1 and 2.

Table 22

Summary of Maneuver Data

Measure	CVCC Advantages
Distance between BLUFOR and OPFOR CoM	CVCC units maintained greater stand-off from the OPFOR than Baseline units
Time to complete exercise	CVCC units were faster than Baseline units in completing each stage
Percent BLUFOR killed	The survival rate for BLUFOR was higher for CVCC than Baseline
Percent OPFOR killed by manned units	Manned CVCC units killed more OPFOR than Baseline units
Number manned vehicles killed	The survival rate for manned vehicles was higher for CVCC than for Baseline units

In evaluating the impact of the CVCC system on navigation, CVCC units clearly executed each stage (and subsequently the entire mission) much faster than the Baseline units. This amounted to a reduction in execution time in the delay (Stage 1) and in the counterattack (Stage 2). In fact, the longer execution times for Baseline units prevented any Baseline unit from successfully completing Stage 3 before the time allotted for the entire scenario expired. Two related measures, time to reach LD and time for companies to reach objectives, also showed an advantage for CVCC.

Some evidence for an improved capability of CVCC units to engage direct fire targets was found. It appears that CVCC units did a better job protecting their forces since Baseline units suffered higher casualties than CVCC units. Also, manned vehicles in the CVCC units were responsible for killing more of the OPFOR than Baseline manned vehicles in Stages 1 and 2. There was no apparent difference in the number of hits per round fired, the number of kills per round fired, or the mean target kill range.

The hypothesized improvement in the capability of CVCC units to control terrain was not directly supported since both CVCC and Baseline units denied the OPFOR passage beyond critical control measures, preventing any comparisons between the two conditions. However, CVCC companies did show an advantage for holding off the enemy force, killing more OPFOR vehicles overall, and sustaining their own combat power. Taken together, these data seem to suggest that CVCC units did control terrain more effectively.

Once again, the preliminary nature of these findings should be emphasized. Due to the limited sample size and the variability of the data for individual measures, it is difficult to draw conclusions. These data are to be combined into a larger data base currently under development, which is designed to produce more statistically reliable results.

Fire Support Battlefield Operating System

Issue 2: Does the CVCC system enhance the Fire Support BOS?

The potential effect of the CVCC on fire support is discussed in this section. A single hypothesis, based on the Conduct Surface Attack component of the Fire Support BOS, organizes the presentation of data.

Conduct Surface Attack

Hypothesis 2.1: The CVCC units' ability to conduct surface attack by indirect fire on the battlefield was expected to be better than the Baseline units'.

Mean accuracy of CFF locations. Mean accuracy of CFF locations was assessed by calculating the average deviation, in meters, of the nearest three OPFOR vehicles from the reported OPFOR location. This measure is based only on those vehicles requesting calls for fire.

The data for this measure are shown in Table E-11. The most notable result was that the CVCC group provided more accurate CFF locations ($\bar{X}$ = 530.75, S.D. = 550.89, n = 8) than the Baseline group ($\bar{X}$ = 1882.20, S.D. = 2518.76, n = 10) in Stage 1 (delay operation). In Stage 2, a low number of reports for Baseline (n = 1) and CVCC (n = 3) prevent any comparisons. The low number of reports may be a reflection of the offensive maneuvers of Stage 2. While making these maneuvers, crews may not have taken as much time to request calls for fire as they did in the defense-oriented Stage 1.

These data indicate CVCC may have increased reported CFF location accuracy. This is evidenced by the difference in accuracy between the Baseline and CVCC groups in Stage 1, but due to infrequency of occurrence, not supported by the Stage 2 data.

Percent of CFFs with correct type. This measure was assessed by calculating the percent of scorable reports for which the reported type of OPFOR vehicle (tank, helicopter, or personnel carrier) was found to have intervisibility with the requesting vehicle. Scorable reports were those containing grid locations and type.

The data for this measure are displayed in Table E-11. During Stage 1, 89% of the CVCC group's CFFs (n = 8) contained the correct vehicle type compared to the Baseline group's 28% (n = 10). As with the CFF location accuracy data for Stage 2, the low number of CFFs prevents Baseline/CVCC comparisons.

These data indicate that CVCC increases CFF report accuracy in terms of vehicle type identified for Stage 1.

Summary of Findings

In sum, both measures indicate CVCC may increase CFF report accuracy (see Table 23 for summary of data). However, data for the CFF locations measure suggest the benefit of CVCC may be slightly reduced during stages that place more time constraints on requesting calls for fire. In both Baseline and CVCC conditions, offensive maneuvers may demand more attention for target acquisition than defensive maneuvers, leading to less time for making the requests and possibly decreasing CFF report location accuracy.

Table 23

Summary of Fire Support Data

Measures	CVCC Advantages
Accuracy of CFFs (meters)	CVCC CFF report location accuracy greater than Baseline for Stage 1
% CFFs with Correct Type	CVCC CFF report vehicle identification accuracy greater than Baseline for Stage 1

Vehicle identification accuracy is clearly achieved with CVCC during Stage 1. This may be due to the fact that a CVCC vehicle commander has menu-style vehicle type options on the CCD's CFF screen available for his immediate selection. In addition, reported vehicle types are considered correct based on all OPFOR vehicles in the reported location with which the reporting vehicle has intervisibility lasting at least six seconds. The CCD map feature may allow for more precise location of these targets, enabling more accurate inclusion of the correct target type.

The results presented in this section indicate how CVCC capabilities can help vehicle commanders form accurate calls for fire to increase the effectiveness of their surface attacks. CVCC use in managing other information vital to mission success, including friendly and enemy situations (e.g., SITREPS and INTEL reports), is discussed in the following Command and Control subsection.

Command and Control Battlefield Operating System

Issue 3: Does the CVCC system enhance the Command and Control BOS?

This section addresses the potential impact of CVCC on command and control. The measures were developed to address five distinct hypotheses. The following categories, each representing one of these hypotheses, were used to organize this section: Receive and Transmit Mission, Receive and Transmit Enemy Information, Receive and Transmit Friendly Troop Information, Manage Means of Communicating Information, Direct and Lead Subordinate Forces, and Assess the Battlefield Situation.

The communication network structures used by the CVCC and Baseline groups in this test were not identical. The digital structure for CVCC groups comprised one level reaching all manned elements instantaneously. This net structure prevented meaningful comparison of communication throughput measures between the two groups. For example, when the CVCC TOC transmitted a FRAGO on the digital battalion command net, all vehicle commanders received the information at the same time. However, when the Baseline TOC transmitted a FRAGO using the voice battalion command net, it had to be relayed on the company command net to the company XOs.

One measure not presented in this section is the time for submission of fuel and/or ammo report, an element of the Receive and Transmit Friendly Information measures. The time the report was requested was flagged on the PVD and subsequently analyzed using the DCA system. The time the report was received in the TOC was retrieved through playback. DCA data are adjusted for exercise start and stop times and exclude times when the exercise was stopped due to technical problems. The playback times do not exclude exercise down times. Therefore, the times from the DCA and playbacks are incompatible. In the future, both time of report request and time received should be flagged.

Receive and Transmit Mission Information

Hypothesis 3.1: The CVCC units' ability to receive and transmit information on the battlefield was expected to be better than the Baseline units'.

Elapsed time from battalion transmission of FRAGO to receipt by XO (Stage 1 & 2). This measure was defined as the total elapsed time between the time the battalion TOC initiates transmission of a FRAGO until the time the last company commander finishes transmitting the FRAGO, including clarification time. Table E-12 presents these data. Baseline FRAGO transmissions ranged from 16.33 to 18.15 minutes to reach the XO. In CVCC battalions, the FRAGOs were received instantaneously by all unit commanders and their XOs.

Consistency of relayed FRAGO (Stage 2 only). The consistency of FRAGO contents was measured by comparing the relayed FRAGO to the scripted FRAGO. The Baseline battalions produced six relays of the FRAGO. The mean percentage of FRAGO elements correctly relayed was 16% (S.D. = 8.20). These data appear in Table E-12. The CVCC condition required no relay since all manned simulators received the digital FRAGO simultaneously.

Duration of request by company commanders to clarify FRAGO/overlay. This measure was defined as the average length of the unit commanders' requests for clarification of the FRAGO and the accompanying overlay. CVCC commanders made no clarification requests, while Baseline commanders made five requests. These data can be found in Table E-13. The likelihood that a CVCC unit commander would have to clarify a FRAGO or an overlay is low because the FRAGO text is in FREE TEXT form, and it can be reread. Also, every vehicle receives identical digital overlays on the CCD.

Receive and Transmit Enemy Information

Hypothesis 3.2: The CVCC units' ability to receive and transmit enemy information on the battlefield was expected to be better than the Baseline units'.

The measures in this subsection address the timeliness of enemy information that is relayed from higher echelons to lower echelons (top-down reports), with the exception of the number of SPOT, CONTACT, and SHELL reports. The timeliness of reports from lower echelons to higher echelons is not meaningful in the present evaluation because lower echelons (Company D, platoon leaders, and scouts) are automated or role-played by test personnel. The accuracy of enemy information that is relayed bottom-up is discussed in the Intelligence BOS (following subsection).

Time to transmit INTEL report full net: battalion TOC to lowest manned net (XO). The time to transmit INTEL reports was defined as the elapsed time between the time the battalion TOC initiated a transmission of the INTEL report to the time the last XO received the report. Baseline transmissions took an average of 43 seconds (S.D. = 22.06). Refer to Table E-14 for this measure's data.

Consistency of relayed INTEL. INTEL report consistency was defined as the percentage of scripted INTEL elements correctly relayed. This measure produced only one data point for each stage in the Baseline condition, because the radio network required only one relay between the battalion command net to the company command net. In Stage 1, the INTEL report consistency relayed by the company commander was 100%. In Stage 2, the consistency was 25%. See Table E-15 for these data.

Quantity of combat reports: CONTACT, SPOT, and SHELL. Although not a defined measure, the number of reports during combat is of interest because a complete description of the battlefield is critical. The number of CONTACT, SPOT, and SHELL reports differed between the CVCC and the Baseline battalions during Stage 2 (counterattack). The number of reports sent during this stage was greater for the CVCC battalions than the Baseline battalions. Eight SPOT reports were sent by the CVCC battalions while only four SPOT reports were sent by the Baseline battalions. More SHELL (CVCC = 4, Baseline = 3) and CONTACT (CVCC = 8, Baseline = 3) reports were sent by CVCC battalions as well. The combination of Stage 2's offensive maneuvers and the absence of the CVCC may place heavy constraints on report sending in Baseline units. The larger number of reports sent overall by CVCC crews during Stage 2 highlights how CVCC can benefit reporting efficiency during complex maneuvers.

Receive and Transmit Friendly Troop Information

Hypothesis 3.3: The CVCC units' ability to receive and transmit friendly troop information on the battlefield was expected to be better than the Baseline units'.

Mean time to transmit SITREP full net: lowest net (platoon) to battalion TOC. The mean time to transmit SITREPs was specified as the elapsed time from the lowest net (platoon) transmission of the SITREP to the time the battalion TOC received the company SITREP. SITREPs from Baseline units took an average of 2.98 minutes to transmit (S.D. = 3.53).

Deviation of BLUFOR location reported in SITREP from actual location. To assess the accuracy of friendly vehicle information transmitted in combat reports, this measure examined the deviation, in meters, of the SITREP's Forward Line of Own Troops (FLOT) from the actual FLOT. The actual FLOT was determined by identifying the most forward vehicle on either flank of the company formation at the time a SITREP was transmitted. The midpoint between the two actual locations was compared to the midpoint between the two reported FLOT locations in the SITREP to yield a direct line distance (see Table E-16 for these data). For Baseline battalions, there was only one scorable report (out of 105) transmitted, because only one SITREP included a FLOT grid location.

For CVCC battalions, four SITREPs were transmitted, two in each stage. The distance between the transmitted and actual FLOT ranged from 427 to 1592 meters. These data reveal another advantage CVCC battalions have because of the capabilities of the CCD. Fewer SITREPs are necessary in CVCC because much of the information contained in a SITREP is available to each unit commander on the LOGISTICS report. The LOGISTICS report provides information on unit equipment, ammunition, personnel, and fuel. The information in the LOGISTICS report is automatically forwarded every 10 seconds and is always correct. In addition, it becomes less essential to send FLOT locations in CVCC because every vehicle and unit commander can see friendly vehicle locations on his CCD. The Baseline battalions must rely on subordinate accounts of the same information, which then must be relayed via radio.

Delay between observed PL/LD/FCL crossing and reported crossing. This measure quantifies the timeliness of control measure reporting within the tactical scenarios. The exercise control staff flagged the time a unit crossed given control measures and the time those control measures were reported on the battalion net. CVCC units were asked to report when they crossed linear control measures despite the fact that their progress could be monitored on CCD and battalion TOC map displays. The data for this measure show CVCC battalions were faster in reporting crossings in the delay stage than Baseline battalions. The ranges for CVCC units were .15 to .48 minutes in the delay stage (Stage 1), and .22 to 3.35 minutes in the counterattack (Stage 2). Baseline unit report latency ranged from .22 to 2.57 minutes in the delay. Only one Baseline battalion reported crossing the designated control measure in the counterattack stage. In this case the delay was 1.95 minutes. These data can be found in Table E-16.

Delay between observed BP arrival and reporting SET at BP. This measure reports the delay, in minutes, between the time a unit arrives within a battle position (delay stage) or objective (counterattack stage), and when the unit reports that it is set in that position. In the delay stage, CVCC units rendered more timely reports ($\bar{X}$ = 4.14, S.D. = 5.41) than did Baseline units ($\bar{X}$ = 9.76, S.D. = 12.62). Only one Baseline report was recorded in Stage 2, 9.22 minutes after the unit was observed entering its objective, preventing any comparisons between Baseline and CVCC units (see Table E-16).

An explanation of these data lies in the capability differences between the CVCC and Baseline vehicles. With the CVCC system, a unit commander can observe his unit's position as reported by the POSNAV system on the tactical map. Since the maneuver graphics are also posted on the CCD, the commander need only confirm that the POSNAV symbols are superimposed on the BP or objective to confirm this unit's arrival. In other words, arrival can be reported immediately, without reliance on subordinate reports. In Baseline, the commander relies more on subordinate reports and observations through the vision blocks. The latter implies a need to verify navigational accuracy, which would further delay a report. Hence, of the two conditions, Baseline reporting is more likely to be delayed if the unit is in contact with the OPFOR.

Manage Means of Communicating Information

Hypothesis 3.4: The CVCC units' ability to manage means of communicating information on the battlefield was expected to be better than the Baseline units'.

Mean duration of voice transmissions between battalion TOC and battalion commander/S3, excluding named reports. Playbacks were used to record the sender, start time, and stop time of each transmission between the battalion TOC and the battalion commander or S3. Excluded from these communications were any combat reports which could be received or prepared using the CCD. A small difference was detected in the average length of voice radio transmissions between the battalion TOC and battalion commander/S3 for CVCC battalions ($\bar{X}$ = 36.20 seconds, S.D. = 31.50) compared to the Baseline battalions ($\bar{X}$ = 27.60 seconds S.D. = 26.40). The Baseline battalions, however, transmitted more reports (n = 133) than the CVCC battalions (n = 22), placing a larger voice load on the radio network. See Table E-17 for these data.

Average length of voice radio transmissions, by echelon. This measure reports the duration of voice transmission; defined as the length of time the microphone was keyed. The data were collected, by vehicle, during each stage and then mean transmission durations were calculated. The means and standard deviations reported in Table E-18 are based on the average transmission durations (in seconds) for each vehicle. The maximum and minimum times reported are absolute values. In order to further evaluate the impact of the CVCC equipment on voice radio traffic, the mean number (in addition to duration) of voice transmissions was analyzed.

The data (see Table E-18) indicate that the difference in average transmission duration was not influenced by condition or echelon. However, far fewer voice transmissions were sent by manned vehicles when digital communications were available. These trends mirrored the voice transmission data discussed earlier in this section between battalion TOC and battalion commander/S3.

Direct and Lead Subordinate Forces

Hypothesis 3.5: The CVCC units' ability to direct and lead subordinate forces on the battlefield was expected to be better than the Baseline units'.

Did Task Force (TF) prevent decisive engagement (Stage 1)? The Battle Master determined whether the TF successfully prevented a decisive engagement. This determination was based on: (a) the Battle Master's assessment of the reaction time of the battalion commander and the company commanders , (b) the proportion of battalion vehicles successfully displacing (50% or more), and (c) a consideration of BLUFOR controller response times. Using these criteria, both CVCC battalions were successful, while both Baseline battalions were not.

Did the battalion withdraw intact (Stage 1 only)? This measure was based on the percentage of the BLUFOR vehicles remaining at the end of the Stage 1. Values obtained from the DCA routine determined BLUFOR strength at the end of a stage. This value was then divided by the starting BLUFOR strength. Values greater than 70% indicated the battalion withdrew intact. The 70% criterion is based on the ARTEP 71-2 MTP. No Baseline or CVCC battalion withdrew intact.

Number of counterattacking companies engaging OPFOR (Stage 2). This measure was determined by the Battle Master's assessment of how many counterattacking companies simultaneously engaged the OPFOR during Stage 2. Negligible differences were found between CVCC and Baseline units (See Table E-19). The number of counterattacking companies engaged ranged from 1 to 3.

To what extent did the battalion meet the brigade commander's intent (Stage 1 and Stage 2)? In order to determine how well the battalion met the brigade commander's intent, a number of previously-defined measures were combined to produce a composite percentage. This paragraph describes how the measure was calculated. For Stage 1, each of the following measures contributed 25% of the total score: (a) the percent of BLUFOR killed by the end of the stage, (b) the number of OPFOR vehicles killed south of PL King, (c) the number of OPFOR vehicles killed south of PL Club, and (d) the number of OPFOR vehicles penetrating a designated line. Each of these component measures was discussed in the Maneuver BOS results subsection. For Stage 2, each of the following measures contributed 33.33% of the total score: (a) the percent of OPFOR killed by end of the stage, (b) the percent of BLUFOR killed by the end of the stage, and (c) the number of OPFOR vehicles penetrating a designated line by the end of the stage. These component measures are discussed in the Maneuver BOS results section.

The data are presented in Table E-20. From these limited data, it is not possible to detect reliable differences between Baseline and CVCC units. Scores on this measure ranged from 81 to 95% in Stage 1, and 95 to 100% in Stage 2.

Assess Situation

Hypothesis SA1: The CVCC unit leaders' assessment of battlefield events was expected to be better than Baseline unit leaders'.

The potential impact of CVCC on situational assessment is addressed in this section. The hypothesis, based on the Assess Situation component of the Command and Control BOS, organizes the presentation of data. The Situational Assessment questionnaire may be found in Appendix C.

The Situational Assessment questionnaire was administered at the conclusion of the test scenario. The questionnaire was originally designed with reference to tactical events in Stage 3 of the test scenario. For units that only completed two stages, the items and comparisons to actual events were adapted to Stage 2. However, two items (destruction of OPFOR vehicles after the order to delay, and deviation between true and reported distance) were not appropriate to Stage 2, and therefore, no data on those items were available for those units. Given that only CVCC units progressed through the third stage, no data were available regarding the ability of Baseline unit members to judge spatial displacement, or to compare the possible effect of CVCC on those kinds of judgments. At the completion of the battalion evaluation, the full database may include Stage 3 data from Baseline groups.

Percentage of destroyed OPFOR tanks correctly identified. This measure was assessed by totaling the number of T72s destroyed (catastrophic kills only) by A, B, and C Companies and by the battalion as a whole, and comparing the data to the unit and vehicle commanders' estimates. The score is expressed as a percentage, see Table E-21.

The CVCC group more accurately reported killed T72s ($\bar{X}$ = 53%, S.D. = 44) than did the Baseline group ($\bar{X}$ = 25%, S.D. = 36) at the battalion level. However, at the company level, the Baseline group made more accurate identifications ($\bar{X}$ = 50%, S.D. = 45) than the CVCC group ($\bar{X}$ = 23%, S.D. = 26). Baseline groups reported higher confidence in their assessments at both echelons (battalion $\bar{X}$ = 3.00, S.D.= 1.41; company $\bar{X}$ = 4.17, S.D. = 1.27) than CVCC groups (battalion $\bar{X}$ = 1.50, S.D. = .58, company $\bar{X}$ = 3.00, S.D. = .77).

The fact that CVCC units were reporting on Stage 3, and Baseline groups were reporting on Stage 2 may help explain these differences. In Stage 3, the BLUFOR displaces to the rear when the OPFOR closes to within 2000 meters, in order to avoid being overrun. Therefore, the subjects' direct observations of the battlefield are conducted at relatively long ranges. In Stage 2, the BLUFOR moves toward the enemy, seizes and holds a tactical objective. In this case, the BLUFOR closes on the OPFOR, or at least maintains its distance from the OPFOR. In all scenarios, company level participants are more likely to be in direct contact with the enemy than are battalion level participants. Given that direct observations may be made at closer ranges in Stage 2, one would expect more accurate enemy vehicle identification at the company level, and higher confidence levels in that assessment.

Percentage of destroyed BMPs correctly identified. Percentage of correct BMP identification was assessed by calculating the percent of correctly reported BMPs suffering a catastrophic kill by A, B, and C Companies and by the battalion as a whole. The data are presented in Table E-22.

The CVCC group correctly reported a greater percentage of destroyed BMPs ($\bar{X}$ = 58%, S.D. = 41.27) than those in the Baseline group ($\bar{X}$ = 15%, S.D. = 16.54) at the battalion level. The CVCC group also reported more accurately at the company level ($\bar{X}$ = 36%, S.D. = 26.30) than the Baseline group ($\bar{X}$ = 29%, S.D = 40.37). Baseline groups at both echelons were more confident in their assessments (battalion $\bar{X}$ = 3.50, S.D. = 1.73; company $\bar{X}$ = 4.17, S.D. = 1.27) than were CVCC groups (battalion $\bar{X}$ = 2.00, S.D. = .82; company $\bar{X}$ = 2.73, S.D. = .65).

Destruction of OPFOR vehicles after the order to delay. This measure required the participants to report whether any enemy vehicles suffered a catastrophic kill after the order to delay was given. The failure of Baseline groups to progress to Stage 3 limited the data in this measure to CVCC groups. Therefore, it is not possible to make any comparisons between groups.

Among CVCC groups, 75% of the participants in the battalion echelon responded accurately to this item. At the company echelon, 83% of respondents responded accurately.

Percentage of own vehicles destroyed. Percentage of own vehicles destroyed was assessed by calculating the percent of A, B, C Company and battalion vehicles correctly identified that suffered catastrophic kills. Refer to Table E-23 for data.

Within the battalion echelon, CVCC group members reported friendly losses more accurately ($\bar{X}$ = 56%, S.D. = 31.06) than did members of the Baseline group ($\bar{X}$ = 18%, S.D. = 11.90). At the company echelon, the margin between conditions was small (Baseline: $\bar{X}$ = 63%, CVCC: $\bar{X}$ = 58%). However, Baseline group scores were more variable than the CVCC group (Baseline: S.D. = 47.07, CVCC: S.D. = 27.79).

The differences at both echelons may be explained by the operational effectiveness utility within CVCC. The operational effectiveness module provides an immediate, up-to-date count of the operational vehicles in the unit.

Deviation between true and reported distance. This distance was assessed by calculating the deviation, in kilometers, between questionnaire response and actual distance between successive BPs in the third stage of the test scenario. Comparative data for this measure are not available due to the failure of Baseline units to progress to the third stage of the test scenario.

The mean deviation score among CVCC group members at the battalion echelon was .38 kilometers (S.D. = .26), as seen in

Table E-24. At the company echelon, the mean score was 1.44 kilometers (S.D. = 2.22).

Summary of Findings

Table 24 summarizes the trends that were identified between the CVCC and Baseline units. One measure demonstrating a likely difference between conditions was the number of voice transmissions. While the duration of voice transmissions did not vary, the number of voice transmissions did, indicating a large reduction in the time that radio networks were tied up with voice traffic for the CVCC condition. The CVCC units sent approximately half the number of voice transmissions as Baseline units. Additional data demonstrating communication differences between Baseline and CVCC units indicated that Baseline units sent many more SITREPS than CVCC units.

Table 24

Summary of Command and Control Data

Measure	CVCC Advantages
Number of voice transmissions	Baseline units sent almost twice as many voice transmissions as CVCC units.
Number of SITREPs	Over 25 times the number of SITREPs were sent in Baseline compared to CVCC.
Clarification of FRAGOs	Baseline required five clarifications, CVCC none.
Number of CONTACT, SPOT, reports during counterattack	CVCC units sent twice as many reports during the counterattack.

The inherent advantages of digital reports are numerous. For example, five requests were made by Baseline units to clarify FRAGOs or overlays. However, none were made by CVCC units because the CCD allowed them to reread the FRAGO when necessary. Additionally, only 15% of the information relayed in Baseline FRAGOs were consistent with the original, while FRAGOs relayed by CVCC groups were 100% consistent. In summary, for CVCC groups, there was no voice relay time because the digital reports were received instantaneously, 100% of the information in digital reports was relayed, and there were no inconsistencies in the relays.

In summarizing situational assessment capabilities, data suggest some possible trends between the Baseline and CVCC groups. However, two of the situational assessment measures can only be analyzed if future Baseline groups complete the final test stage. Furthermore, the tactical differences between Stage 2 and Stage 3 may be enough to influence the accuracy of participant responses, such that the data should not be compared. Modifications should be considered prior to implementation of the Situational Assessment questionnaire in future research efforts. In all, preliminary findings suggest that the CVCC equipped units have advantages over Baseline units in the realm of command and control. A related area of investigation in the battalion evaluation is whether the CVCC offers advantages in the transfer of intelligence information. Measures dealing with this question are discussed in the following Intelligence BOS subsection.

Intelligence Battlefield Operating System

Issue 4: Does the CVCC system enhance the Intelligence BOS?

This section examines the effect of CVCC on collecting intelligence information. One hypothesis, based on the Collect Threat Information component of the Intelligence BOS, organizes data presentation.

Collect Threat Information

Hypothesis 4.1: The CVCC units' ability to collect threat information on the battlefield was expected to be better than the Baseline units'.

Accuracy of SPOT report locations. The assessment of SPOT report location accuracy was based on the deviation, in meters, of the nearest OPFOR vehicle to its reported OPFOR location. The "observed" and "destroyed" elements of the SPOT reports were scored independently.

The location accuracy data are presented in Table E-25. During Stage 1, SPOT report locations of observed enemy forces were more accurate ($\bar{X}$ = 351.17, S.D. = 272.62, n = 12) for Baseline units than those from the CVCC units ($\bar{X}$ = 456.17, S.D. = 573.93, n = 12). However, location accuracy was higher with the CVCC units ($\bar{X}$ = 404.63, S.D. = 397.86, n = 8) than with Baseline ($\bar{X}$ = 708.00, S.D. = 1003.83, n = 4) during Stage 2.

Reports identifying the location of destroyed enemy vehicles were more accurate for CVCC units in Stage 1, but Baseline report accuracy was higher in Stage 2. However, the Baseline results were based on only two reports in Stage 1 and one report in Stage 2, compared to 12 and 8 reports for CVCC.

Correctness of SPOT report number and type. For each scorable SPOT report, this measure was assessed by calculating the percentage of reported vehicles, of the reported type, which were found to have intervisibility with the reporting vehicle.

Independent calculations were made for the "observed" and "destroyed" elements of the reports.

Refer to Table E-25 for a listing of these data. During Stage 1, 77% (S.D. = 23.79) of CVCC SPOT reports contained the correct number of vehicles observed compared to 58% (S.D. = 31.84) of Baseline's reports. Likewise, observations in CVCC SPOT reports from Stage 2 were 100% accurate compared to the 67% (S.D. = 47.20) accuracy of Baseline reports.

Accurate identification of the number and type of enemy vehicles was better with the CVCC group in both Stages 1 and 2. Although, the data include only three SPOT reports with identification information from Baseline units in Stage 1 and one in Stage 2, compared to CVCC units with 12 reports in Stage 1 and 8 reports in Stage 2). However, the fact that CVCC units had the opportunity to create more complete SPOT reports may show an indirect advantage for CVCC capabilities.

Accuracy of SHELL report locations. The accuracy of SHELL reports was assessed by computing the deviation, in meters, of the nearest OPFOR artillery impact to the reported artillery impact.

The data for this measure are in Table E-25. SHELL reports from the CVCC group were more accurate ($\bar{X}$ = 1461.75, S.D. = 996.51, n = 4) than those from the Baseline group ($\bar{X}$ = 1701.56, S.D. = 982.74, n = 9) during Stage 1. However, in Stage 2, SHELL reports from the Baseline group were more accurate ($\bar{X}$ = 1070.67, S.D. = 78.50, n = 3) than those from the CVCC group ($\bar{X}$ = 1262.00, S.D. = 702.58, n = 4).

Accuracy of CONTACT report locations. CONTACT report accuracy was assessed by calculating the deviation, in meters, of the nearest OPFOR location.

Table E-25 presents the CONTACT report accuracy data. The CVCC group provided more accurate reports ($\bar{X}$ = 875.89, S.D. = 873.04, n = 9) than did the Baseline group ($\bar{X}$ = 982.36, S.D. = 1106.73, n = 11) in Stage 1. Stage 2 report accuracy was higher, though, with the Baseline group. Again, Baseline's Stage 2 results were based on three reports compared to eight for CVCC.

Correctness of CONTACT report type. This measure was based on the percent of scorable CONTACT reports for which the reported type of OPFOR vehicle was found to be visible to the reporting vehicle.

The data for this measure are displayed in Table E-25. During Stage 1, 87% (S.D. = 20.17, n = 9) of the CONTACT reports from the CVCC group contained the correct vehicle type compared to 58% (S.D. = 42.01, n = 11) from the Baseline group. In Stage 2, 56% (S.D. = 49.55, n = 8) of the CVCC group's CONTACT reports included correct vehicle types, compared to 50% (S.D. = 70.71, n = 2) of Baseline's reports.

Summary of Findings

A summary of major findings related to the Intelligence BOS appears in Table 25. For every report type discussed in this section, the CVCC units' vehicle identification accuracy was better than the Baseline units'. The CVCC system seems to present unit commanders with a "clearer picture" of the current battlefield situation, aiding them in more accurate identification of enemy vehicles types. The CVCC allows a unit commander to monitor friendly and enemy vehicle locations on the tactical map, leaving more time for him to make precise vehicle identifications.

Table 25

Summary of Intelligence Data

Measure	CVCC Advantages
Accuracy of SPOT report locations, during counterattack	CVCC units were more accurate compared to the Baseline units.
Correctness of SPOT report number and type	CVCC units were more accurate compared to Baseline units.
Correctness of CONTACT report type during delay	CVCC units were more accurate compared to Baseline units.

Mixed results were achieved, however, with the location accuracy of the SPOT, SHELL, and CONTACT reports. In all cases but one, CVCC units sent more accurate reports than Baseline during Stage 1, while the reverse was true for Stage 2. In the more defense-oriented Stage 1, CVCC units may have taken better advantage of the lasing technique for inputting accurate target locations into the CCD. The only conflicting result in Stage 1 came from observed vehicle location accuracy of SPOT reports, in which Baseline reports were more accurate than CVCC. Better Baseline performance in Stage 2 could have been due to the smaller cell sizes associated with these conditions compared to CVCC conditions.

To enhance trends noted in the data from the performance measure described above, measures concerning the interaction of the participants with the equipment were addressed.

Soldier-Machine Interface

Two diagnostic issues are addressed in this subsection: (D1) How frequently were the CCD features used? (D2) How frequently were the CITV features used? These issues address various aspects of CVCC utilization. Usage measures, averaged across stages, quantified the frequency with which different features of the CCD (Issue D1) and the CITV (Issue D2) were utilized. Additional SMI data were drawn from SMI questionnaire ratings, written comments and comments recorded during debriefing sessions from unit and vehicle commanders (n = 16) during the battalion evaluation.

The automated usage data in this section are organized by echelon levels of battalion and company because of the responsibility differences between the battalion commander and the S3 (battalion echelon) compared to the company commanders and their XOs (company echelon). Differences between echelons have been found in previous SMI efforts (O'Brien et al., 1992; Ainslie et al., 1991). These data can be found in Tables E-26 to E-34.

The SMI CCD and CITV Questionnaires were administered to determine the acceptability of these components to the CVCC participants. More specifically, soldiers were asked to rate CCD and CITV capabilities, answer open-ended questions and offer suggestions for improvement. The rating scale on the questionnaires consisted of a seven-point scale: "1 - Totally Unacceptable," "2 - Very Unacceptable," "3 - Somewhat Unacceptable," "4 -Borderline," "5 - Somewhat Acceptable," "6 - Very Acceptable," "7 - Totally Acceptable."

When responding to individual items on the SMI questionnaire, a unit or vehicle commander was asked to consider how acceptable CVCC components were in helping him fight a battle. The concept of acceptability was defined as whether a specific CVCC capability: (a) enabled him to perform his job, (b) was easy to use, and (c) was not confusing. This definition was presented in written form on the questionnaires and was also read aloud. All SMI questionnaire data are presented in Tables E-35 and E-36.

The data presented under most headings include Usage data were not collected for all features. To facilitate description of related equipment usage and SMI questionnaire data, most headings include automated usage measures, SMI questionnaire ratings, and written and debriefing comments. When equipment usage data is followed immediately by SMI questionnaire data, data tables are not presented in consecutive order.

CCD Input Devices

Information can be input to the CCD via the touchscreen, the thumb cursor, CITV laser or the gunners's laser depending on the task. For instance, two of these features, the touchscreen and the thumb cursor, can be used to activate the CCD functions (e.g., opening reports, changing map scales, etc.).

The integration of the CCD and the CITV allows users to input grid locations to reports. The CITV laser or the gunner's laser can be used to input exact grid locations to CONTACT, SPOT, CFF, SHELL, NBC, INTEL, SITREP, and ADJUST FIRE reports, by lasing to an object when a report location is needed. Input via a laser device is most beneficial for CONTACT, SPOT, and CFF because enemy location is crucial. The alternative methods for input of grid location are the touchscreen and the thumb cursor.

The touchscreen vs the thumb cursor. In order to determine which CCD input device is preferred by soldiers, several measures were considered. First, the percent of control inputs by touchscreen was defined as the proportion of the total number of control inputs (touchscreen and thumb cursor) to the CCD via the touchscreen. This measure did not include inputs to the CCD that were made with the CITV laser. Battalion level personnel used the touchscreen 100% of the time. The company level personnel also preferred the touchscreen as an input device: they used the touchscreen 99.8% of the time (see Table E-35).

Based on these figures, the touchscreen was the most preferred input method to the CCD. The data show that the thumb cursor was rarely used for input since the maximum percentage for any one unit commander inputting via the thumb cursor was 2%. The thumb cursor was disabled in one simulator (C company's XO) during Week 5 because of cursor instability on the CCD. However, the thumb cursor may be the preferable input device for commanders who complained that they could not activate the corners of the tactical map via the touchscreen. Their fingers were too big and came into contact with the edge of the screen below the point they wanted to touch.

The SMI questionnaire ratings of the touchscreen and the thumb cursor (Table E-35) support the input device usage data. The SMI ratings showed that 81% of unit and vehicle commanders rated the touchscreen as "Somewhat Acceptable" or higher. Forty percent of commanders rated the thumb cursor as "Borderline," and 47% rated it "Somewhat Unacceptable" or worse. Only 13% rated the thumb cursor as "Somewhat Acceptable."

Laser input. The percent of grid inputs by laser device was defined as the proportion of the total number of grid location inputs to the CCD reports using the laser. The data indicate that grid locations were input by laser 46% of the time by battalion personnel and 34% of the time by company personnel (see Table E-26). This finding is expected since company echelon vehicles are more likely to be in close contact with the enemy and use the touchscreen because it is faster than entering grid locations via laser.

The SMI questionnaire item that addressed the integration of the CCD with the CITV, such as lasing to an object to input grids in a report, was rated highly. Fifty-six percent of the unit and vehicle commanders rated this capability as "Totally Acceptable" and 37% rated it as "Very Acceptable" (see Table E-35).

In debriefing sessions, several soldiers remarked that they preferred the laser as an input device over the touchscreen because the laser was more accurate. However, the usage data show that the touchscreen was used more often.

Overall, the data suggest that the touchscreen is used more often than the other input devices by participants in this effort, although inputting grid locations by laser was rated positively as well. These findings are similar to those from previous SMI evaluations (Ainslie et al., 1991; O'Brien et al., 1992).

Navigation Function

The Navigation function allows unit and vehicle commanders to create navigation routes and send them to their driver or to other vehicle commanders. A navigation route can include up to six waypoints that are input to the system by selecting points on the tactical map. Once waypoints have been entered into the system, they can be sent manually to the driver's steer-to-display or they can be sent automatically, using the autoadvance feature. SMI questionnaire data and debriefing comments were used to evaluate the usability of this function for soldiers in the present study.

Several items on the SMI questionnaire addressed the Navigation function. First, unit commanders were asked to rate their ability to navigate using POSNAV. Eighty-one percent of unit commanders rated this feature as "Totally Acceptable" and 19% rated it as "Very Acceptable."

Other questionnaire items referring to navigation functions were: creating routes, changing waypoints in a route, and sending waypoints to the driver. The most common rating on all three of these options was that they were "Totally Acceptable" functions. The majority of unit and vehicle commanders agreed that they would not change the Navigation function. In general, unit and vehicle commanders found this component easy to use and understand.

Another item on the questionnaire addressed the ability to allocate more responsibility to the driver. This ability was rated as "Very Acceptable" by 56% of commanders and "Totally Acceptable" by 44%. The amount of time saved by this method may be a factor in the commanders' ratings. With POSNAV, less attention (e.g. giving directions to the driver, keeping track of distance travelled, using azimuth indicator, etc.) was necessary for navigational purposes after a waypoint had been sent.

Drivers were queried about the Navigation function as well. In an open-ended question drivers were asked if they had any problems using the steer-to-display. A majority of the drivers indicated that they had little trouble using this feature for navigation. When asked if, in a real tank, the driver's display would improve their performance, 88% of the drivers agreed that it would.

According to the unit and vehicle commanders and the drivers in this evaluation, the Navigation function was one of the easiest to use and most time saving components of all the CCD features.

Tactical Map

The methods used to investigate the usability of the Tactical Map include a number of equipment usage measures and SMI questionnaire ratings.

Map scale. Usage data show that battalion level personnel generally preferred to use the 1:50,000 scale map (52% of time) although they also spent a substantial amount of time using the 1:125,000 scale (36%). The company commanders, however, used the 1:50,000 scale 69% of the time and were more likely to use a scale with greater detail, as they spent 26% of the time on the 1:25,000 scale (see Table E-27). This is what would be expected as the company commanders are responsible for their company and need to see the area and vehicle icons in substantial detail. The battalion commanders may prefer to view a larger area of the battlefield in order to see all their company forces. It should be noted that the largest map scale, 1:250,000, was rarely used by company or battalion commanders.

Comments made on the SMI questionnaire supported the usage data. When asked how they would change the tactical map, two commanders said they would favor a 1:100,000 map scale instead of the 1:125,000 scale, to match the Army standard. Several unit commanders were adamant in their statements that the map screen needed to be larger. Apparently many commanders had problems seeing details on the map such as numbers and phase line names.

Map terrain features. A second usage measure was the percent of time each map feature was in effect. The map features include contour lines, grid lines, rivers, roads, and vegetation (see Table E-28). For battalion commanders, all the features were on 99% of the time with the exception of vegetation, which was on 74% on the time. Company commanders were somewhat less likely to use contour lines ($\bar{X}$ = 80%) and vegetation ($\bar{X}$ = 69%). Because company commanders usually used more detailed map scales, they may have preferred fewer map features in order to keep the map from becoming visually cluttered. Overall, these data suggest that commanders were satisfied with available map terrain features.

Map Movement Feature. The scroll function on the tactical map entails FOLLOW, JUMP, and MOVE. The JUMP and FOLLOW options of this function are activated using a dedicated function key.

If JUMP is activated, eight boxes appear around the perimeter of the map at 45 degree increments. When a box is activated (by touchscreen or thumb cursor), the map scrolls one-half the distance of its length or width in the desired direction. The MOVE function allows the user to place his own vehicle icon anywhere on the display, relative to his location. The FOLLOW mode allows the map to scroll beneath the vehicle icon wherever it was last placed on the map using the MOVE function.

On the SMI questionnaire, soldiers were asked to rate the Map scroll function. Fifty percent rated this function as "Very Acceptable" and 31% rated it as "Totally Acceptable" (Table E-35). These ratings suggest that the commanders were satisfied with the function. The acceptability ratings were higher for the scrolling function in this evaluation compared to similar ratings from the Battalion TOC Evaluation, perhaps because system response time has improved since the Battalion TOC Evaluation (O'Brien et al., 1992).

The usage measure for the Map Scroll functions was the percent of time each map scroll function was in effect. There were only slight differences in mode usage based on echelon for FOLLOW (company = 46%, battalion = 49%) and JUMP (company = 52%, battalion = 49%), while the MOVE function was rarely used (less than 2% of the time) by either echelon group (see Table E-29).

Vehicle Icon Aggregation. Aggregation of vehicle icons is another feature of the tactical map. This feature allows the user to reduce the amount of visual information on the tactical map by aggregating individual vehicle icons into platoon-level or company-level icons. No usage data were collected on this feature but the SMI Questionnaire addressed it. This feature was rated "Totally Acceptable" or "Very Acceptable" by 81% of the unit commanders. The lowest rating was "Somewhat Acceptable" (18.80%). Comments on the SMI questionnaire indicated that most commanders preferred to aggregate the vehicle icons at the platoon level or individual vehicle level. One unit commander stated that he liked to aggregate by platoon because "it doesn't clutter the screen too much and still lets you see the elements of each company." A commander who preferred aggregation at the individual vehicle level wrote "it's a plus knowing where individual vehicles are."

An overall rating of the tactical map on the SMI questionnaire indicated that it is a well-accepted feature of the CCD (Table E-35). Eighty-one percent of the commanders rated the tactical map as being "Very Acceptable" or better, and only 12% of the commanders rated the tactical map as "Borderline."

CCD Reports

The reports that can be created on the CCD are SHELL, SPOT, CONTACT, CFF, ADJUST FIRE, NBC, INTEL, and SITREPs. In addition to the above reports, the CCD can receive FREE TEXT reports, FRAGOs, and overlays sent from the battalion TOC. Several equipment usage measures, SMI questionnaire ratings and written comments were utilized to examine the CCD report function. Comments from debriefing sessions were also utilized.

Reports received. For company commanders, the mean number of all reports received (total number of unique and duplicate reports received, averaged across three stages) was 75 (see Table E-30) and the mean number of unique reports received was 72 (see Table E-31). The mean number of all reports received was 53 for battalion commanders and the mean number of unique reports received was 52 (see Table E-31). Thus, the number of reports received by vehicle commanders was not greatly inflated due to the reception of duplicate reports. Duplicate report problems were reported in the company SMI evaluation (Ainslie et al., 1991). However, because of software changes, duplicate reports were not a significant problem in the battalion TOC evaluation (O'Brien et al., 1992) or this evaluation, as the data above indicate. Hence, throughout the remainder of this section, "reports" will refer to "unique reports" unless otherwise stated.

Fifty percent of commanders rated the "number of reports received" item on the SMI Questionnaire as "Somewhat Acceptable" or "Totally Acceptable" while the other 50% rated this item as "Borderline" or below (Table E-35). It is helpful to look at the comments that were made pertaining to the number of reports received. One unit commander commented that the number of reports he received was "totally overwhelming." He and three other unit commanders suggested that a "filter" was needed that could select out reports that did not pertain to them. Another recommendation was that unit commanders be able to address reports to specific call signs. This capability would "be extremely helpful in preventing information overflow," wrote one battalion S3.

Changing the priority of reports was also a common suggestion. For example, one battalion commander wrote "As a battalion commander I am very dependent upon SPOT reports for visualization of the battlefield. The fact that these reports were low priority on the CCD greatly hindered my effectiveness." A company commander suggested that the individual user should set the report priority; for instance, an FSO would set CFFs as high priority whereas a ground commander would set CONTACT and SPOT reports as high priority.

Reports opened. The reports opened measure was defined as the proportion of the total number of unique reports received on the CCD which were subsequently opened. Battalion commanders opened 51% of the reports received while company commanders opened 33% (see Table E-32). Because battalion level personnel are responsible for all company elements it is a reasonable expectation that they would open more reports. However, company level personnel also have a battalion command net and receive the same reports on this net as the battalion commanders. This may partially explain why company commanders were more likely to suggest an automatic report filter. Conceivably, company commanders perused the reports in the report queue as they were received. Their decision to open a report may have been based on the report type, when the report was created, and the report origin. Perhaps the decision making process regarding what report should or should not be opened resulted in increased mental workload on the part of the company level personnel. The battalion level personnel, on the other hand, may not have been as overwhelmed because they did not have to go through the above decision making process, simply opening the report. This possibility will be investigated further in analyzing the complete database.

In one debriefing, a company commander and his XO agreed that the SAFOR vehicles sent too many SITREPs. The company commander went on to say that he automatically deleted SITREPs from SAFOR units. This may be another reason why company commanders were deluged with reports that they had difficulty managing. The SAFOR reports were sent on company nets; therefore, the battalion commanders did not receive them.

DIS exercises designed to train information management skills are described in Winsch et al. (in preparation). The results above indicate that such a training program should be useful in training skills for future fielded systems.

Creating reports. On the SMI questionnaire, unit commanders rated the "Creating reports" item pertaining to the creation of digital reports on the CCD. Seventy-five percent of the commanders rated this item "Somewhat Acceptable" or higher. Twenty-five percent rated the item "Borderline" or below (refer to Table E-35). The majority of commanders were satisfied with the report creation capabilities on the CCD. One company commander, who did not find the capability acceptable, made the comment that commanders need to have the ability to create FREE TEXT reports, overlays, and FRAGOs at the company level. Another commander's comment was that the actual report formats were acceptable, but the report prioritization should be changed. In future SMI efforts the report priority issue should be addressed on the questionnaire.

Report formats and icons. The "Report formats" item on the SMI questionnaire was rated as "Somewhat Acceptable" by 50% and "Very Acceptable" by 43% of unit commanders (see Table E-35). A few unit commanders thought that the ability to create FREE TEXT messages should be incorporated in the CCD, as stated earlier.

In reference to the report icons, 73% rated them as "Very Acceptable." Comments indicated that report icons could be improved if they contained more information. For example, it was suggested that SPOT report icons have not only number observed but also the number destroyed. Another suggestion was that dead BLUFOR vehicles display an icon at its last known location with a black box around it to indicate a kill.

Report signals. Incoming reports are signaled visually and auditorially to the unit commanders. A report is signaled visually by a flashing report icon on the tactical map and the receive button is highlighted.. Additionally, reports are signaled auditorially with one or three beeps in the headsets depending on the priority of the incoming report (one beep for low priority reports and three beeps for high priority reports).

Seventy-three percent of the unit commanders rated the auditory signals as "Somewhat Acceptable" or higher (Table E-35). The occasional lower ratings were partially due to technical problems; one commander's simulator did not generate any beeps during this evaluation. Another reason for low ratings became apparent in debriefing sessions when several unit commanders explained that they did not rely on the beeps to get their attention because they were not as meaningful as voice reports. For example, the beeps did not carry the emotional urgency that sometimes accompany a voice report, and there was no way to distinguish an incoming CONTACT report from any other high priority report if relying solely on the beeps. Therefore, some verbal messages were more likely than beeps to get participants' attention because they contain more diverse information.

The visual signals were rated "Totally Acceptable" or "Very Acceptable" by 56% of the commanders and "Somewhat Acceptable" by 31%. Although comments suggested that the map became cluttered when numerous reports were received simultaneously, the commanders were trained to avoid this problem. The CCD has several functions to declutter the Tactical Map: deleting particular icons, deleting by amount of time posted, or deleting the corresponding report.

LOGISTICS report. A new feature introduced in the Battalion Evaluation was the LOGISTICS report. The LOGISTICS report is an automatically distributed report that can be accessed for current status of ammunition, equipment, fuel, and personnel by showing the status in a green, amber, red, or black (GARB) colored bar. A unit commander can get LOGISTICS information on his own vehicle or unit level information. Two questions on the SMI questionnaire that addressed this feature were: (a) Do you find the LOGISTICS report to be useful? and (b) How would you change the LOGISTICS report? In response to the first question, all commanders agreed that the LOGISTICS report was useful because of the up-to-date information. SITREPs were less necessary because much of the SITREP information was available in the LOGISTICS report. In answer to the second question, commanders' suggestions on improving the LOGISTICS report included: constantly displaying GARB information on ammunition, equipment, fuel, and personnel in a corner of the CCD screen; distinguishing type of ammunition (HEAT and SABOT) separately; and displaying a LOGISTICS main function key on the bottom of the CCD screen (instead of in the report menu) for quick access.

Overlays. Commanders were asked to rate the "Capability to receive/transmit overlays" on the SMI questionnaire. This item was rated "Very Acceptable" or "Totally Acceptable" by 69% of commanders (see Table E-35). Nineteen percent rated this CCD feature as "Somewhat Acceptable." Although unit commanders were trained to remove overlays from the Tactical Map, vehicles monitors noted that some unit commanders were retrieving new overlays before deleting the old overlays. Consequently the features of one overlay were difficult to distinguish from another. The hesitancy in removing overlays may have been summed up by a company XO who requested "the ability to remove old overlays from [the] map without trying to guess which ones they are." Apparently, this XO found it difficult to determine which overlay was which when several were posted on the CCD at the same time. Further comments concerning the overlay component included details for improving the graphics quality and the labelling of the overlays so there is no question about content.

Global CCD Assessment

Several SMI usage measures and questionnaire items addressed CCD features from a global point of view. Unit commanders were asked to rate the CCD for "its contribution to your ability to perform your duties." Eighty-one percent of unit commanders rated this item as "Very Acceptable" or higher. Only one unit commander rated this item as "Borderline."

When asked in an open-ended question whether the CCD was more useful in an offensive or defensive operation, 56% on the unit commanders said it was equally useful in both situations. Twenty-five percent said the CCD was more useful in offensive operations because of the navigational capabilities and the ability to locate friendly units. Approximately 19% of the unit commanders said the CCD was more useful to them in defensive operations. Reasons given were that more time was available to plan in defensive operations, and that in a real tank they would spend more time outside of the hatch during offensive operations and therefore would not have the ability to use the CCD in its present location.

Unit commanders were also asked whether they were more likely to use the CCD before or after contact with the enemy. Most unit commanders remarked that they were equally likely to use the CCD prior to and after contact but not during contact. For example, a company XO wrote that he was too busy fighting during contact to be a computer operator. However, no trend emerged comparing usage prior to contact versus usage after contact with the enemy.

Information collected by vehicle monitors on equipment usage during this evaluation illustrate the amount of time users spend using the CCD and CITV as opposed to looking out the vision blocks or the GPSE. In the Baseline condition, commanders used the vision blocks approximately 84% of the time and the GPSE 16% of the time. In the CVCC condition, the commanders' attention shifted from the vision blocks (6% of time) and the GPSE (3% of time) to the CCD (60% of time) and the CITV (31% of time). It is evident that a large amount of visual attention is directed toward the CCD and CITV. More research is necessary to determine if appropriate amounts of visual attention are allocated to this equipment.

<u>The CITV</u>

This section contains the results of the CITV SMI Questionnaire and the equipment usage measures. The rating scale on the CITV SMI Questionnaire was identical to the scale used on the CCD SMI Questionnaire described earlier. A copy of the CITV questionnaire can be found in Appendix C. The data for the SMI CITV Questionnaire are presented in Table E-36.

The automated usage data in this section are organized by echelon levels of battalion and company. The usage measures for the CITV consisted of percent time in each CITV mode, number of times the CITV laser was used, and number of times Designate was used.

<u>Operating mode</u>. The usage measures show the percent of time the unit commanders stayed in the CITV modes (Manual Search mode, Autoscan mode, GLOS mode) versus the GPS mode (see Table E-33). In the GPS mode the CITV is not functional. In Manual Search mode, the commander controls the movement of the CITV with the control handle. If the handle is not moved then the view through the CITV does not change. In Autoscan mode, the commander sets a sector that he wants to scan and the CITV continuously scans that sector. The GLOS mode allows the commander to quickly slew the CITV to the main gun's location. Battalion commanders and S3s, on average, spent the most time in the GPS mode ($\bar{X}$ = 50%), followed by Manual Search mode ($\bar{X}$ = 37%) and Autoscan mode ($\bar{X}$ = 13%). Company commanders and XOs spent an equivalent amount of time in the Manual Search mode ($\bar{X}$ = 44%) and the GPS mode ($\bar{X}$ = 50%), followed by Autoscan mode ($\bar{X}$ = 6%). The GLOS mode was rarely used by any unit or vehicle commander. One company XO wrote that he preferred Manual Search because he had control of the sight and knew exactly where he was scanning.

<u>Identification Friend or Foe (IFF)</u>. The commanders were trained to use the IFF cautiously. Specifically, the commanders were told that if they identified a vehicle with the IFF function they should always verify the IFF in the GPSE or vision blocks. Although 50% of the commanders rated the IFF as "Somewhat Acceptable" or higher (see Table E-36), the written comments tended to be less positive. For example, several commanders remarked that the IFF was not very accurate and they would be hesitant to use it in the field (with its present reliability of 80% correct identification) because allies and enemies have some equipment in common. Another complaint about the IFF was that when it was needed the most (over 2000 meters) the reliability decreased.

<u>Designate</u>. Although unit commanders found this feature to be highly acceptable, usage measures (Table E-34) show they did

not use it very often ($\bar{X}$ = 1.17 times per battalion commander or S3, $\bar{X}$ = 1.42 per company commander or XO). One hundred percent of the unit commanders rated it either "Very Acceptable" or "Totally Acceptable." According to logs kept by vehicle monitors during the CVCC condition, the percent of firing done by the unit or vehicle commanders (as opposed to gunners) was less than one percent. These data suggest that the unit commanders were relying on the gunner to do the majority of target engagements.

Summary of the Findings

CCD. The SMI questionnaire ratings and comments revealed that unit commanders found most features of the CCD to be acceptable. In other words, most components of the CCD were easy to use, helped them perform their job, and were not confusing. The POSNAV capabilities of the CCD were especially well-accepted. Several unit commanders agreed that not only did it take less time to navigate, POSNAV gave them confidence because they were less likely to get lost. The CCD improved their ability to perform the task of commanding a company or battalion.

CITV. Most of the features on the CITV were rated as acceptable by the unit commanders. The IFF was one feature of the CITV that commanders were reluctant to use. On an overall rating of the CITV the ratings ranged from "Somewhat Acceptable" (6%) to "Very Acceptable" (69%) to "Totally Acceptable" (25%). In all, the CITV was considered to be a useful component by the vehicle and unit commanders.

Training Assessment

The quality of the Baseline and CVCC training can influence performance data if the participants do not attain the required skills to successfully use the equipment in the tactical scenarios presented. The training materials and techniques discussed in this subsection were conceptualized during the company evaluation as described in Atwood et al. (1991). The current training materials and methods are the result of several iterative evaluations involving testing and subsequent revisions. Standardization of the training techniques is emphasized during staff training and reinforced continually throughout Baseline and CVCC test weeks. Trainers use standard outlines, checklists, and guidelines to ensure consistency across individual trainers and across test weeks. The quality of the Baseline and CVCC training materials and the effectiveness of the current standardized training procedures are judged from analysis of various training instruments as well as training staff observations.

Due to the interim nature of this report, only data from the CVCC Vehicle Commander Training Evaluation Questionnaire are presented (see Appendix E for data tables). Data for Baseline unit and vehicle commanders, gunners, and drivers and for CVCC gunners and drivers are not presented. This subsection presents data suggesting potential trends in CVCC training which may be more fully explored in the SMI/Training report to be prepared at the conclusion of the battalion evaluation.

The CVCC version of the training questionnaire utilized two types of questions: a) items requiring ratings evaluating the quantity and clarity of different components of the training programs based on a 5-point scale with 1 at the low end (Poor) and 5 at the high end (Excellent), and b) open-ended questions requesting commanders' views on strengths, shortcomings, and potential improvements for the current CVCC training programs. There were sixteen commanders assigned to the CVCC condition, making the number of responses for each question equal to 16 except where otherwise noted.

Commanders based their training evaluation ratings on whether a specific training event prepared them to meet performance standards as derived from various assessment methods. First of all, CVCC participants completed CCD and CITV Skills Tests which provided the first opportunity for participants to rate their own performance using the CVCC equipment against the standards of completeness and effectiveness (i.e., training was received on all the functions and was effective enough to allow him to perform tested functions correctly). Before taking these tests, participants were told to consider their performance on the tests as indicators of how well the training on the individual components (e.g., the CCD classroom) had prepared them to complete the tasks.

After the skills tests were completed, criterion for preparedness was expanded from performance on isolated functions to the training opportunities provided by various training scenarios to facilitate the maximum transfer of skills to a tactical situation. Although the term "tactical situation" was left generic, the test scenario just completed provided participants with an opportunity to assess their own level of preparedness to use the CVCC equipment. Therefore, each participant rated whether the successive training scenarios provided unique and increasingly demanding and realistic opportunities to utilize the CCD and CITV in preparation for execution of a tactical situation like the one provided in the test scenario.

Individual Training

CVCC individual training included the M1 simulator hands-on training provided in Baseline but did not include the navigation training. CVCC individual training did include hands-on training on the components of the CVCC system, in particular the POSNAV components which provided equivalent navigation training to that in Baseline. Tables E-37 through E-41 contain data summarizing the CVCC unit and vehicle commanders' ratings of the instructor-led and hands-on simulator training provided on the CITV and the CCD, respectively.

The CVCC opening briefing was designed to provide participants with information on the history and operational concepts underlying the CVCC equipment. Table E-37 shows that 88% of the commanders felt that the instructor provided enough operational comments on the new equipment. One vehicle commander wrote that the classroom briefing should emphasize using the position of POSNAV icons relative to threat icons to reduce fratricide.

The quality of the CITV training in the classroom and hands-on forums was considered next. Table E-38 shows that 69% rated the components of the CITV classroom instruction as "Above Average" or "Excellent." Eighty-eight percent rated the CITV classroom instructor as "Above Average" or "Excellent" and rated his tactical examples as "Average" or better (n = 14 with 2 missing cases).

Table E-39 shows that the CITV hands-on training was more highly rated than the classroom training, with 94% of commanders rating the CITV hands-on as "Above Average" or "Excellent." Seventy-five percent felt their vehicle trainers' explanations of the equipment were "Above Average" or "Excellent." The CITV Skills Test was also received well, with 75% rating the test as "Above Average" or better.

In lieu of classroom instruction, the CCD training featured a demonstration of some of the more complex CCD functions in order to prepare the commanders for their hands-on session in the simulators. This CCD demonstration was shortened from forty-five minutes to thirty minutes based on comments from a previous evaluation (see O'Brien et al., 1992). Data for the CCD demonstration and CCD hands-on training are shown in Tables E-40 and E-41, respectively. The demonstration was well received by the group, with 81% rating the presentation as "Above Average" or "Excellent," and 94% rating the instructor as "Above Average" or "Excellent." Several wrote that the demonstration prepared them so well that they felt impatient with the repetition of information in the CCD hands-on training.

The unit and vehicle commanders rated the CCD hands-on training favorably as well, with 88% of the participants evenly divided between "Above Average" or "Excellent." Vehicle trainer explanations of the CCD received "Above Average" or "Excellent" ratings from 69% of the respondents. Many participants augmented their ratings with written suggestions on how the hands-on training could be improved. Some of the quicker learners expressed impatience with vehicle trainer adherence to the "explain and demonstrate" method of training. Commanders were concerned that this lock-step approach to training even the simplest CCD function was limiting their own hands-on time on the equipment. Although several received "No-gos" on some CCD skills test tasks, the test itself received no ratings of less than "Average," with 75% rating the test as "Above Average" or "Excellent."

The first of the two CVCC refresher training components, the CCD refresher demonstration, was designed to correct some equipment usage shortcomings noted by the vehicle trainers as well as to offer additional hints for optimizing the CCD features. Fifty-seven percent of the commanders felt that the CCD refresher demonstration was "Average," with the other 43% rating it as "Above Average" or "Excellent" (n = 14, 2 cases missing). Upon completion of the CCD refresher demonstration, they were asked to perform map manipulation and message processing exercises at their own pace, called "refresher tasks." Sixty-nine percent felt that the refresher tasks were "Above Average" or "Excellent."

Although much of the individual training for the CVCC condition concentrated on the CVCC equipment, hands-on training on the basic M1 tank simulator was provided as well. Table E-42 shows that basic simulator training was rated as "Above Average" or "Excellent" by 81% of the unit and vehicle commanders.

Tactical Training Exercises

Table E-43 presents the CVCC commanders' ratings on the tactical training exercises adequacy in preparing them to use the CITV in a tactical situation. Table E-44 presents similar data for the CCD. The mean ratings of the tactical training exercises increased incrementally from the lowest-rated crew-level exercise to the higher-rated battalion-level exercises. Fifty percent of the respondents considered the crew exercise to be "Above Average" or better in preparing them to use the CITV. A higher percentage, 63%, rated the crew exercise to be "Above Average" or "Excellent" for CCD preparation. Although a few felt that the crew exercise was too fast-paced, most managed to complete at least one navigation sandbox using the CVCC navigation features. They also used the CCD report functions and CITV scanning capabilities to acquire, engage, and report on multiple stationary gunnery targets. Seventy-five percent rated the company STX as "Above Average" or better for the CITV, and sixty-nine percent rated it "Above Average" or better for the CCD.

For the battalion level exercises, 75% of the commanders felt that the battalion STX offered an "Above Average" or better opportunity to use both the CITV and the CCD. Ratings were even higher for the battalion training scenario, with 88% giving "Above Average" or better ratings for CITV usage opportunities and 81% giving the same ratings for the CCD. Eighty-eight percent of the respondents (Table E-45) felt that the tactical scenarios provided "Above Average" or "Excellent" hands-on opportunities for both the CITV and CCD. The cumulative training resulted in unit and vehicle commanders who felt well-prepared for the battalion training scenario, with 81% giving preparation ratings of "Above Average" or "Excellent" as seen in Table E-46.

As Table E-47 shows, 69% of the CVCC vehicle commanders indicated that there were CITV and CCD functions that they did not use during the battalion training scenario. Some functions cited as not used were the CITV's Designate and Rate Set functions, and the CCD's hot icon, NBC, and SITREP report functions. Reasons for not using these CITV and CCD functions revolved around lack of time to use them (stated as a reason why Designate was not used), the responsibilities intrinsic to a particular duty position (e.g., battalion commanders seldom generate their own CFF reports), lack of an appropriate circumstance (an NBC event) or feeling that a function is unnecessary (e.g., forwarding logistics information in a SITREP when the CCD Logistics module sends it automatically).

None of the unit or vehicle commanders indicated that the CITV or CCD training had inadequately prepared them to use the omitted functions. However, they did offer several suggestions for improved CVCC training. The most common request was for more training on retrieving text FRAGOs from the OLD file. Another was a request that more extensive training be provided on the capability to lase and place report icons relative to POSNAV icons on the CCD map in order to reduce fratricide.

Training Objectives and Quality of Feedback

The clarity ratings for the CITV training objectives and during-training feedback are shown in Table E-48. Table E-49 shows the CCD clarity ratings. Eighty-eight percent of the commanders found the training objectives "Somewhat Clear" or "Very Clear" for the CITV. Ninety-four percent perceived the CCD training objectives as "Somewhat" or "Very Clear."

The vehicle trainer in each simulator was the primary provider of feedback during training scenario execution and kept a checklist to help monitor the crew's equipment usage; tactical feedback was not permitted. Sixty-three percent of the commanders felt that the CITV feedback during training was either "Somewhat Clear" or "Very Clear" with another 25% finding it "Neutral." Fifty-six percent felt that the CCD feedback during training scenarios was "Somewhat Clear" or "Very Clear" with another 31% finding the feedback "Neutral." It appears that a large factor in the variability of ratings for training scenario feedback was whether the participant was satisfied by the vehicle trainer's CVCC equipment-oriented feedback in lieu of tactical feedback. Another factor in the large number of "Neutral" responses may have been the limited opportunity for the vehicle trainer to provide the necessary feedback at the end of each scenario.

The issue of equipment-oriented versus tactical feedback was a factor in the debriefing ratings as well. Unit and vehicle commanders used the 5-point "quality" scale to rate the debriefings. The debriefing ratings are shown in Table E-50. Sixty-three percent considered the battalion STX debrief to be "Above Average" or "Excellent." When evaluating the battalion training scenario debrief, the ratings were a bit higher, with 75% finding the debrief "Above Average" or "Excellent." Accompanying comments were divided between those who wanted more feedback on their personal performance (i.e., as in a military AAR) and those who wanted no feedback on their personal performance and believed the emphasis should be solely on the test equipment.

SAFOR as a Training Tool

When asked about the potential contribution of SAFOR as a training tool, 100% of the commanders rated it "Average" or above (see Table E-51).

Suggestions for Fielded CVCC Equipment

When asked for suggestions on training the CVCC equipment if it were fielded, several unit and vehicle commanders focused on the requirement for adequate time to reach the proficiency level demanded for actual combat mission execution. They agreed that high standards would have to be placed on equipment usage. Others stressed that gunners should be cross-trained on the CVCC equipment in case they had to replace the vehicle commanders, and that frequent training opportunities would be the key to remaining proficient.

Summary of the Findings

The CVCC unit and vehicle commanders data favorably reflect CVCC training. Eighty-eight percent or more of the respondents rated their CCD and CITV hands-on training and tactical scenario usage opportunities as "Above Average" or "Excellent," with basic simulator training rated highly as well. Consequently, almost as high a percentage of commanders described their preparation for the battalion training scenario as "Above Average" or better. Potential improvements to the CVCC training program were identified (such as adding training on overlays containing text), but these data show that the current, much-piloted training materials and standardized training procedures effectively prepare the unit and vehicle commanders to use the basic simulator and CVCC equipment in a tactical test scenario.

Methodological Implications

An assessment of the evaluation's methodological limitations was performed to identify options for improving the experimental methodology. With enhancements for future research in mind, a "lessons learned" framework was used to develop suggestions for key methods and procedures. Where appropriate, suggestions have been provided in writing to the MWTB site manager.

Given the use of kill-suppress to protect manned simulators, it is important for a crew to know when their vehicle has sustained a killing hit. This would give them an immediate basis for modifying pertinent battlefield behavior. A clear feedback signal (visual and/or auditory) should be developed and implemented on the manned simulators.

The SAFOR constraints discussed in the Methodological Limitations subsection of the Method section are characteristic of current distributed interactive simulation technology. Improvements in SAFOR capabilities, to include more responsive and intelligent behavior, would materially enhance the simulation methodology. New SAFOR developments underway in the DIS program, such as the Modified SAFOR and Computer Generated Forces efforts, should help.

Limited processing capacity of the computer image generator hardware led to occasional loss of visual information available to the driver. In particular, when numerous vehicles were visible to a manned simulator, the vehicle images in the driver's vision blocks were prone to flash or disappear for a time. This adversely impacted his ability to drive, help acquire targets, etc. A hardware upgrade could obviate this problem and enhance the overall quality of the simulation.

The inability to place minefields and obstacles on the terrain database somewhat compromised the realism of the simulation environment. The ability to emplace minefields has been developed since finalization of evaluation procedures and could be employed in future research. Expanded engineer support capabilities should be developed to support obstacles and related features.

Time constraints in the testing schedule led to the use of maximum scenario execution time limits. As a result, both Baseline units exhausted the available time before they could complete Stage 3 of the test scenario. This meant that no Baseline data were available from Stage 3 for comparison with the CVCC units' performance. The lost opportunity to generate a larger database was unfortunate. To remedy this, future research could schedule additional time for test scenario execution or the test scenario(s) might be constructed to require less time for execution.

The flagging and recording of events by control staff observing a PVD did not afford the reliability desired. Competing tasks, distractions, and difficulty in interpreting on-line tactical events resulted in lost and unusable data elements. It may be possible to develop procedures for obtaining log-based data elements from DataLogger recordings, and efforts in this direction have been initiated at MWTB. This would greatly increase the reliability of the associated data.

In contrast with earlier CVCC evaluations, digital FRAGOs were implemented in the form of overlays with associated text, rather than free text reports. As such, FRAGOs were not classified by the DCA system as a type of report. This makes it very difficult to include FRAGOs in analyses of measures broken out by report type. Adjusting the analytical software to support convenient analyses across the full spectrum of report types would be worthwhile.

The Situational Assessment techniques used in this evaluation resulted in data interpretation problems, partly due to the failure of Baseline units to complete Stage 3 of the test scenario. This shortcoming was largely unanticipated during the planning of the evaluation. A concerted effort to systematically develop reliable instruments and procedures is needed. The development program should include iterative pilot testing and revision, along with validation against consensus criteria.

Resource limitations necessitated only partial monitoring of manned simulators during test exercises. This seriously limited the opportunities to obtain in-simulator observational data of crew performance. It would be helpful in future projects to ensure monitoring of every simulator during data collection. In addition, development of an electronic clipboard for convenient in-simulator use could significantly enhance observational recording capabilities.

Manual reduction of data was complicated in some cases by the difficulty in converting DataLogger time to real time. A recently developed MWTB capability to record real clock time as part of the data stream during recording of test events should resolve this problem in future research efforts.

The following measures under the Maneuver BOS require further development: range to OPFOR at displacement, exposure index, time to acquire target, time between lases to different targets, and time from lase to first fire. It is intended that these measures will be refined and included in the comprehensive database.

Problems in the implementation of elapsed time for fuel and ammo reports arose, preventing this Baseline measure from being properly analyzed. The battalion TOC requests for these reports were "flagged" and analyzed using the DCA system. The resulting reports were captured in playbacks of the radio traffic. Since DCA measures were adjusted for exercise breaks and start times, it was not possible to integrate these data. In future evaluations this measure should be implemented by "flags" for DCA analysis.

The communication network structures used by CVCC and Baseline groups in this test were not identical. The net structure for CVCC groups contained one level that could reach all manned elements instantaneously, resulting in a digital net structure that prevented meaningful comparison of communication throughput measures between the two groups. For example, when the CVCC TOC transmitted a FRAGO on the digital battalion command net, all vehicle commanders received the information at the same time. This led to the exhibited "instantaneous" report transmission times for CVCC throughput measures. However, when the Baseline TOC transmitted a FRAGO using the voice battalion command net, it had to be relayed on the company command net to the company XOs. Future evaluations should address this limitation by requiring the radio network configuration structure for Baseline and CVCC groups to be identical.

Many measures relating to communications effectiveness required transcription of voice radio transmissions during off-line exercise playbacks. This process proved to be very time-consuming. Failures of the playback system occurred frequently and required starting the run over at the beginning of the tape. System upgrades to prevent frequent failures would significantly reduce the time required for transcription playbacks. In the long run, perhaps voice recognition technology could be adapted to automate the process of converting spoken transmissions to a paper record.

It should be noted that many lessons learned from previous CVCC research efforts, especially the company-level evaluation (Leibrecht et al., 1992), were implemented in the current effort. These include:

1. Addition of a filtering mechanism for duplicate digital reports.

2. The capability to receive and relay integrated digital FRAGOs.

3. A logistics module which allows for automatic updating of resource status across echelons.

4. Addition of positions critical to armor operations, such as company XO, FSO, and S3, to the task organization of friendly forces.

5. More realistic timing of SAFOR reports.

6. Development and refinement of many performance measures.

7. Treatment of echelon as a primary variable where appropriate.

8. Adjustment of report measures for non-unique reports where appropriate.

Conclusions and Recommendations

In the previous section, operational effectiveness data were presented by BOS, followed by SMI and training data. Since the nature of the findings in this evaluation are preliminary due to limited sample sizes and variability of the data, it is difficult to draw clear conclusions for many measures. This section presents conclusions in terms of possible trends that may be confirmed in a complete battalion database. These data will be combined with subsequent data to form a larger battalion-level database, currently under development. Refer to the end of each "Results and Discussion" subsection for a more complete summary of the data. Suggestions for future research follow description of the conclusions.

Conclusions

CVCC units outperformed Baseline units by: inflicting more casualties on enemy forces and sustaining lighter casualties themselves (with CITV); allowing company commanders and XOs to prevent opposing forces from encroaching on their defensive positions; completing each stage more quickly (no Baseline group completed an entire test scenario); controlling their terrain more effectively; issuing more accurate CFFs and SPOT reports for at least one stage; spending less time communicating over the voice-radio networks; issuing fewer SITREPS and requests for FRAGO clarification; having greater opportunities to create reports during a counterattack; and helping commanders provide more accurate identification of enemy vehicle type.

Recommendations for Future Research

Changes in the combined arms battlefield, including advanced weapon systems and new threat contingencies, demand new C3 technologies such as CVCC. Research efforts to date have established clear advantages for the CVCC system (Du Bois & Smith, 1991; Du Bois & Smith, 1989; Leibrecht et al., 1992; Quinkert, 1990). The complete results of the battalion evaluation are expected to reinforce these advantages. At the same time, extensive research and development efforts are needed to support successful fielding and deployment of the CVCC system. Important remaining questions include:

1. How can the CVCC system be optimally implemented in a combined arms, vehicle-based environment? Future research should include an evaluation of CVCC technology in a combined arms environment possibly using M1, M2, M3, and Line-of-Sight/Anti-Tank (LOSAT) vehicles at different echelons.

2. What is the contribution of automated TOC capabilities to operational and tactical aspects of performance when the TOC is staffed by participants? Future efforts should assess on the training requirements of a participant-staffed TOC and evaluate its contributions.

3. What are the best SMI design and format features for the CVCC system? Before the CVCC system is fielded, direct comparison of system design features and formats for the CVCC system should be conducted.

4. What task-based requirements should drive future training development for the CVCC system? It is important to do a thorough analysis of tasks and skills from a component and system perspective before the CVCC system is fielded.

5. How can training be developed to maximize retention and transfer of training? CVCC efforts should assess the learning and retention functions associated with CVCC skill attainment. Transfer of training studies should be conducted to isolate areas where transfer of skills is problematic.

6. What is the best procedure for ensuring that manual skills are maintained once tasks become automated? Exploration of the amount and frequency of refresher training required for retention of manual skills replaced by automated functions (e.g., navigating with a paper map) should be conducted.

7. How can allocation of attention be influenced to minimize information overload and optimize performance? Future research should systematically address this question, beginning with a thorough analysis of task priorities from an information management and system design perspective.

Armed with answers to these and related questions, C3 on the future digitized battlefield should be enhanced dramatically. The resulting improvement in force effectiveness can be expected to yield substantial payoffs in future conflicts.

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APPENDIX A

TEST SCENARIO MATERIALS

Appendix A contains the following sections:

A-1	Friendly and Enemy Situation Graphics
A-2	Battalion OPORD 200
A-3	FRAGOs to OPORD 200
A-4	Battalion SOP (CVCC Version)

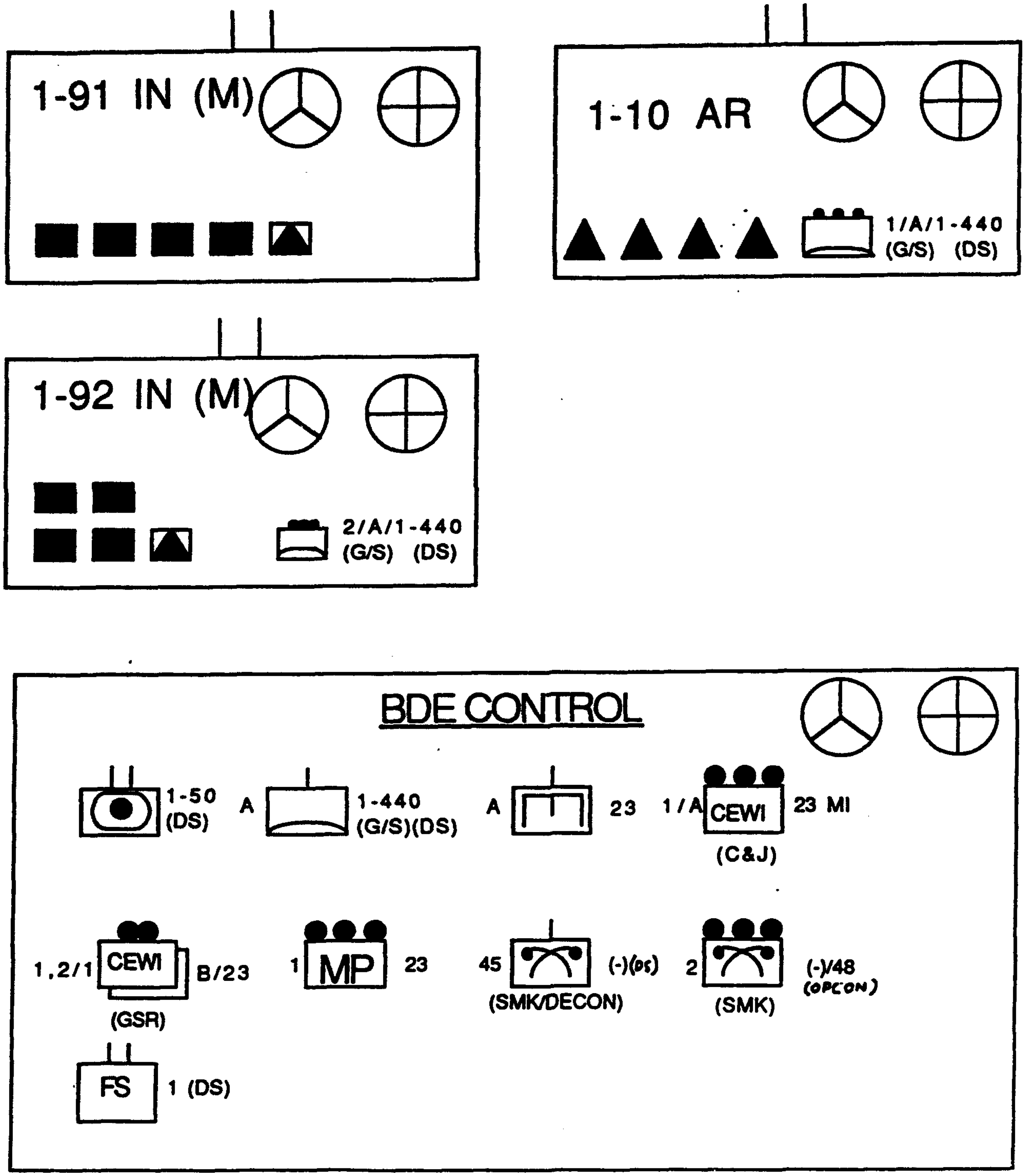
A-1

FRIENDLY AND ENEMY SITUATION GRAPHICS

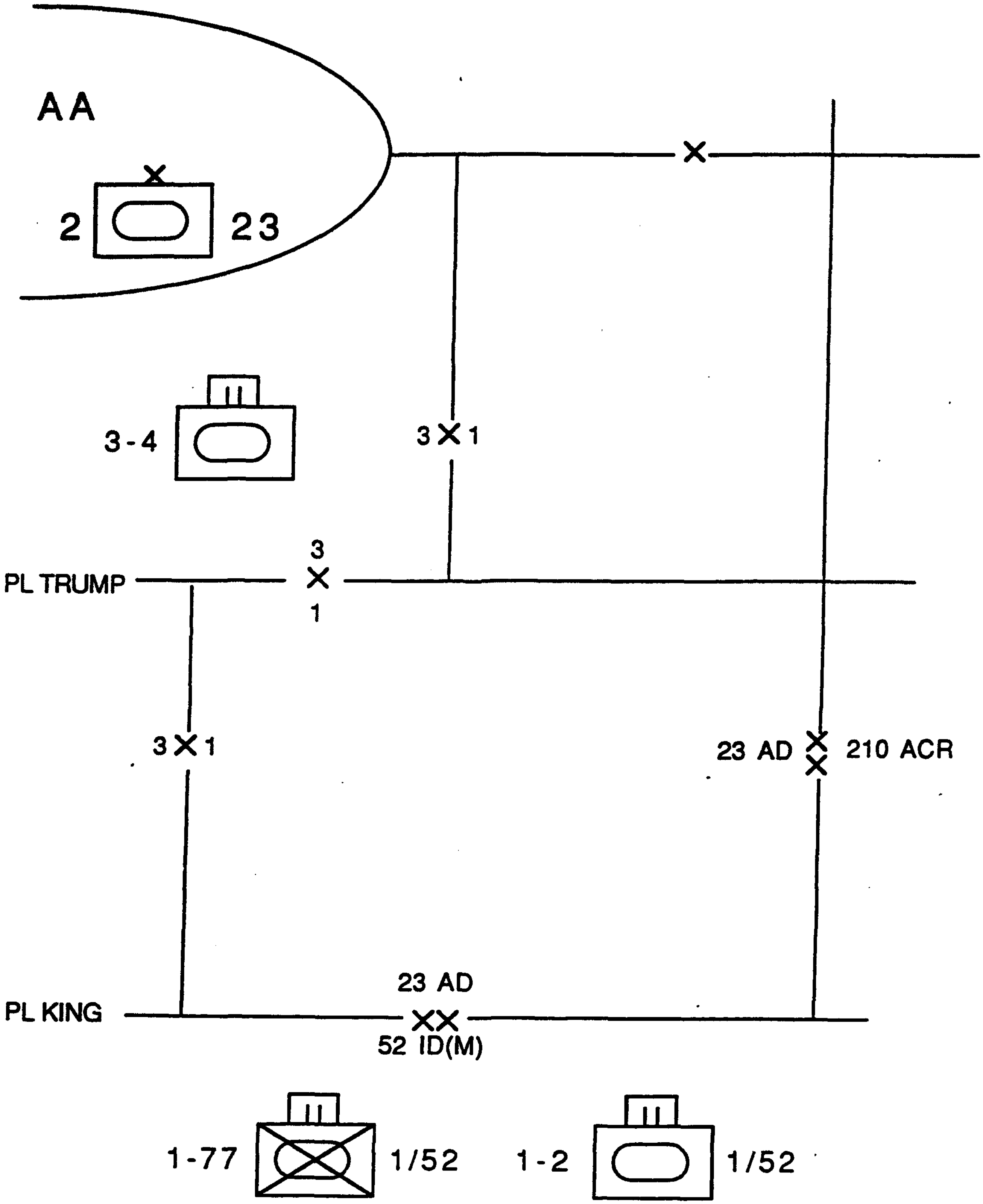
Section A-1 contains the following graphics:

Task Organization
Friendly Situation
8 CAA Deployment
39th GMRD Tactical Deployment

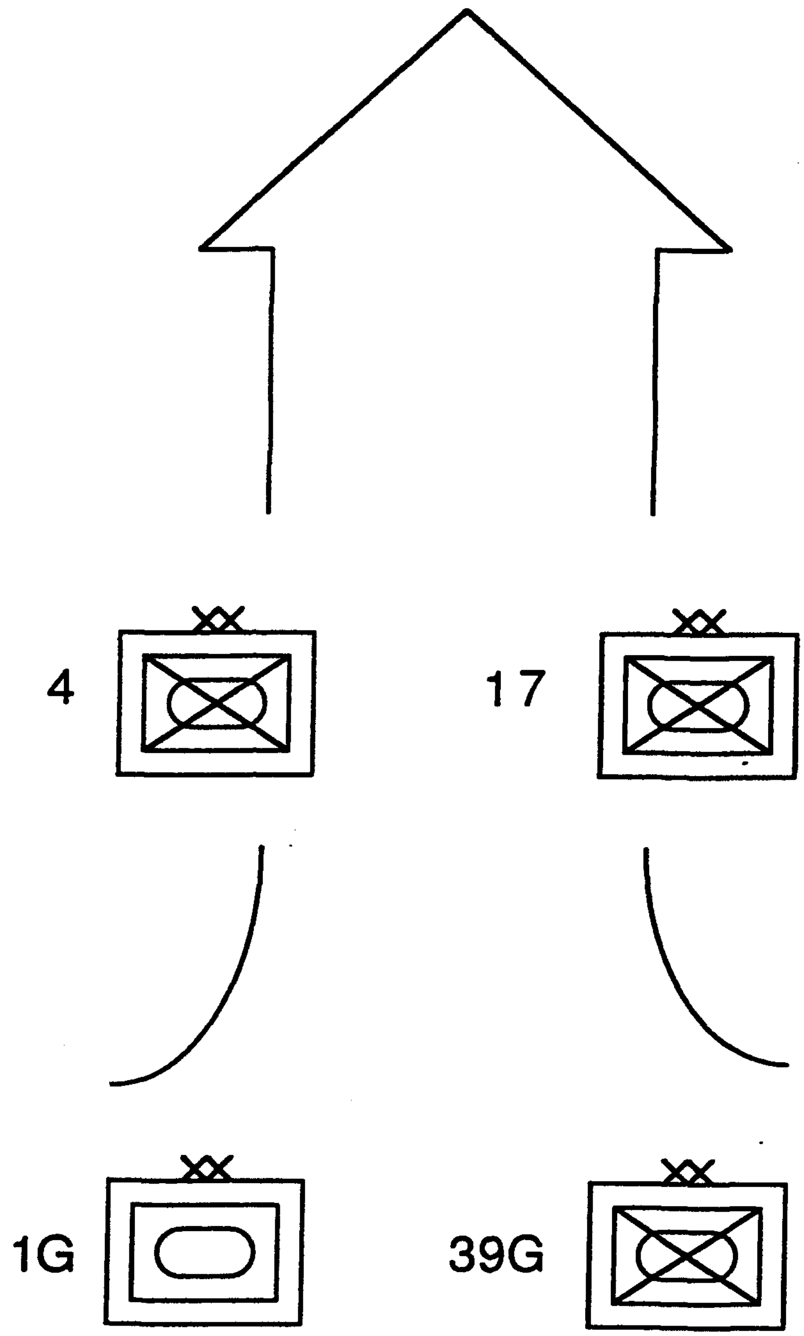
TASK ORGANIZATION



FRIENDLY SITUATION

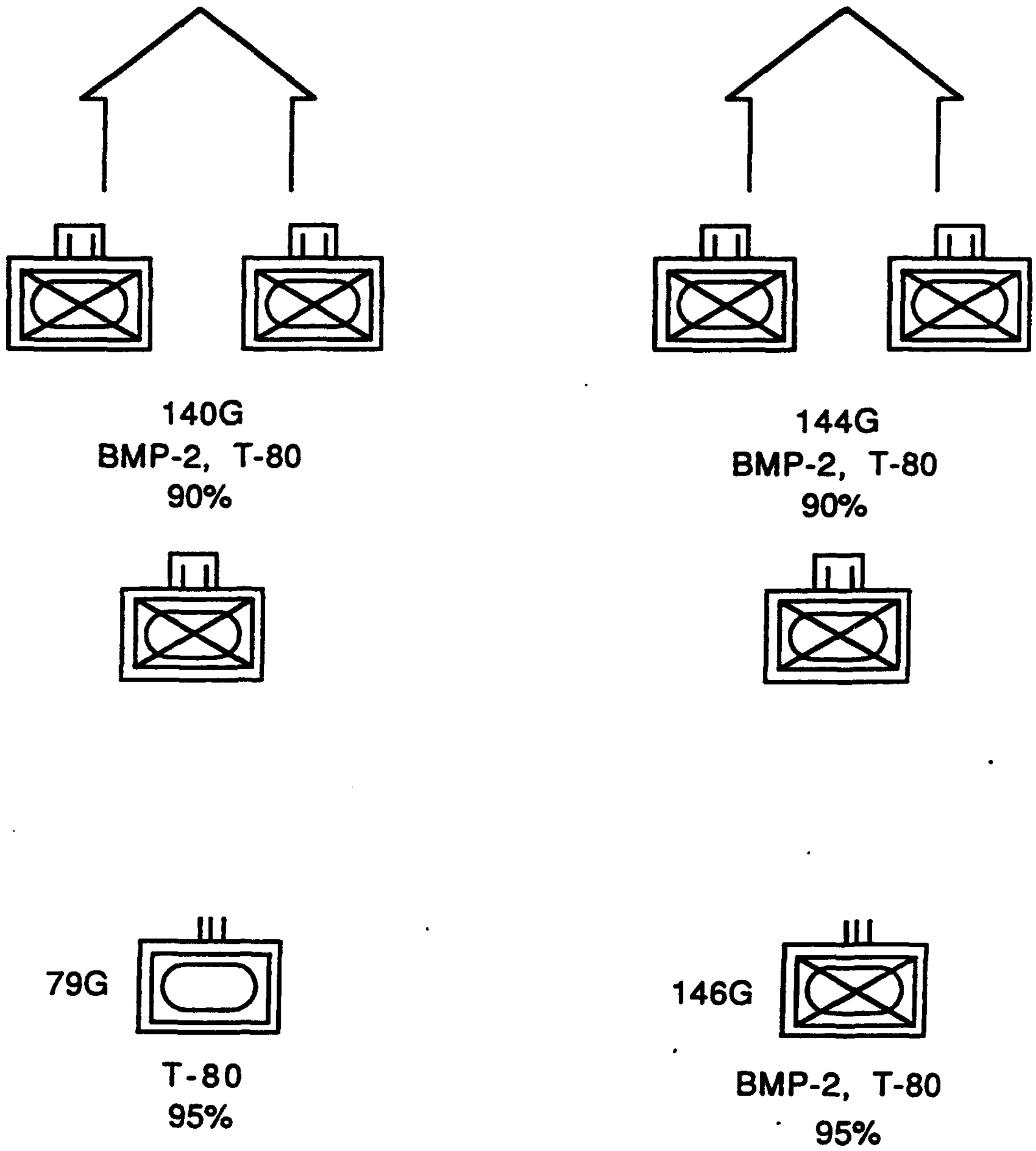


8 CAA DEPLOYMENT



39th GMRD

Tactical Deployment



A-2

Battalion OPORD 200

VERSION 3.2 (22 APR 92)

Copy 3 of 12 Copies
1-10 AR, 1ST Bde, 23 AD
ES866925
__0530R ___ 9_

OPORD 200

Reference: Map Series V753, V751 Kentucky - Indiana, Sheets M3753 I, II, III, IV; M3760 II, III Edition 1-AMS, 1:50,000.

Time Zone Used Throughout Order: ROMEO

Task Organization:

A Co, 1-10 AR

B Co, 1-10 AR

C Co, 1-10 AR

D Co, 1-10 AR

Bn Control
Scout Plt
Hvy Mort Plt
1/A/1-440 ADA (V/S) (DS)

Bn Trains
MST/B/1 FSB

1. SITUATION

a. Enemy Forces. Annex A (Intelligence Overlay)

(1) Overview. The 17th MRD has been attacking for the last 24 hours from SE to NW along the Elizabethtown-Brandenburg axis. The 1st Bde, 52 ID(M) has stopped the 17th MRD, just south of Elizabethtown, and forced the commitment of the second echelon division, the 39th GMRD. The 39th GMRD has forced the withdrawal of the 1st Bde, 52 ID(M). The 39th GMRD is currently pursuing the 1st Bde, 52d ID(M). In our sector, we will most likely face elements of the 144th GMRR, and possibly the 140th GMRR, of the 39th GMRD.

(2) Composition and Disposition. The 39th GMRD is equipped with the BMP-2 and T-80. The 144th GMRR is to our front, and the 140th GMRR is to our right. The 146th GMRR is the second echelon regiment behind the 144th GMRR. The 79th GTR is the second echelon regiment behind the 140th GMRR. The 144th GMRR consists of three MRBs and one tank battalion. The MRBs will fight as task organized reinforced MRBs, according to standard threat doctrine. The 144th GMRR is currently located vic ES950580-FS020600 and is estimated at 90% strength.

(3) Most Probable Course of Action. The 144th GMRR will continue to attack NW along the Elizabethtown-Brandenburg axis and attempt to seize crossing sites over the Ohio River vic ET 730070. The enemy main effort will most likely be the right portion of our sector, west of the Otter Creek corridor. The most likely formation is two (2) MRBs (+) up and one (1) back. Each MRB can be expected to approach with two (2) MRCs (+)

forward and one (1) back. All rivers in our sector are fordable and the terrain offers good cross country mobility.

b. Friendly Forces.

(1) (Higher) 1st Bde 23 AD accepts battle handover from and assists with the rearward passage of lines of 1st Bde, 52 ID (M) NLT __0950R ___ 9_. 1st Bde delays in sector from - __0950R to __1350R ___ 9_ to destroy the first echelon regiments of the 39th GMRD forward of PL TRUMP. The Brigade commander's intent is to hit the enemy hard at PL KING, disrupt his pursuit, and destroy the leading companies of the lead regiments. He intends to continue the delay in depth, continuing to attrite the enemy, to force the commitment of the second echelon regiments north of PL TRUMP.

(2) (L) 210 ACR delays in sector on the Corps eastern flank.

(3) (R) 1-92 IN (M) accepts battle handover from and assists the rearward passage of lines of TF 1-77, then delays in sector from __0950R ___ 9_ to __1350R ___ 9_ to destroy the 140th GMRR south of PL TRUMP.

(4) (Front) TF 1-2, 1st Bde, 52 IN (M) conducts a withdrawal and battle handover at PL King and executes a rearward passage of lines through 1-10 AR NLT __0950R ___ 9_.

(5) 1-91 IN (M) (Bde Reserve) prepares defensive positions vic PL TRUMP NLT __0950R ___ 9_. O/O conducts counterattack south.

(6) 1-50 FA DS to 1st Bde.

(7) A/23d ENGR OPCON to 1st Bde, 23 AD.

(8) A/1-440 ADA DS to 1st Bde, 23 AD.

c. Attachments and Detachments. See Task Organization.

2. MISSION

1-10 AR accepts battle handover from, and assists in rearward passage of lines of TF 1-2 NLT __0950R ___ 9_ at PL KING. 1-10 AR delays in sector from __0950R to __1350R ___ 9_ to destroy the 144th GMRR south of PL TRUMP. O/O conducts rearward passage of lines through 1-91 IN (M).

3. EXECUTION

a. Concept of Operation. Annex B (Operations Overlay). My intent is to accept the battle from TF 1-2 at PL KING and destroy 4 reinforced motorized rifle companies at PL KING. We will then delay in sector, defending from successive company BPs, destroying the enemy without becoming decisively engaged, forcing the deployment of the 146th GMRR, the second echelon regiment following the 144th GMRR, prior to PL TRUMP.

(1) Maneuver. The battalion scouts will establish Contact Points 7, 9, 10, and 2 forward of PL KING and assist TF 1-2, 1st Bde, 52d IN (M) in their rearward passage of lines. My intent is to hit the enemy hard at PL KING, disrupt his pursuit, and destroy at least one company each in EAs STING, WHIP, and CHAIN. The 144th GMRR's main effort is expected to be in the right portion of our sector. A Co will probably be hit hardest due to its location on our right and because of the open terrain in its sector. We will fall back to BPs, vic PL JACK, in order to confirm his main effort. As we delay throughout the Bn sector, I plan to keep constant contact with the enemy unless we are forced to pull back to prevent a major penetration. I see few opportunities to shape the battlefield for a counterattack, but we must be ready to launch a limited counterattack if the enemy exposes a flank or appears vulnerable. We will prevent the 39th GMRD from penetrating PL TRUMP until after __1350R ___ 9_. I plan to accomplish this delay in three phases:

(a) Phase I. Cover the BHL with three Cos in BPs 10, 20, and 30, and position at least two platoons forward in each. Accept the battle handover from TF 1-2, and assist as they conduct a rearward passage of lines through our sector on Passage Lanes ELEPHANT, PONY, DOG, AND CAT. Scouts establish observation of enemy forces and follow TF 1-2 through the passage points, then consolidate and screen the left flank. Destroy the lead enemy companies in EAs STING, WHIP, and CHAIN. Displace if an enemy company closes to within 2000 m or when an enemy unit of company size or larger attempts to bypass one of our companies. A Co will probably delay to BP 13 first, overwatched by B Co. B Co will then delay to BP 23, overwatched by A Co and C Co. C Co will delay to BP 33 overwatched by B Co. Do not cross PL CLUB without permission.

(b) Phase II. Cos continue to defend on successive BPs in the battalion sector. Scouts establish Screen Line ONE along eastern boundary. Bn will be alert for enemy exposed flanks which would present opportunities for counterattack. I anticipate that A Co will be hard pressed on the right flank. As they delay to BP 11, D Co will stage in BP 42, then counterattack into the enemy's flank forward of BP 11. B and C Co will protect D Co's flank, then fall back to and defend from BPs 24 and 34, respectively. A Co will support the counterattack by fire from BP 11, then withdraw to BP 12, consolidate, and reconstitute the Bn reserve. D Co will consolidate on BP 11 after its counterattack. The timing on this limited counterattack is critical. We must anticipate the opportunity and have the forces in motion before it's too late.

(c) Phase III. Continue to attrite the enemy between PL SPADE and PL TRUMP. Be prepared to launch limited counterattacks if opportunities arise. We must force the commitment of the second echelon regiment, 146th GMRR prior to PL TRUMP. Scouts establish Screen Line TWO. Cos occupy BPs vic. PL TRUMP and defend to retain. O/O establish contact with 1-91 Mech scouts at designated Contact Points and conduct BHO and rearward passage of lines through 1-91 Mech on designated Passage Lanes. O/O move to assembly areas (TBD) to become the 1st Bde Reserve.

(2) Fires (Fire Support Overlay):

(a) 1-10 AR has priority of FA Fires within the Bde.

(b) Priority of Fires (FA): Phase I--Scouts, A Co, B Co, C Co, D Co; Phase II, III--A Co, B Co, C Co, D Co, Scouts.

(c) Priority of Fires (Mtrs): Phase I--Scouts, A Co, B Co, C Co, D Co; Phases II, III--A Co, B Co, C Co, D Co, Scouts.

(d) 1-10 AR has two FASCAM minefields available. FASCAM requires Bde Cdr's approval for use.

(3) Obstacles.

(a) Priority of Support: A Co, B Co, C Co, D Co.

(b) Priority of Effort: Countermobility, survivability, mobility.

b. A Co.

(1) Phase I: Defend BP 10. Provide guides for Passage Lane PONY. Engage enemy in EA STING.

(2) O/O delay thru BP 13 to BP 11. Be prepared to defend from BP 13.

(3) Phase II: On order, defend BP 11.

(4) O/O support D Co counterattack by fire.

(5) Phase III: On order, defend BP 12.

(6) On order, conduct rearward passage of lines on Passage Lanes BLUE and GREY.

c. B Co.

(1) Phase I: Defend BP 20. Provide guides for Passage Lane DOG. Engage enemy in EA WHIP.

(2) O/O delay though BP 23 to BP 24. Be prepared to defend from BP 24.

(3) Phase II: On order, defend BP 42.

(4) O/O delay to BP 21.

(5) Phase III: On order, defend BP 41.

(6) On order, conduct rearward passage of lines on Passage Lane YELLOW.

d. C Co.

(1) Phase I: Defend BP 30. Provide guides for Passage Lanes CAT and ELEPHANT. Engage enemy in EA CHAIN.

(2) O/O delay through BP 33 to BP 34. Be prepared to defend from BP 34.

(3) Phase II: On order, defend BP 31.

(4) Phase III: On order, defend BP 32.

(5) On order, conduct rearward passage of lines on Passage Lanes PURPLE and BLACK.

e. D Co.

(1) Phase I-III: Be prepared to reinforce A, B, or C Co sector once enemy's main effort is identified.

(2) Occupy BP 40 initially; be prepared to occupy BP 22.

(3) Be prepared to conduct counterattacks to maintain integrity of the Bn sector or when opportunities arise, with priority of planning for counterattack from BP 42 to relieve pressure on A Co, vic BP 11.

(4) Be prepared to occupy BP 22 and to conduct rearward passage of lines on Passage Lane ORANGE.

f. Scouts.

(1) Phase I: Establish Contact Points 7, 9, 10 and 2 NLT __0800R ___ 9_. Screen forward of PL KING. O/O, conduct rearward passage of lines on routes PONY, DOG, CAT, and ELEPHANT.

Consolidate at CP 10, then screen BN left flank from rear of C Co to PL CLUB.

(2) Phase II: Establish Screen Line ONE.

(3) Phase III: Establish Screen Line TWO.

g. Mortars.

(1) Phase I: Occupy initial Firing Point vic ES895810. Be prepared to operate split section to support Bn delay.

(2) Phase II-III: Move under control of Bn FSO. On order, coordinate own rearward passage of lines.

h. 1/A/1-440 ADA. Priority of protection: reserve and TOC.

i. Coordinating Instructions.

(1) PIR:

(a) Concentrations of ten or more tanks.

(b) Use of Chemical munitions.

(c) Use of airmobile opns.

(d) Report penetration of CO size or greater at all PLs.

(e) Report changes in enemy equipment, uniforms, formations, etc. which would indicate commitment of second echelon units.

(2) MOPP: Level 1 in effect NLT __0950R ___ 9_.

(3) OEG: 70 cGy Report 50 cGy.

(4) Air Defense Warning -- Yellow.

(5) Weapons Control Status -- Tight.

(6) Disengagement criteria: MRC close within 2000 m or when company size unit attempts to bypass your position.

(7) Other Reporting Requirements.

(a) Report BH complete.

(b) Report initial enemy contact.

(c) Report crossing PLs.

(d) Report Passage of Lines complete.

(8) Recognition symbol for rearward passage of lines is orange panel marker front of vehicle during the day -- red flashlight at night.

4. SERVICE SUPPORT. Annex E (Service Support). (Omitted)

5. COMMAND AND SIGNAL.

a. Command.

(1) Succession of Command: SOP.

(2) Cmd Group will be to rear of B Co.

(3) Bn TOC initial location ES866925, subsequent location ES851947.

(4) Alternate Bn CP is Combat Trains CP.

(5) Brigade Main CP located vic ET872023.

(6) Brigade TAC located vic ES877947.

(7) Brigade alternate CP is Bde Tns ET785227.

b. Signal.

(1) SOI index ALPHA in effect.

(2) Radio listening silence in effect __0930R ___ 9_ until first contact is reported or passage of lines completed.

ACKNOWLEDGE:

OFFICIAL:

PATTON
Cdr

HASZARD
S3

Annexes: A--Intelligence
B--Operations Overlay
E--Service Support (Omitted)

Copy ___of ___Copies
1-10 AR, 1st Bde, 23 AD
ES866925
__0530R ___ 9_

VERSION 3.1 (22 APR 92)

ANNEX A (INTELLIGENCE) TO OPORD 200

REFERENCE: Map Series V753, V751 Kentucky - Indiana, Sheets M3753 I, II, III, IV; M3760 II, III Edition 1-AMS, 1:50,000.

Time Zone Used Throughout Order: ROMEO

1. GENERAL. (See Appendix 1, Enemy Situation Overlay)

a. Enemy Situation

(1) Location. The first echelon divisions of the 8th CAA have been stopped by the 52d IN (M). The 1st GTD and the 39th GMRD, second echelon divisions of the 8th CAA, were committed at 0200 hrs this morning to continue the attack northwest along the Elizabethtown to Brandenburg axis. The 1st Bde faces the 39th GMRD, which is currently moving north vic. ES850580 to FS020600.

(2) Strength. The 1st echelon regiments of the 39th GMRD consist of the 140th GMRR, on our right, and the 144th GMRR to our front. These regiments are estimated at 90% strength. The second echelon regiments, the 79th GTR following the 140th GMRR, and the 146th GMRR following the 144th GMRR, are estimated at 95% strength.

b. Enemy Capabilities. The enemy is expected to advance into the 1st Bde sector NET __1000R ___ 9_. They can attack in the brigade sector with 2 MRRs followed by a second echelon, consisting of 1 MRR and 1 TR. The MRRs are equipped with BMP-2s and T-80s. There are unconfirmed reports that the 79th GTR has been upgraded to T-80 Us. Use of chemical agents is anticipated.

c. Most Probable Course of Action. The 144th GMRR will continue to attack NW along the Elizabethown-Brandenburg axis with 2 MRBs (+) in the first echelon followed by 1 MRB (+) in the second. The regimental tank battalion has been split up to provide tanks to each MRB. Each MRB will consist of three (3) MRCs with four (4) tanks each. These MRBs will also probably attack two (2) up and one (1) back. The enemy main effort will most likely be the right portion of our sector, west of Otter Creek. The first echelon MRBs will attack along Avenues of approach A1 and A2 to seize Bn immediate objectives vic ES860830 and ES930855. Expect the second echelon MRB to be committed at this point along A1 and continue north-northeast to seize the MRR immediate objective vic ES810920 to ES875955. Expect the RAG to support the initial attack from vic ES9174. Significant Bn-size flank AA from the east are: B1--ES9683; B2--ES9294. From the west, two Bn size AA are significant: C1--ES8579 and C3--ES8288, respectively.

2. PRIORITY INFORMATION REQUIREMENTS (PIR)

a. Para 3,i,(1), OPORD 200.

b. Has the 2d echelon MRB been committed to AA A1 (NAI 30, 31, 32, 33, and 34.)?

c. Where has the RAG been positioned (NAI 30)?

d. Is the enemy attempting to attack the Bn flanks (NAI 20, 21, 22, and 23)?

e. Will the enemy conduct airmobile operations (NAI 36 and 45)?

f. Is the enemy headed toward Brandenburg (NAI 33, 34, 35, 42, 43)?

g. Is the enemy in MOPP 3 or 4?

h. Is the enemy using new formations or equipment, such as the T-80U?

3. INTELLIGENCE ACQUISITION TASKS.

a. Subordinate and Attached Units.

(1) A Co. Size, composition, and direction of enemy. (NAI 20, 21, 30, 31, 32, 33, 34, 35, and 36).

(2) B Co. Size, composition, and direction of enemy. (NAI 30, 31, 32, 34, 35, 40, 41, 42, 43, and 45.)

(3) C Co. Size, composition, and direction of enemy. (NAI 22, 23, 40, 41, 42, 44, and 45).

(4) Scouts. Size, composition, and direction of enemy. (Initial--NAI 30, and 40; subsequent--NAI 22 and 23).

(5) GSR. Initial--NAI 30, 31, 40, and 41.

b. Higher and Adjacent.

(1) 1st Bde. (1-92 IN (M)). Size, composition, and direction of enemy. (NAI 20 and 21).

(2) 1st Bde, (210 ACR). Size, composition, and direction of enemy. (NAI 22 and 23).

4. MEASURES FOR HANDLING PERSONNEL DOCUMENTS AND MATERIAL. SOP.

5. DOCUMENTS AND EQUIPMENT REQUIRED. Omitted.

6. COUNTERINTELLIGENCE. Omitted.

7. REPORTS AND DISTRIBUTION. SOP.

8. MISCELLANEOUS INSTRUCTIONS. Omitted.

APPENDICES:

1 -- Enemy Situation Overlay
2 -- NAI/TAI

Copy ___of ___Copies
1-10 AR, 1st Bde, 23 AD
ES933776
__0530R ___ 9_

VERSION 3.0 (23 APR 92)

APPENDIX 2 (NAI/TAI) TO ANNEX A (INTELLIGENCE) TO OPORD 200

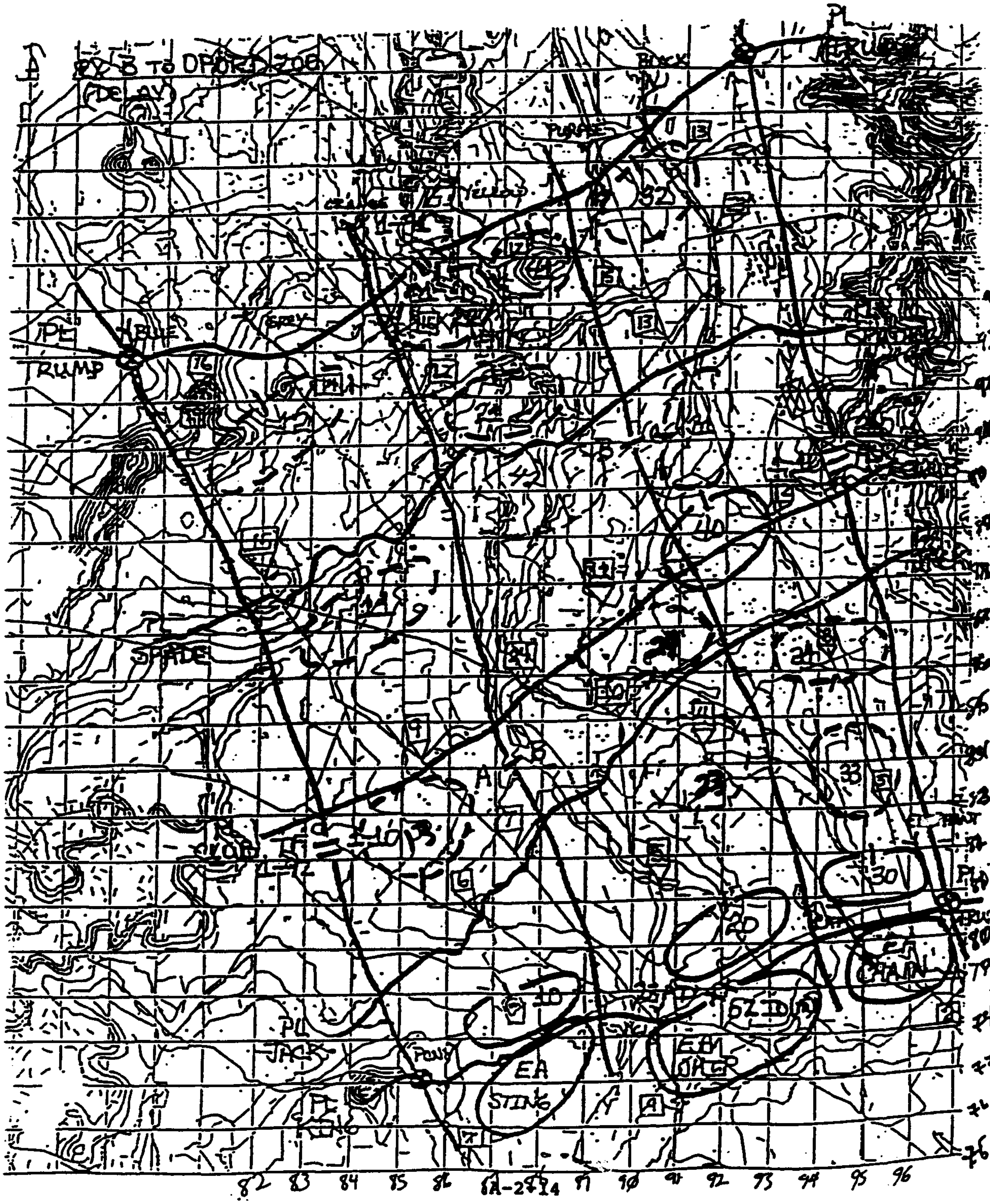
REFERENCE: Map Series V753, V751 Kentucky - Indiana, Sheets M3753 I, II, III, IV; M3760 II, III Edition 1-AMS, 1:50,000.

Time Zone Used Throughout Order: ROMEO

1. NAI/TAI Information tasks.

NAI/TAI	Unit	Information
20	1-92 IN (M)	Is enemy attacking flank? Size, composition, direction?
21	1-92 IN (M)	Is enemy attacking flank? Size, composition, direction?
22	210st ACR Scouts	Is enemy attacking flank? Size, composition, direction?
23	210st ACR Scouts	Is enemy attacking flank? Size, composition, direction?
30	Co A, B Scouts Div Arty GSR	Where is RAG? Has 2d echelon MRB been committed? Size, composition, direction?
31	Co A, B GSR	Has 2d echelon MRB been committed? Size, composition, direction?
32	Co A, B	Has 2d echelon MRB been committed? Size, composition, direction?
33	Co A	Has 2d echelon MRB been committed? Is enemy headed toward Brandenburg? Size, composition, direction?
34	Co A, B	Has 2d echelon MRB been committed? Is enemy headed toward Brandenburg? Sized, composition, direction?
35	Co A, B	Is enemy headed toward Brandenburg? Size, composition, direction?

36	Co A	Will enemy conduct airmobile opns? Size, composition, direction?
40	Co B, C Scouts GSR	Size, composition, direction?
41	Co B, C GSR	Size, composition, direction?
42	Co B, C	Is enemy headed toward Brandenburg? Size, composition, direction?
43	Co B	Is enemy headed toward Brandenburg? Size, composition, direction?
44	Co C	Size, composition, direction?
45	Co B, C	Will enemy conduct airmobile opns? Size, composition, direction?


TO OPORD 206
DELAY
PL
TRUMP
SPADE
PL
JACK
EA
STING
EA
CHAIN

Copy ___of ___Copies
1ST BDE, 23 AD
ES877947
__1024R OCT 04

VERSION 3.1 (22 APR 92)

FRAGO 1 to OPORD 20

Reference: No Change
Task Organization: No Change

1. SITUATION

39TH GMRD shifting course from N to NW through the 1-92 IN (M) sector. Enemy right flank is exposed and vulnerable to counterattack.

2. MISSION

On order, 1st Bde counterattacks in sector to destroy the 144th GMRR and force the deployment of 2d echelon regiments of the 39th GMRD.

3. EXECUTION

a. 1-10 AR (main effort).

(1) Counterattack on order, from BPs vicinity PL SPADE, along Axis Stingray to seize OBJ Ice (ES855826).

(2) Attack by fire into EA SHARK to destroy remnants of 144th and to prevent envelopment of 1-92 IN (M).

(3) Be prepared to withdraw to original sector if 2d echelon regiments are committed.

b. 1-92 IN (M).

(1) Establish a hasty defense vic PL CLUB and PL QUEEN to fix the enemy in support of 1-10 AR's counterattack.

(2) O/O, lift and shift fires south.

c. 1-91 IN (M).

(1) Follow 1-10 AR as Bde Reserve.

(2) O/O, counterattack thru 1-10 AR into EA SHARK (main effort, O/O).

d. Coordinating Instructions.

(1) PL QUEEN (PLD) effective on implementation. PLD may be adjusted based on progress of 1-10 AR delay in sector.

(2) Boundary change between 1-92 and 1-10 effective on implementation of this FRAGO. Bde (Div) eastern boundary change effective when elements of 1-10 are clear of proposed 210 ACR sector.

(3) Earliest time of implementation: _______ (40 min from issuance).

4. SERVICE SUPPORT. No Change.

5. COMMAND AND CONTROL

Bde Cdr currently located with 1-10 AR vic ES851947.

ACKNOWLEDGE:

OFFICIAL:

KNOX
Cdr

TANK
S3

A-3

FRAGOs to OPORD 200

Section A-3 contains the following FRAGOs:

FRAGO 1 to OPORD 200
FRAGO 2 to OPORD 200

Copy ___of ___Copies
1-10 AR, 1ST Bde, 23 AD
ES866925
__~~1049~~R ___ 9_
1105

VERSION 3.1 (22 APR 92)

FRAGO 1 TO OPORD 200

Reference: No Change
Task Organization: No Change

1. SITUATION

a. 144th GMRR shifting course from N to NW through the 1-92 IN (M) sector. Enemy right flank is exposed and vulnerable to a counterattack.

b. 1ST BDE counterattacks in sector to destroy the 144th GMRR and force the deployment of 2d echelon regiments of the 39th GMRD.

c. 1-92 IN (M) establishes hasty defenses vic PL CLUB and QUEEN to fix the enemy in sector.

d. 1-91 IN (M) follows 1-10 AR as Bde Reserve. O/O counterattacks through 1-10 AR.

2. MISSION

1-10 AR counterattacks at ____________ (execute time specified by ECR) from current positions along Axis Stingray to seize OBJ ICE (ES855826), attacks by fire into EA SHARK (ES845810) to destroy the 144th GMRR.

3. EXECUTION

a. Concept (see overlay): 1-10 AR counterattacks with three Cos abreast, from left to right: C Co, B Co, and A Co. Counterattack should engage the 144th's 2nd Ech MRB its right flank. Be prepared to withdraw to original sector when 2d echelon regiments are committed.

b. A Co: counterattack along AXIS BETTY to seize OBJ RAIN (ES835835). Orient from TRP 01 to TRP 02.

c. B Co counterattack along AXIS PAM to seize OBJ SNOW (ES854824). Orient from TRP 02 to 03.

d. C Co counterattack along AXIS LIZ to seize OBJ FOG (ES871814). Orient from TRP 03 to 04.

e. D Co support by fire from BP 11. Prepare to reinforce, in priority, B Co, A Co, and C Co.

FRAGO 1 TO OPORD 200 (23 APR 92) (BASELINE--ORAL FRAGO)

NOTE: To be read orally on Bn Command net, per events schedule. Where used, "X" refers to the time this FRAGO is transmitted.

"GUIDONS, THIS IS YANKEE THREE-THREE, ORDERS, OVER."

NOTE: All subordinates respond.

"FRAGO: ENEMY ATTACK SHIFTING TO NORTH WEST; VULNERABLE TO FLANK ATTACK."

"NOVEMBER COUNTERATTACKS TO DESTROY THE 144TH AND FORCE DEPLOYMENT OF 39TH 2ND ECHELON."

"MIKE DEFENDS TO OUR RIGHT."

"YANKEE COUNTERATTACKS AT __________ (time specified by ECR) ALONG AXIS STINGRAY TO SEIZE OBJ ICE (ES855826); ATTACKS BY FIRE INTO SHARK (ES832823-855811-835788-812802) TO DESTROY 144th AND TO FORCE DEPLOYMENT OF SECOND ECHELON REGIMENTS."

"YANKEE ATTACKS WITH THREE COMPANIES ABREAST: FROM LEFT TO RIGHT: CHARLIE, BRAVO ALPHA."

"ALPHA: ATTACK ALONG AXIS BETTY (from BP 12 - ES860890 - 860870) TO SEIZE OBJECTIVE RAIN (ES835835). ORIENT SW."

"BRAVO: MAIN EFFORT--ATTACK ALONG AXIS PAM (from BP 24) TO SEIZE OBJECTIVE SNOW (ES854824): ORIENT SW."

"CHARLIE: ATTACK ALONG AXIS LIZ (from BP 34) TO SEIZE OBJECTIVE FOG (ES871814): ORIENT SW."

"DELTA: SUPPORT BY FIRE FROM ONE-ONE; STAND BY TO REINFORCE BRAVO, ALPHA OR CHARLIE IN THAT ORDER."

"SIERRA: SCREEN LEFT FLANK-MAINTAIN FLANK CONTACT."

"KILO: FOLLOW BRAVO."

"BRAVO BLITZ WHEN ALPHA CROSSES SPADE. ALPHA AND CHARLIE KEY ON BRAVO; REMAIN ON LINE."

"WESTERN BOUNDARY CHANGE EFFECTIVE NOW: ES 745920-829840-799753. EASTERN BOUNDARY EFFECTIVE WHEN SCOUTS CLEAR 210'S NEW SECTOR: BOUNDARY IS ES921982-925901-901779."

"OTHER GRAPHICS EFFECTIVE NOW:

"PL QUEEN: ES834864-850870-886876-924892."
"LINE OF DEPARTURE: NW-SE RUNNING ROAD VIC ES850870-870860-910847-953825."

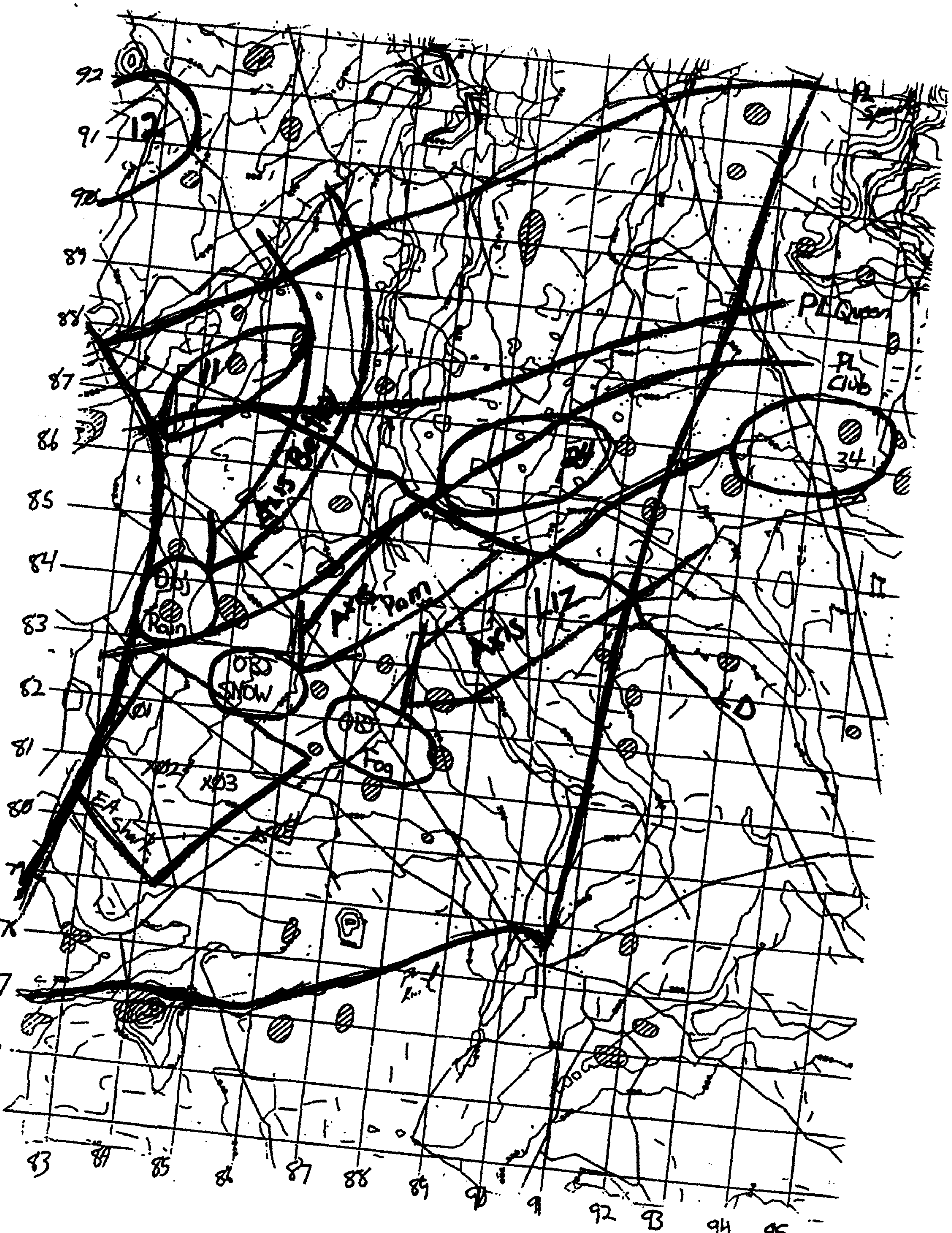
"REPORT REDCON ONE. ACKNOWLEDGE, OVER."

NOTE: All subordinate units respond. If necessary, transmit added graphics.

FRAGO 1 to OPORD 200 (7 JUL 92) (CVCC-Digital FRAGO)

FROM: Y33
TO: Bn Cmd Net

FRAGO 1-200
~~Ref: xxxxxxxx~~
SITUATION
Enemy attack shifting to NW, flank exposed.
Friendly -1st Bde CATKs to destroy 144th, force 39th GMRD to commit 2d Ech.
1-92 def on bn R.
1-91 (Bde Res) O/O CATKs thru 1-10.
MISSION -1-10 CATKs at ____R to seize ICE, fires into SHARK to kill 144th.
O/O delays 2d ech MRR.
EXECUTION
D spt/fire from BP11, prep reinf B,A,C.
Coordination -Atk on line, key on B. O/L eff now. 210 Bdy eff when 1-10 clears sector.
END



12
11
PL Queen
PL Club
34
OBJ Rain
OBJ SNOW
OBJ Fog
EA Shark
LIZ
X03
LD

Copy ___of ___Copies
1-10 AR, 1ST Bde, 23 AD
ES866925
__1310R ___ 9_

VERSION 3.2 (22 APR 92)

FRAGO 2 TO OPORD 200

Reference: No Change
Task Organization: No Change

1. SITUATION

a. Enemy. 2d echelon regiments of the 39 GMRD are moving NW into the Bde sector. ETA: ____ (20 minutes from time of FRAGO publication).

b. 1ST BDE defends along PL ACE to delay the enemy in sector S of PL TRUMP until ____ (approx 2 hrs).

c. 1-92 IN (M) delays in sector on our right flank.

d. 1-91 IN (M) Bde Reserve, reoccupies positions at PL TRUMP, to our rear.

2. MISSION

a. 1-10 AR defends at ____________ (time specified by ECR) along PL ACE (83 E-W grid line). On order, delays enemy S. of PL TRUMP until ____ (approx 2 hrs).

3. EXECUTION

a. Concept (see overlay). 1-10 AR defends from BPs along PL ACE with three Cos abreast; from left to right, C Co, B Co, and A Co. D Co occupies a BP to the rear as Bn reserve. On order, Bn delays in sector.

b. A Co: defend from BP 25; orient toward TRP AQ30. On order, displace to subsequent BPs 11 and 12.

c. B Co: defend from BP 45; orient toward TRP AR30. On order, displace to subsequent BPs 46, 21, and 22.

d. C Co: defend from BP 35; orient toward TRP AT30. On order, displace to subsequent BPs 26, 31, and 32.

e. D Co: occupy BP 46. Prepare to reinforce, in priority, B Co, A Co, and C Co. On order, displace to BP 41.

f. Mortars: locate to rear of B Co.

g. Scouts: screen eastern flank.

h. Companies report when "set" in BPs.

4. SERVICE SUPPORT. No Change.

5. COMMAND AND CONTROL

Bn Cdr will locate to rear of B Co vic BP 45.

ACKNOWLEDGE:

OFFICIAL:

PATTON
Cdr

HASZARD
S3

FRAGO 2 Overlay

(FOR TRAINING ONLY)

FRAGO 2 TO OPORD 200 (23 APR 92) (BASELINE--ORAL FRAGO)

NOTE: To be read orally on Bn Command net, per events schedule. Where used, "X" refers to the time this FRAGO is transmitted.

"GUIDONS, THIS IS YANKEE THREE-THREE, ORDERS, OVER."

NOTE: All subordinates respond.

"FRAGO: SECOND ECHELON MRR IS APPROACHING BN SECTOR FROM SOUTH EAST, ETA: 20 MINUTES."

"NOVEMBER RESUMES DELAY AT PL ACE. BDE DISPOSITION PER ORIGINAL ORDER."

"YANKEE DEFENDS ~~FROM~~ AT ________ (time specified by ECR) ALONG PL ACE (83 E-W gridline), DELAYS ENEMY S OF PL TRUMP FOR ANOTHER TWO HOURS."

"ALPHA: DEFEND FROM BP 25 (ES840840) ORIENT SOUTH. DELAY THRU BPs 11 THEN 12."

"BRAVO: DEFEND FROM BP 45 (ES867840) ORIENT SOUTH. DELAY THRU BPs 46 THEN 21, THEN 22."

"CHARLIE: DEFEND FROM BP 35 (ES896840) ORIENT SOUTH. DELAY THRU BP 36 THREE-SIX (ES902870) THEN BPs 31 AND 32."

"DELTA: OCCUPY BP 46 (ES873875). BE PREPARED TO REINFORCE BRAVO, ALPHA OR CHARLIE IN THAT ORDER. BLITZ TO BP 41 ON ORDER."

"KILO SUPPORT FROM CENTER OF SECTOR."

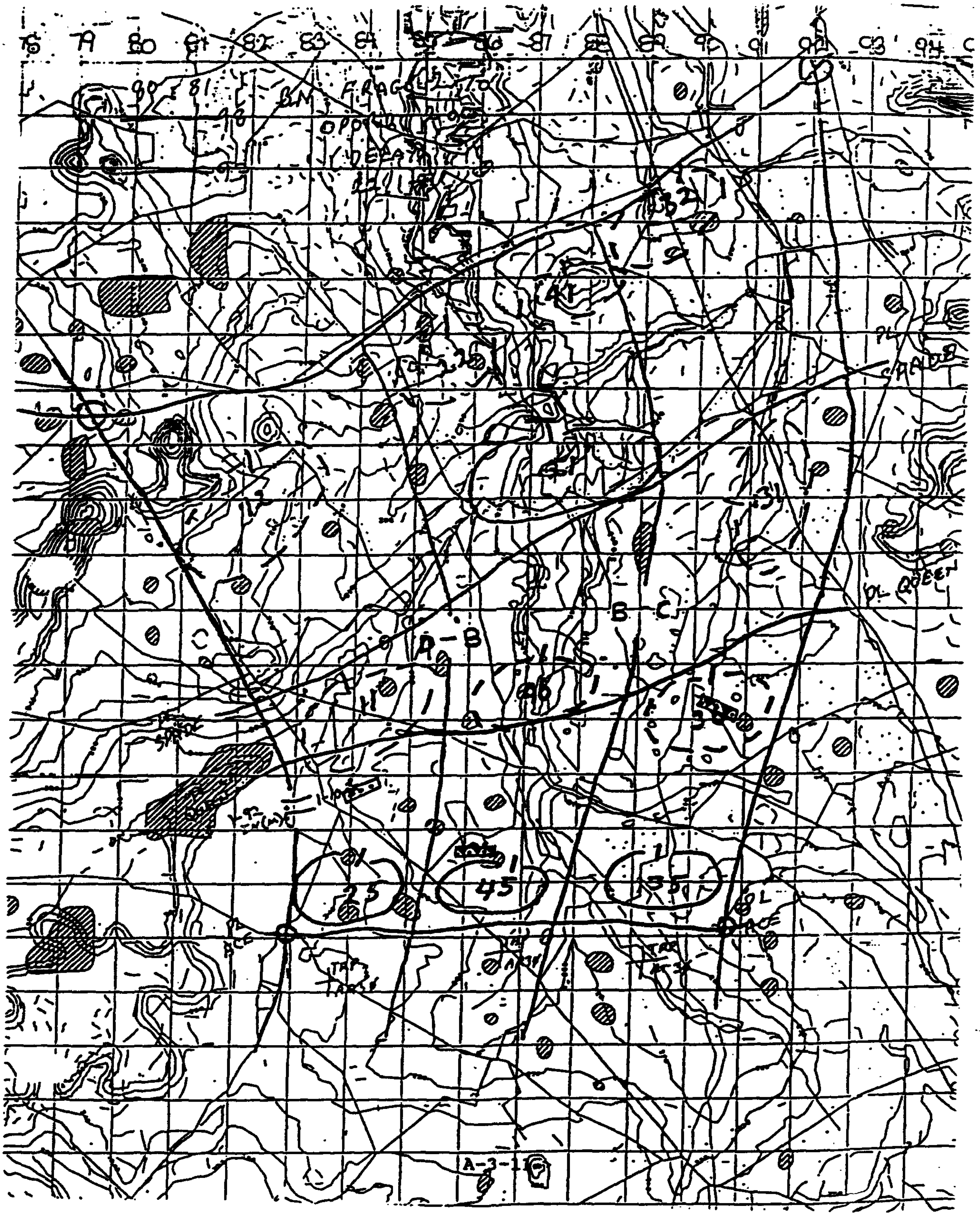
"SIERRA: SCREEN LEFT FLANK."

"BLITZ WHEN READY, REPORT WHEN SET. ACKNOWLEDGE, OVER."

FRAGO 2 TO OPORD 200 (7 JUL 92) (CVCC--Digital FRAGO)

FROM: Y33
TO: Bn Cmd Net

FRAGO 2-200
Ref: xxxxxxxx
SITUATION
Enemy -2d Ech MRR moving
NW into Bn sector, ETA:
20 min.
Friendly -1st Bde resumes
delay, 1-92 on our R, 1-
91 to rear @PL TRUMP.
MISSION -1-10 defends at
____R along ACE, delays
En S of Trump for 2 hrs.
EXECUTION -see O/L.
D: b/prep reinf B,A,C.
Coord: move when ready,
report REDCON1.
END


A-3-11

A-4

Battalion SOP Extract (CVCC Version)

CVCC BATTALION LEVEL EVALUATION

BATTALION SOP EXTRACT (EXPERIMENTAL)

Administrative Note.

This SOP applies to training and test exercises in the CVCC Battalion Evaluation, experimental condition. Its purpose is to standardize the routine combat, combat support (CS), and combat service support (CSS) procedures within the battalion during the conduct of collective training exercises, the test scenario(s) and data collection exercises.

Administrative Guidelines. The on-site exercise staff consists of civilian personne' filling a number of roles. These roles can be segregated into three basic functions: control staff, unit augmentees, and trainer/observers.

The control staff includes the Exercise Director, Exercise Coordinator, Battlemaster, Assistant Battlemaster, and Floor Monitor. During the course of tactical scenarios, these staff members will assume both administrative and tactical roles. In their administrative role, control staff will control exercise duration, breaks, briefings, and so on. In their tactical role, control staff assume the positions of the Bde commander and staff, and adjacent unit personnel, as required.

The control staff also includes the OPFOR operator. Opposing forces are controlled according to standard scripts that do not vary by unit or condition. Interaction between unit members and the OPFOR operator will be limited to tactical debriefings.

Unit augmentees include the TOC staff and BLUFOR SAF operators. These personnel assume roles within the Bn: the XO, S2, Asst S3, FSO, and subordinate Co Cdrs or Plt Ldrs, as required by the situation. Although these personnel are familiar with the scenarios that are to be played out, they are not permitted to use that privileged information in any manner to influence the actions of military participants. It is imperative that all members of the unit respect the need to maintain standardization between iterations of the test, and therefore interact accordingly with the unit augmentees.

During the course of tactical events, the Bn will receive Bde FRAGOs or encounter situations requiring the development of a Bn FRAGO. During these periods, unit augmentees will play their unit roles as realistically as possible: responding to the commander without providing any priveleged information. Prior to FRAGO execution, a standardized Bn FRAGO will be interjected by the unit augmentees. The standardized" FRAGO must be adopted and executed, regardless of the degree of similarity or difference with the FRAGO that was developed by the command group and staff, in order to maintain standard schemes of maneuver between test weeks.

Simulator trainer/observers work directly with crews in the simulator, and have two roles. They serve as tank crew instructors during the early phases of training, and offer refresher training and advice during the training exercises should problems be encountered. During test events, trainer/observers monitor activities in selected simulators as a part of the data collection effort. They are not permitted to assist the crew in any way during test events, although they may assist in trouble-shooting if equipment malfunctions occur.

All simulators will be manned at all times during training and test events (except during scheduled and maintenance breaks), in order to assure complete training and data collection. During tactical events, all interaction with control staff and unit augmentees (excluding administrative matters) will be conducted "in character."

Contents

Annexes

I. GENERAL.

A. <u>Purpose and Scope.</u> This SOP standardizes the routine combat, combat support (CS), and combat service support (CSS) procedures within the battalion during the conduct of tactical operations. It applies to all personnel and units assigned, attached, OPCON or DS to the battalion, either temporarily or permanently.

B. <u>Reference.</u> This is an extract of the Combined Arms Heavy Battalion/Task Force Standard Operating Procedure (SOP), Special Text 17-17 (ST 17-17), dated May 1990; modified for purposes of the CVCC BN Evaluation (experimental condition).

C. <u>Conformity.</u> All battalion personnel will read and comply with this SOP extract. Follow the procedures of ST 17-17 in cases not covered by this extract.

II. *COMMAND AND CONTROL.*

A. <u>Organization.</u>

1. Command Group: CDR & S3 in simulators (with gunner & driver)

2. TOC Group: XO, S2, Asst S3, FSO.

B. <u>Succession of Command.</u>

BN XO
BN S3
B CO CDR
C CO CDR
A CO CDR
D CO CDR

C. <u>Orders.</u>

1. Complete OPORDs will be prepared and issued when time permits. FRAGOs will be issued when required.

2. Warning Orders (WO) will be issued when a change of mission is received.

3. Orders group.

a. Prior to tactical operations the BN CDR may assemble subordinate leaders for detailed oral orders:

Orders Group A:	CDR, XO, S3
Orders Group B:	Group A + staff
Orders Group C:	Group B + CO CDRs
Orders Group D:	CDR, S3, CO CDRs

b. During tactical operations oral and/or digital FRAGOs will be transmitted by radio. When time permits, warning orders and FRAGOs will be transmitted in digital text and overlay formats. Digital warning orders will be freetext messages. Digital FRAGOs will normally consist of an overlay with text. When time is critical, oral FRAGOs will be implemented and followed up with digital messages.

D. Security Readiness Condition (REDCON).

1. REDCON-1 (Full alert): All personnel alert, in the simulators, and prepared for action. All equipment functional and in good operating condition. Simulators ready to move immediately. Weapons in battlecarry or standby condition.

2. REDCON-2: Stand to complete. All simulators ready to move within 15 minutes of notification. Weapons in standby condition.

3. REDCON-3: Crews stand down for scheduled break. Simulators remain operational and running. Simulators ready to move in 30 minutes. Ready racks/ammunition boxes fully loaded, weapons clear and safe.

4. REDCON-4: Simulators shut down. Simulators ready to move in 1 hour.

III. ORGANIZATION FOR COMBAT.

A. Task Organization. The standard Bn task organization will be as follows, unless modified by OPORD or FRAGO. As used below, the term "partially-manned" means: two manned simulators containing the Co Cdr and XO, and SAFOR platoons.

Co A (Partially-manned)

Co B (Partially-manned)

Co C (Partially-manned)

Co D (SAFOR)

Bn Control
- Scout Plt (SAFOR)
- Hvy Mort Plt (Simulated)
- Attached, OPCON and DS units (notional)

Bn Trains (notional)

B. Intelligence. Priority Intelligence Requirements (PIR): Report the following immediately. Additional PIR will be specified in OPORDs.

1. Apparent enemy plans/indications of attack or movement.

2. Enemy use of NBC weapons.

3. Location, composition, identity, activity of enemy forces.

4. Direction of enemy advance.

5. Enemy aircraft.

C. Fire Support.

1. Scheduled fires: FSO insures that scheduled fires are executed as planned, until lifted or shifted according to unit progress. FSO monitors Bn Cmd and O&I nets and observes unit progress on Bn TOC workstation to coordinate supporting fires with maneuver.

2. Immediate/on call fires:

a. Any crew may initiate a call for fire (CFF). Tank crews will initiate immediate calls for fire using the digital CFF format. The Co XO (acting as FIST) is responsible for relaying calls for fire to the FSO, and for integrating indirect fires to support the Co scheme of maneuver.

b. Crews will use the digital adjust fire report format to shift fires, to execute fires for effect (FFE) when rounds are successfully adjusted on target, and to end the current fire mission (EOM). Adjust fire reports (to include EOM) are assumed to refer to the last target requested by the originator.

c. The Co XOs will request final protective fires (FPFs) by voice radio on the Bn O&I net.

3. In the absence of immediate calls for fire and scheduled fires, the FSO will obtain targeting data from the S2 and attack targets per the Bn Cdr's guidance and intent. The FSO will clear suspected danger-close fires with the Asst S3 and/or closest friendly Co Cdr/XO.

D. Air Defense.

1. Readiness posture--situation dependent.

a. White - Attack not expected.
b. Yellow - Attack expected.
c. Red - Attack imminent.

2. Weapons control status: FREE unless downgraded by OPORD or FRAGO.

IV. TACTICAL OPERATIONS.

A. Hatch positions. For the purpose of this evaluation, all simulators will operate closed-hatch.

B. Operations.

1. Maintain liaison left to right, supporting to supported, front to rear at each echelon. During passage of lines, maintain liaison from passing to stationary unit.

2. No crossing boundaries without prior approval.

3. Battlecarry (Tanks). Effective whenever the unit is forward of the LD/LC or is established in forward defensive positions (e.g., when enemy contact is possible):

Main gun: SABOT loaded and indexed;
Battle Range settings: Sabot = 1200, HEAT = 900, Coax = 500;
Coax locked and loaded, manual safe off;
LRF safety set on first return;
Trigger select on safe;
Cal .50 locked and loaded, manual safety off, cupola in power mode, Cal .50 manual elevation crank safed and locked;
Loader's M240 dismounted and ammo stowed during extended operations in closed hatch.

4. Standby condition. Used when the unit is behind the LD/LC, or in defensive positions in depth when enemy contact is possible but not likely. All weapons will be in battlecarry posture with manual safeties on and the LRF in safe.

C. Tactical Road Marches.

1. Order of March: IAW OPORD/FRAGO.

2. March speed: 50 KPH.

3. Formation: column.

4. Scheduled halts (breaks): as directed by Bde (exercise control cell).

D. Offensive operations.

1. Bn formations: as situation dictates.

2. Actions on contact.

a. Return fire, deploy, and report (send digital CONTACT report).

b. Seek cover and concealment.

c. Develop situation through direct and indirect fire and movement.

d. Send a digital SPOT report as soon as possible and again when enemy situation changes (e.g., enemy withdraws or is destroyed).

3. Consolidation.

a. Eliminate all enemy resistance on the objective.

b. Establish a hasty defense (prepare to repel counter attack).

c. Prepare to continue the mission.

d. Co XO submit digital SITREP to Bn.

e. Bn S3 & Bn TOC staff monitor operational readiness of each subordinate unit through the automated system. Voice radio is the back-up medium to clarify/verify status.

E. Defensive operations.

1. Deliberate occupation of a battle position (BP).

a. Companies enter BPs from rear.

b. SAFOR platoons report SET to CO CDR when in position.

c. CO CDR report SET to BN when in position.

d. Co XO submit digital SITREP to BN.

2. Hasty occupation of a BP.

a. All tanks will come from rear of BP and go immediately into a turret down position selected by the platoon leader (SAFOR).

b. Co XO submit digital SITREP to BN.

V. COMMAND AND SIGNAL.

A. COMSEC.

1. All FM radio nets are secure.

2. Report any loss of SOI material to Bn ASAP.

3. Reports/information about the unit or friendly elements will always be transmitted by secure means.

4. SOI extract for Bn evaluation is attached.

B. Voice Radio Frequency Settings. The following is the standard battlecarry configuration(s) for SINCGARS radio sets on command simulators.

1. Bn Cmd Group.

a. Primary ("A") Radio: Bn Cmd.

b. Alternate ("B") Radio: Bde Cmd.

2. Co Cdrs.

a. Primary ("A") Radio: Co Cmd.

b. Alternate ("B") Radio: Bn Cmd.

3. Co XOs.

a. Primary ("A") Radio: Bn O&I.

b. Alternate ("B") Radio: Co Cmd.

4. Plt Ldrs/PSGs.

a. Primary ("A") Radio: Plt net.

b. Alternate ("B") Radio: Co Cmd.

C. Digital Net Structure.

1. Bn digital net: Bn Cdr, XO, S2, S3, assistant S3, S4, FSO, Co Cdrs and XOs.

2. Co digital net: Co Cdr, XO, Plt Ldrs and PSGs.

3. Plt digital net: Plt Ldr, PSG, two wing tanks.

D. Reporting

1. Report Preparation. Any crew observing a tactical event may generate and transmit the appropriate report. Crews will input enemy locations using the LRF to ensure report precision.

2. Report Responsibilities. See also: Annex C, Reports.

a. Commanders and Plt Ldrs report/relay battle-critical/time sensitive information (CONTACT reports, SPOT reports, NBC warnings) directly to the next echelon commander. Co Cdrs relay these upward flowing digital reports on the Bn net. Voice traffic between Co Cdrs and Bn is transmitted on the Bn Cmd net.

b. XOs report/relay Calls for Fire and all routine reports (SHELL, SITREPs, INTEL, and NBC reports) directly to the TOC on the Bn net. The XO also relays INTEL traffic from Bn on the Co net. The Co XO will consolidate Plt SitReps and transmit only a the consolidated, Co SitRep to the Bn. XOs will input FLOT endpoints by touching the map screen near the flanks of the Co's forward elements, as indicated by the unit's icons. Voice traffic between Co XOs and the TOC is transmitted on the Bn O&I net.

3. Coordination, orders.

a. Digital overlays are prepared by the TOC and transmitted on the Bn Cmd net. Co Cdrs relay overlays to plts, plt ldrs relay to individual tanks.

b. Digital FRAGOs and free text messages of command interest are prepared and transmitted or relayed by the TOC. Cdrs relay FRAGOs to subordinates, and supplement text with oral FRAGOs, as necessary. Other traffic is relayed down by the Co XO as appropriate.

c. Command nets also serve as the medium for combat-critical/time-sensitive coordination between sister elements (cross-talk). In order to reduce voice traffic, use CCD icons to monitor adjacent unit positioning, movement and the enemy situation, as much as possible.

VI. SERVICE SUPPORT

CSS is not exercised in the current evaluation. However, the impact of logistics on ongoing tactical operations must be considered. Logistic information is provided on an automated query basis. Cdrs, XOs, Plt Ldrs/PSGs and the S3 will periodically check the status of subordinate elements via the CCD. Individual tank commanders will also periodically check vehicle status via CCD. Be prepared to transmit or verify status using voice radio, if requested.

ANNEX A to 1-10 AR SOP

PRECOMBAT INSPECTION (PCI) CHECKLIST

A. Uniform

1. BDU/Soft Cap
2. Earplugs
3. Cold weather gear (as needed)
4. ID tags and ID card

B. Briefed on current mission/situation

C. Briefed on cold/hot weather injuries

D. Tank Commanders

1. Map with current overlay
2. Current SOI extract
3. Leaders packet to include unit SOP, markers, pen/pencil

E. Simulators, General

1. Simulator preops check complete
2. Ammo status: full load
3. Fuel topped off
4. Commo check accomplished

F. Armament Systems: Ammunition loaded and all switches in battle carry configuration.

G. Experimental equipment

1. CITV on, polarity, sectors, scan rate, and control modes checked and set.
2. Current operations and other required overlays posted on CCD map. Map scaling, scrolling, and aggregation features checked, set at desired scale, position, and echelon, respectively.
3. Initial route established, saved, and initial waypoint designated for driver. Auto advance set, if desired.

ANNEX C to 1-10 AR SOP

Reports

Report formats shown on the next few pages indicate the fields that are input for each report using the CVCC. Where abbreviations are used in the CCD, the full field title is indicated in this annex. Example reports are shown as they appear when received.

Combat-Critical Reports

Contact Report

Purpose: To report initial enemy contact.

Prepared/Relayed by: Co Cdr

Format:

WHAT[a]	WHERE[a]
[ ]	[ ]
[ ]	[ ]

Example:

FROM C21 **ORIG** C21/0905

WHAT	WHERE
Tank	ES782946
PC	ES784945

Spot Report

Purpose: To report results of enemy contacts, enemy activities, and friendly activities.

Prepared/Relayed by: Co Cdr

Format:

WHAT[a]	OBSERVED	DESTROYED
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]

WHERE
HEADING
ENEMY ACTION
OWN ACTION
AS OF

Example:

FROM A06 **ORIG** A11/1021

WHAT	OBSERVED	DESTROYED
PC	5	6
Tank	0	7

WHERE ES784921
HEADING 30
ENEMY ACTION Gnd Atk
FRIENDLY ACTION Delay
AS OF 22 1856:42

Notes
[a]Icons depict locations on the map screen when the report is in the receive queue, open, or posted to the map.

Call For Fire

Purpose: To initiate indirect fires on a grid location or preplanned target (see also, Adjust Fire).

Prepared/Relayed by: Co XO

Format:	Example:
WHAT[a]	FROM B05 ORIG B05/0843
LOCATION[a]	WHAT PC
CONCENTRATION NUMBER[b]	LOCATION ES721934
OBSERVER-TARGET LINE[c]	CONC NO AB4008
	OTLINE 47

Adjust Fire

Purpose: To adjust artillery or mortar fires from the last round fired in an adjust fire sequence, to adjust from a known point, or to end a mission in progress.

Prepared/Relayed by: Co XO

Format:	Example:
TARGET[a]	FROM A05 ORIG A23/0859
DIRECTION	TARGET ES992734
L/R SHIFT	DIRECTION 4800
A/D SHIFT	L/R SHIFT 0
FFE [ ] EOM [ ]	A/D SHIFT A 50
	FFE [X] EOM [ ]

Notes

[a]Icons depict locations on the map screen when the report is in receive the queue, open, or posted to the map.

[b]A concentration number is automatically provided if the selected target location is within 50 m of an existing, preplanned target and the preplanned target is posted on the top overlay.

[c]The observer-target line is automatically provided when the target is designated.

Routine Reports

Situation Report

Purpose: To report the unit's location, enemy activity, and commander's/leader's intent.

Prepared/Relayed by: Co XO

Format:

```
AS OF
FLOT[a] [        ]
        [        ]
ENEMY ACT [        ]
          [        ]
CRITICAL SHORTAGES:
    Personnel  [ ]
    Ammunition [ ]
    Fuel       [ ]
    Equipment  [ ]
COMMANDER'S INTENT
```

Example:

```
FROM    D05   ORIG D05/0906
AS OF 13 0901:21
FLOT    ES893903
        ES728873
ENEMY ACT    Attack
              Medium
CRIT SHORT   [    ]
CDR INTENT   Delay
```

NBC Report

Purpose: To report enemy nuclear, biological and chemical operations, activities or attacks.

Prepared/Relayed by: Co XO

Format:

```
OBSERVER LOCATION
ATTACK LOCATION
BURST TYPE
ATTACK TYPE
FLASH/BANG TIME[d]
NUMBER SHELLS
NUCLEAR CRATER DIAMETER (M)[d]
NUCLEAR CLOUD WIDTH (DEG)[d]
NUCLEAR CLOUD HEIGHT (DEG)[d]
```

Example:

```
FROM S11  ORIG S11/2242
OBS LOC    ES987789
ATK LOC    ES959800
BURST TYPE   Air
ATTACK TYPE  Nuclear
FLASH/BANG TIME  3
NO. SHELLS     1
NUC CRATER DIA (M)
NUC W (DEG)   5
NUC HT (DEG)
```

Notes

[a]Icons depict locations on the map screen when the report is in receive the queue, open, or posted to the map.
[d]These fields only apply to nuclear reports.

Shell Report

Purpose: To report enemy indirect fire activities and locations.

Prepared/Relayed by: Co XO

Format:

NUMBER
WHERE[a]
AS OF

Example:

FROM D05 **ORIG** D11/1128
NUMBER 24
WHERE ES895882
AS OF 09 1122:49

Intelligence Report

Purpose: To report enemy activities, friendly activities, and obstacle locations.

Sent by: Bn S2, relayed by Co XO.

Format:

ENEMY UNIT	**FRIENDLY UNIT**
WHAT[a]	**WHAT**[a]
NUMBER	**NUMBER**
WHERE[a]	**WHERE**[a]
ACTIVITY	**ACTIVITY**
HEADING	**HEADING**

OBSTACLES:
WHAT[a]
WHERE[a]
WHERE[a]

AS OF

Example:

FROM Y02 **ORIG** H33/1015
ENEMY
20 PC ES787901
Gnd Atk Hdg 350
FRIENDLY
9 Tank ES790926
Delay Hdg 15
OBSTACLES
Blown Bridge ES787918
AS OF 06 1000:37

Notes
[a]Icons depict locations on the map screen when the report is in receive the queue, open, or posted to the map.

Personnel Status Report

Purpose: To provide current status of personnel in the unit. Represents available out of total authorization for unit (combat vehicle crews only).

Prepared by: Transmission fully automated by on-board sensors. Report displayed on demand.

Format: GARB color-coded bar chart representation of unit status, for the aggregate unit and each immediately subordinate element.

Ammunition Status Report

Purpose: To provide current status of ammunition for weapon systems. Represents basic load remaining on operational vehicles.

Replaced by: Transmission fully automated by on-board sensors. Report displayed on demand.

Format: GARB color-coded bar chart representation of unit status, for the aggregate unit and each immediately subordinate element.

Fuel Status Report

Purpose: To report current status of on-board fuel supply. Represents percent of basic load remaining on operational vehicles.

Replaced by: Transmission fully automated by on-board sensors. Report displayed on demand.

Format: GARB color-coded bar chart representation of unit status, for the aggregate unit and each immediately subordinate element.

Equipment Status

Purpose: To provide the unit's current equipment status. Represents available out of total authorization for unit (tanks and scouts only).

Prepared by: Transmission fully automated by on-board sensors. Report displayed on demand.

Format: GARB color-coded bar chart representation of unit status, for the aggregate unit and each immediately subordinate element.

ANNEX D to 1-10 AR SOP

Brevity Codes

BANDITS	Enemy Aircraft
BENT	Vehicle inoperative; not mission capable
BLITZ	Move, move to, move out
BOGEY	Unidentified Aircraft
ESTABLISHED	Unit Consolidated at designated control measure
FIX	Current Location
GEAR 1 GEAR 2 GEAR 3	Bounding Overwatch Traveling Overwatch Traveling
GET	Put individual specified by call sign on radio (e.g.: GET Y03A)
GUIDONS	Net Call Subordinates answer in sequence
LOW SKY	Vehicle in turret-down position
ORDERS	Oral orders to follow.
PRESENT	Call sign principal report to specified location.
RACEHORSE	Displace without internal overwatch
SIDECAR	Displace with internal overwatch
TOPHAT	Vehicle in hull-down position
UP	Vehicle mission capable
ZAPPED	Vehicle Destroyed

ANNEX E to 1-10 AR SOP

SIGNAL OPERATING INSTRUCTIONS
(EXTRACT)

Prefixes and Frequencies

23rd AD			
23rd AD	S0F	Cmd	–
2nd BDE/23rd AD	P2T	Cmd	–
3rd BDE/23rd AD	K4W	Cmd	–
1-23 Cav	T5G	Cmd	–
A Trp (Gnd)	M7E	Cmd	–
C Trp (Air)	A9X	Cmd	–
23rd Engr (Cbt)			
A Co	C8K	Cmd	–
DivARTY			
TAB	U8L	Cmd	–
210th ACR	S5H	Cmd	–
52d ID (M)			
1st Bde/52d ID(M)	H2O	Cmd	–
1-77 Mech/1/52 ID	X3V	Cmd	–
1-2 AR/1/52 ID	Y4Z	Cmd	–
3-4 AR	S6Q	Cmd	–
1st Bde, 23 AD			
BDE	M4N	Cmd	60000
		O&I	CB 15
1-91 IN (M)	G7J	Cmd	–
1-92 IN (M)	F3M	Cmd	–
4-4 AR	D1P	Cmd	–
1-50 FA	C1R	Cmd	–
1-10 AR			
BN	X5Y	Cmd	50000
		O&I	30000
HHC	W7S	Cmd	–
A Co	A1A	Cmd	45000
B Co	B2B	Cmd	40000
1st Plt		Plt	55000
C Co	Z6C	Cmd	35000
D Co	R4D	Cmd	–

Challenge and Password
WOOLY -- SNAKE

Call Signs

Commander	06
CofS/Exec Off	05
ACofS, G-1/S-1	01
ACofS, G-2/S-2	02
ASIC/BICC	62
ACofS, G-3/S-3	03
Liaison Officer	79
ACofS, G-4/S-4	04
CSM/1SG	07
FSCOORD/FSO/FIST Ch	63
1st/Sct Plt	
Plt Ldr	11
Plt Sgt	14
2nd Veh/A/C	12
3rd Veh/A/C	13
2nd/Mort Plt	
Plt Ldr	21
Plt Sgt	24
3rd/AT Plt	
Plt Ldr	31
Plt Sgt	34
4th/Spt Plt	
Plt Ldr	41
Net Control Station	33

Suffixes

Asst	A
Driver	D
Gunner	G
Loader	L
RTO	R

f. Mortars: follow B Co.

g. Scouts screen Bn left flank from C Co left rear to Bn Bdy. Maintain contact with 210 ACR.

h. Coordinating instructions.

Boundary change: Eastern lateral boundary effective when scouts clear proposed boundary. Western lateral boundary effective immediately.

Phase Line QUEEN and the LD are effective immediately.

4. SERVICE SUPPORT. No Change.

5. COMMAND AND CONTROL

Bn Cdr currently located with B Co vic BP 21.

ACKNOWLEDGE:

OFFICIAL:

PATTON
Cdr

HASZARD
S3

FRAGO 1 Overlay

APPENDIX B

EXERCISE CONTROL PROCEDURES

Appendix B contains the following sections:

B-1

CONTINGENCY RULES FOR PERSONNEL, TECHNICAL AND EXERCISE PROBLEMS

CVCC Battalion Evaluation

CONTINGENCY RULES FOR PERSONNEL, TECHNICAL AND EXERCISE PROBLEMS

These contingency rules address general and specific problem areas that may be encountered during the conduct of the CVCC Battalion Evaluation. These rules are guidelines that should be used as appropriate. Decision makers will be required to exercise professional judgement in all applications of these rules.

Contents

A. General Rules

1. **Decision Authority**: The Exercise Director assigned to the research effort retains overall decision authority for any and all matters that may impact on the conduct of the test or the data collection effort.

2. **Basic Approach**:

a. The option with the least disruptive overall impact will normally be the preferred course of action. The goal is to identify solutions which minimize impacts on:

(1) The data collected or the measures involved (e.g., lost or contaminated data).

(2) C3 dynamics (e.g., interaction between the Bn and Co Cdrs).

(3) Scenario execution, including SAFOR (e.g., firepower, maneuver, mission accomplishment).

b. Whenever problems are encountered that may impact on test conduct, an estimate of the time necessary to correct the situation will be made. Delays will normally be appropriate for short-term problems, whereas adjustments to crew and/or simulator configurations may be necessary for longer-term problems. See "B. Rules for Missing Participants" and "E. Rules for Technical Problems" for a comprehensive set of decision guidelines.

(1) Short-term problems are those which can likely be corrected within the time frame of a training period, training exercise, test scenario, or data collection exercises (DCEs). That is, a problem that can be corrected quickly enough to allow the current and subsequent exercises to be completed on the day scheduled. Example: replacing an IDC board in a simulator with a board that is in stock on-site.

(2) Longer-term problems are those likely to outlast the current event (as described above). That is, a problem that cannot be "worked around" or corrected quickly. Example: a faulty IDC board for which no replacement is available on-site.

(3) The weekly schedule will be followed for all scheduled training and test events until delays occur. When delays occur, the primary goal is to accomplish all training on the day for which it is scheduled. If an event is not accomplished on the day scheduled, the Exercise Director will publish a revised exercise schedule at the earliest opportunity. Events will be rescheduled so as to accomplish required data collection activities and standardize the collective training sequence across iterations. See "F. Rules for Schedule Adjustments when Delays Occur."

3. **Standardization:**

a. The events lists detail the actions which ECR personnel must ensure are accomplished during each scenario or exercise. Control staff will ensure that all events are executed, and that ad lib communications with participants are consistent with the script, based on the progress of the scenario.

b. All control staff will avoid conversation that provides the current test group with any information about the performance of prior test groups. This includes characterizing the current group's performance in terms of implied norms (e.g., "average" or "better than average"). Such information is confidential and may contaminate test results.

c. Staff personnel will not volunteer non-scripted information either prior to or during test events. Staff personnel may answer questions regarding technical/tactical information that should not be withheld (e.g., the S2's assessment that a given area is trafficable, or a SAFOR operator's assessment of a platoon's operational readiness).

d. Staff personnel will ensure that participants do not gain inadvertent access to non-scripted information, or premature access to scripted events. At no time will participants be allowed in the ECR. They will be permitted inside the TOC only during designated periods (Co STX, pre-mission planning) and at the STEALTH only during Leader's Recon exercises. No crewmember will enter a simulator prior to the specified in-sim time for unit exercises. Staff-only paper materials will be safeguarded from participant access.

4. <u>Visitors</u>:

a. The Exercise Director is the on-site POC for any and all visitors during CVCC tests. Visits will be coordinated through ARI, DCD, CCTB senior officer and/or the CCTB site manager. The CCTB receptionist will be kept aware of scheduled visits, and will refer unannounced visitors to the Exercise Director, CCTB senior officer, and/or the site manager.

b. Visitors' conversations with staff and participants will normally be limited to breaks. Official visitors will be granted limited access to controlled areas (e.g., ECR, TOC) based on the visitors' need-to-know, and the nature of ongoing test activities.

c. Neither research staff nor participants will receive unofficial visitors (e.g: family members, friends) in the research facility during the conduct of training or tests.

5. <u>Administrative Actions</u>:

a. The Exercise Director and/or Battlemaster will ensure that the participant chain of command, exercise control personnel, TOC staff, simulator RAs, CCTB technicians, and the ARI POC are informed of all changes to the training and testing schedule.

b. All adjustments to the training and testing program, to include personnel, equipment, and schedule will be documented on affected data collection logs.

B. Rules for Missing Participants

1. **General**: The Exercise Director will verify that all participants are aware of attendance requirements for a test week during the initial introduction. Soldiers with appointments or other anticipated absences will either reschedule the appointment or be replaced by the unit prior to the start of their training.

2. **Battle Roster**:

a. Vehicle commander assignments will become permanent as soon as the first training event commences. Gunner and Driver assignments are fixed as soon as crew training commences. The participating unit has until that time to resolve any absences or to find suitable substitutes.
b. Vehicle commander absences: A vehicle commander's absence for training or test events may require the reassignment of other vehicle commander roles. Such role changes will be followed through to all affected crews. For example, if the Bn Cdr is absent, the S3 assumes his role, vacating the S3 position. In that event, the unit completes the exercise without an S3.

3. **Term of Absence**:

a. Any participant that misses a significant portion of a collective training event may be dismissed for the remainder of the test week at the discretion of the Exercise Director. All participants must complete all seat-specific training. Significant portions of collective training include (but are not limited to): the entire crew training period or any single stage of a training event, to include the preparation stage. The exercise director will consult with other research staff to determine whether a short-term absence during a portion of any stage constitutes a significant loss of scheduled training, and therefore becomes grounds for dismissal of the participant.

b. Temporary (short-term) absences justify delayed start times for training events. Once a training or test event begins, the participant group will remain constant for the remainder of the event unless an emergency arises. Permanent vehicle commander absences will modify the unit structure for the remainder of the test, and may influence the manner by which the Bn Cdr employs his force. It is therefore preferable to delay the start of an event if the absent officer is expected to return soon. If a participant is called away temporarily after a scenario starts, he will resume his position at an appropriate break point when he returns, unless the loss of training meets the preceding criteria and results in his dismissal.

c. The loss of up to two crews (as the result of Veh Cdr absences) can be managed. The loss of a third crew represents an unacceptable level of lost data.

C. Rules for Missing Research Staff

1. The Exercise Director will manage personnel issues not covered in the established contingency plan, as required.

2. Training assignments are managed by the floor monitor with the concurrence of the Exercise Director.

D. Rules for Participant/Staff Interaction

1. The purpose of CVCC participant training is to prepare soldiers to operate the simulators during the test exercises. The performance of some tasks during test scenarios and events is critical to the success of the test, as a whole. If a participant is experiencing difficulty accomplishing a discrete CCD task that is critical to the exercise (e.g., post an overlay to the CCD, or restore the map screen after it has been scrolled so far that the vehicle icon is lost and the TC is misoriented), unobtrusive prompts or hints should be used to lead the participant through the task, at the discretion of the Exercise Director.

2. During training and test events, control staff personnel in the TOC and ECR will remain in character during all tactical communications with participants. This includes most communications between the TOC and the ECR in order to maintain the focus on the tactical exercise. Control staff will step out of character only for administrative communications.

3. Participant requests for information from the TOC or ECR will be handled as follows.

a. Information that represents feedback, synthesis of previously reported information, or the status of an ongoing action will be provided immediately. For example, if the Bn Cdr asks the status of a fire mission, the FSO may respond, "none available," or "guns are repositioning."

b. Information that is not readily available will be notionally referred to an appropriate tactical element (e.g., CEWI units, Fwd Spt Bn), and an appropriate delay imposed. If the information is or may be tactically relevant to the current situation,[1] it will only be provided if scripted. Other information without immediate tactical relevance may be transmitted for the sake of realism.

c. A complete set of procedural rules for BLUFOR SAF operators and RTOs is published separately as the "SAF Radio Operator Protocols." Procedural guidelines for the control of SAF vehicles are integrated in events lists, as supplemented by operator notes.

E. Rules for Technical Problems

1. <u>Simulator or Software Breakdowns</u>:

a. Short-term:

(1) Minor problems (e.g., non-critical CITV malfunction): Delay start of training/exercise or fix without interrupting or suspending training/exercise or repair at scheduled break.

(2) Major problems (e.g., critical CCD malfunction, simulator crash): delay start of training/exercise or suspend training/exercise for repairs.

b. Longer-term: The loss of up to two (2) simulators may be accommodated for a training scenario, test scenario or the data collection exercises. The loss of a third simulator would result in unacceptable data loss. In that event, the Exercise Director will coordinate with ARI to determine what follow-up action is feasible. If the simulator can be returned to operation prior to the end of the test week, it may be used if the crew is considered available, as described in subparagraph (3), below. The following actions will be taken to adjust for the loss of simulators:

(1) During individual training, double up on available trainers.

(2) During collective training and test exercises, reallocate simulators as follows:

---

[1]The test of tactical relevance must be applied carefully. If there is any question, treat the information as potentially relevant.

(a) For Training and Test Scenarios: Maintain the Bn Cdr, all Co Cdrs, and two Co XOs.

(b) For DCEs, maintain the fully manned platoon, the Co Cdr and the Bn Cdr.

(3) If a crew loses significant training because of a simulator breakdown, as defined in section B.3, then the crew will be dismissed and the test will continue with the reduced number of crews and operating simulators. If the simulator is subsequently repaired, it will serve as a back-up for the remainder of the test week.

2. <u>TOC Workstations (CVCC only)</u>:

a. Short-term: See paragraph E.1.a.

b. Longer-term: Reorganize available workstations and reassign operators as required.

3. <u>Radios</u>:

a. Simulators: Short-term malfunctions will be repaired as soon as possible, commensurate with rules for simulator breakdowns (paragraph E.1.a). Longer-term malfunctions will be handled as follows:

(1) Training/Test scenarios. See paragraph E.1.b.(2)(a).

b. TOC/ECR. For longer-term malfunctions:

(1) Training/Test Scenario(s). Replace the affected radio by implementing the following steps, in the order listed.

(a) S2/FSO share one RT on the Bn O&I net.

(b) Reallocate radios and remote speakers between the ECR and the TOC to maintain monitoring capabilities.

(c) If further losses occur, reallocate the ECR radio monitoring the 1st Plt net.

4. <u>SAFOR</u>:

a. No training scenario, test scenario, or will begin if sufficient SAFOR equipment is non-functional. For all exercises, three workstations and simulator hosts are required.

b. If a SAFOR malfunction occurs during a scenario, the normal course of action will be to freeze the scenario and save the exercise on each workstation immediately. As soon as the malfunction is resolved, the scenario will resume as soon as the exercise can be restored on all workstations.

F. Rules for Schedule Adjustments When Delays Occur

1. No more than one test scenario or the set of data collection exercises will be conducted in a single day. The pre-mission briefing and preparation will occur on the same day as the associated exercise.

2. Collective training and test exercises will be terminated:

a. Upon completion of the scenario;

b. At the end of the training day; or

c. At a logical point when the maximum time allotted for the exercise is fulfilled, at the discretion of the Exercise Director. Time allocations for training and test events are shown in Table III. "Execution time," as used in Table III, refers to the actual run time of scripted scenario events from "T-hour" to scenario completion, less breaks and maintenance down-time.

3. When problems occur during the conduct of hands-on training or testing, the Exercise Director will determine whether participants will remain in place (in simulators) or be allowed to go on break. Generally, participants will not be left in place for greater than 10 to 15 minutes. When maintenance delays occur, participants will be asked <u>not</u> to discuss the ongoing scenario with the exercise staff or each other.

4. Between-stage breaks during scenarios may coincide with a lunch break.

5. Exercises may continue after 1700 hrs if coordination with the site manager has verified that site support staff are available. No scenario will be continued overnight.

6. An AAR/debriefing may be delayed to the next day, if necessary.

G. Rules for Deviations from Planned Events

1. **Allowable Deviations:**

a. Generally, tactical situations which progress logically from scripted events will be allowed to play themselves through to a natural conclusion. Control staff will avoid limiting the tactical decisions of the Bn or Co Cdrs beyond scripted constraints. TOC staff will fully support the Bn Cdr as situations develop, taking care not to corrupt the process with privileged information. Likewise, SAFOR operators will execute the orders given them from manned simulators in order to play the situation out.[2]

b. Under no circumstances will SAFOR engagement parameters be modified, or the Bomb button used to kill off BLUFOR or OPFOR units during the course of a stage or scenario.

2. **Misoriented Participants:**

a. SAFOR operators will avoid giving precise position data to participants over the radio, except for that information provided in the symbolics message screen.

b. Under the conditions of this test, manned simulators will routinely operate adjacent to unmanned (SAFOR) elements. Participants will be admonished not to follow the semi-automated forces, but instead, to actively navigate their own vehicles. If a manned simulator is separated from subordinate SAFOR elements, the Battlemaster will determine whether to let the participant wander, or to provide hints to help the crew reorient itself. Generally, if the vehicle commander continues to maintain effective command and control of a subordinate unit, remains behind friendly lines, and remains within the unit sector, he will be left alone.

b. If the lost crew is in line of sight of any friendly element, tactically appropriate actions, consistent with fratricide prevention procedures, will be taken to identify the vehicle and direct it to its own unit. Example: a SAFOR operator with estimated line-of-sight (LOS) to the lost vehicle reports an unidentified friendly vehicle to his front (or flank). The lost vehicle's exact location will not be transmitted, but an approximate direction and range from the SAFOR unit will be provided. It then becomes the chain of command's responsibility to identify the errant vehicle, and take appropriate action.

---

[2]This guideline assumes that the reconstitution of units and imposition of canned FRAGOs at the beginning of subsequent stages, along with the scripted intelligence and operations play provide sufficient control for the test event.

c. If the crew asks for help but is out of LOS contact, help will be limited to tactically based responses. For example, if an engagement occurs after a crew asks for assistance, a SAFOR operator may direct the lost vehicle to the sound of the guns.

3. Misunderstood Orders or FRAGOs: Every effort (save the extension of preparatory time) will be made prior to execution to ensure that all participants understand the mission. BLUFOR operators will remain alert for orders from the Bn or Co Cdr that do not correspond with the established plan (e.g, imply misunderstanding). Generally, these will be handled as allowable deviations, unless the change might result in the loss of significant data (e.g., takes the unit out of position for a scripted engagement). If such orders are received, the operator will alert the Battlemaster and/or Exercise Director, and stall (ask for a retransmission). The Battlemaster/Exercise Director will determine whether to intervene. Possible interventions include:

a. Direct that BLUFOR and OPFOR march rates be modified so that the OPFOR intercepts the unit at a suitable location, or such that the OPFOR's arrival is delayed until the unit is back in position.

b. Assume a tactical role to verify the errant unit's position and intentions, and to influence the Bn to revert to a more suitable scheme of maneuver (e.g., get the unit back where it belongs).

4. Inappropriate Initiative: The Battlemaster will caution participants against unrealistically aggressive behavior that takes advantage of the kill suppress feature (e.g., a lone tank counterattacks or performs high-risk reconnaissance). The kill suppress feature will not be addressed or acknowledged by the Battlemaster directly in any "open forum" (e.g: scenario debriefing). On Wednesday of each test week, this topic will be addressed during the officer's call. At that time, representatives from ARI, DCD, and the research staff will discuss the rationale for kill suppress and its implications. Participants will be asked to assume the responsibility for appropriate behavior. Subsequent instances will be addressed one-on-one between the Battlemaster or Exercise Director and the individual participant.

B-2

BATTLEMASTER PROCEDURES

Battlemaster Procedures

1. Battlemaster is responsible for insuring that all interactions follow appropriate Army procedures wherever it is possible. He is also responsible for answering all questions regarding military operations.

2. Battlemaster will inform participants that they must conserve ammo while executing Stages 2 and 3 of Test Scenario.

3. Battlemaster must coordinate with Data Logger operator on when to stop and start stage breaks and with PVD operator for sending flags to key the stop and start of each stage. The receipt of the digital Situation Report by the CCD operator is the key for the Battlemaster to end that stage.

4. Battlemaster is to inform the participants during Pre-Brief Activities that the "Rambo" attitude during execution of a scenario will not be tolerated.

5. Battlemaster will stress the point that during the company STX he will be acting as Bn Cdr and during remainder of scenarios as the Bde Cdr. He must conduct himself in such a manner as to convey this image to the participants.

6. Battlemaster will ensure that the control staff is familiar with the OPORD for conducting scenario in regards to the priority of fires, and preplanned fires desired by the unit and understands actions required to accomplish firing mission.

7. Battlemaster must be observant during Pre-Brief Activities (Bde pre-brief) to assure the participants' understanding of what is expected of them, not only in execution of Bde order but in the conduct of the overall test.

8. Battlemaster is to ensure that the BLUFOR operators are familiar with the events list for the designated scenario and that they understand that their "Birds-eye view" of the battlefield is not to effect the normal reporting requirements. Battlemaster must ensure that BLUFOR operators not lead or make decisions for the commanders based on their additional knowledge of the situation.

9. Battlemaster is to reinforce with all ECR personnel that there will be no discussion with participants in regards to other units' performances during their tests. This is confidential information and may contaminate test results.

10. Battlemaster is responsible for all activities in the ECR, to include the personnel participating as support staff, visitors or other interested parties. The ECR is off-limits to unit personnel participating in the tests. This should be emphasized during the Pre-Brief Activities and any information exchange required between participants and SAFOR operators should be conducted outside the ECR. Any visitors or government support personnel should inform

the Battlemaster as to their need of access to the ECR during a test. In the event that this process is not followed, it is the Battlemaster's responsibility to control their entrance to the ECR.

11. Battlemaster is responsible for all ECR equipment in preparing it for an operational test. He may have an assistant or designate to someone else certain duties to prepare the different systems for operation, but the ultimate responsibility is his. The Battlemaster should make a last minute check of all systems while participants are engaging in their Mission Pre-planning Activities.

12. Battlemaster is responsible for all Pre-Brief Activities in preparation for running scenarios. He must be familiar with all the functions required to conduct the Brigade Brief and other actions outlined in the Pre-Brief Activities outline. He is to ensure that all materials necessary for this presentation are present and available in sufficient quantities for the participants, including the back-up paper overlays for simulator and TOC personnel. This back-up material will be made available at the end of the preparation phase.

13. Battlemaster is responsible for all Debriefing activities, including conducting the AAR session. The Battlemaster must collect any comments from ECR personnel on unit performance to provide as feedback to the participants during the debrief. The AAR session should be tape-recorded and that recording should be transcribed as soon as possible.

14. Battlemaster should be familiar with the functions of the simulators and TOC WSs.

15. Battlemaster or Assistant Battlemaster will present the classroom CITV training unless the Test Director himself gives the class.

16. Battlemaster must emphasize the importance for the unit to follow the OPORD in executing the scenario. He should tell the participants that the reserve company cannot be changed (D Co) as this will be a SAFOR company. He will stress the importance in using A Co as the lead company for all exercises as this is a fully-manned company.

B-3

SAFOR OPERATOR PROCEDURES

SAFOR Operator Procedures

1. The ECR must constantly strive to achieve two goals. First, they must strive to present the scenarios to participants in a standardized and consistent fashion. Without such standardization, systematic analysis of performance date is not possible. A critical part of the standardization process is making sure that same set of key events occur in each run of a scenario. Each of these events provides an opportunity for collecting a particular performance measure. If the event is not conducted, a critical data point will be lost. Second, the ECR staff must provide the participants with sufficient leeway so that they can respond to the preplanned events in a tactically realistic manner. In line with this, it is critical that ECR personnel who play subordinate units respond to and do not lead the commander's actions. ECR personnel have a "birds-eye view" of the battlefield that gives them additional information that units in the field would not have. ECR personnel must make extra efforts not to use this information when role-playing BLUFOR units.

2. The following is a list of verbal reports that the BLUFOR operators should be familiar with because they are reports listed in the various Co/Bn orders and Bn SOP:

a. Report SET (in BP, on obj) to co cdr.

b. Report apparent enemy plans/indications of attack or movement.

c. Report enemy use of NBC weapons.

d. Report location, composition, identity, and activity of enemy forces.

e. Report direction of enemy advance.

f. Report crossing LD, CP, and PL.

g. Report Battle Handover complete.

h. Report initial enemy contact.

i. Report Passage of Lines complete.

j. Report changes in enemy formations (2nd Ech committed).

k. Report FST 1's sighting.

l. Report use of chemical munitions.

m. Report air mobile operations.

n. Report status of vehicles.

o. Report ammo, KIA, MIA, and POL status.

3. BLUFOR operators will not discuss with participants what or how individuals performed in other tests. This is confidential information and may compromise test results if discussed with participants.

4. BLUFOR operators will discuss any mission planning issues with participants outside the ECR. Participants are not allowed in the ECR.

5. BLUFOR operators will provide input to the Battlemaster on their observations of the units' performance during execution of all scenarios. This information will become feedback to the units during the Debriefs.

6. OPFOR operator will provide input to the Battlemaster from observation of the units' performance.

7. CCD Stand-alone operator must be familiar with the OPORD for scenario to be executed. This includes specifically the priority of fires in the OPORD and the preplanned fires the unit has developed. The operator must inform the Battlemaster if the fires requested are landing on friendly units and provide this information as input for the Battlemaster's feedback during the Debrief. As part of this feedback, the operator will note whether the unit adhered to its priority of fires and preplanned fires. Additionally, the operator will provide an estimate (by sender) of type and number of reports sent, which will help identify those participants who were deficient in sending reports. Finally, it is critical that the operator inform the Battlemaster when the final SITREP at the end of each stage is completed.

8. All SAFOR operators must check their individual stations for proper functioning and have the stations prepared for the scenario to be executed. Any malfunctions must be reported immediately to the Battlemaster and then to support personnel.

B-4

SAFOR OPERATOR RADIO PROTOCOLS

SAF Operator Radio Protocols

1. General: In Baseline, with the exceptions noted below, reports will only be rendered when they appear in the message display. In CVCC, only messages displayed that do not have a CCD format (e.g., crossing phase lines, etc.) will be rendered verbally, except as noted below. Note the exception regarding report timing in paragraph 2.d., below.

a. All reports will be rendered using appropriate formats, prowords and brevity codes.

b. Reports for separate elements will be rendered using separate transmissions. Combined transmissions (e.g.: "B06: B11, 21 AND 31 ARE REDCON 1, OVER") are unacceptable.

c. SAF operators must role-play intra-unit coordination on the Co nets. E.g., if an enemy force is moving out of range of 1st plt into an area covered by second plt, send "21, THIS IS 11, FIVE BMPS MOVING WEST TO YOUR AREA, OVER."

2. SAF operator originated reports:

a. Report REDCON 1 to the immediate commander at the beginning of each stage, for each independent element. E.g.: the operator controlling the scouts, A and D Cos would report REDCON 1 for A11, A21 and A23 to A06, and for D06 and S11 to Y06.

b. In the case of initial contact during any given stage or scenario, within each company, and in both conditions the first indication of enemy contact will prompt a verbal contact report. Reporting cues and procedures are listed below. Use CARDINAL directions as opposed to grids in these initial contact reports.

(1) Use the following procedure to make initial reports:

(a) Draft the report in writing;
(b) Visually verify the report against the SAF Map Display;
(c) Send it.

(2) If an OPFOR icon appears on the BLUFOR operator's PVD: The operator determines which platoon would most likely see that enemy element and informs the RTO. The RTO transmits a contact report from that platoon leader, based on exactly what a tank commander might see. E.g.: "B06, THIS IS B31, CONTACT, TANKS, NORTH."

(3) If no OPFOR icons appear, but the BLUFOR opens fire on an unknown enemy force: The RTO selects an engaged element and determines the cardinal direction to the OPFOR force that has been engaged. He renders a contact report from any engaged element, describing the enemy force as "Tanks and PCs," and reports that the unit is engaging. E.g.: "B06, THIS IS B11, CONTACT, TANKS AND PCS, NORTH, ENGAGING."

(4) If the engagement closes to within 2000 meters, and no reports have appeared in the message screen, render a summary of the situation in order to keep the commander informed, and to prompt disengagement. E.g.: "A06, A21, I HAVE HEAVY <CONTACT><PRESSURE> <TO MY FRONT><FROM THE NORTH>, REQUEST PERMISSION TO MOVE NOW! OVER."

(5) SAF Cos and Scouts only: When artillery fires are observed, except those of known friendly origin, a SAF unit with assumed LOS will report "Y33, THIS IS S11, OBSERVING ARTILLERY, VIC [GRID]." This includes artillery received on the unit's own position. The operator should <u>never</u> report, "RECEIVING ARTILLERY MY POSITION."

c. When a SAF unit opens fire on a PREVIOUSLY REPORTED enemy element, the operator reports, ". . . ENGAGING NOW."

d. Whenever a SAF unit begins a move, crosses a phase line, occupies a BP or AA, etc, the operator will report the action. These reports will often be prompted on the message screen. E.g.: "Y06, THIS IS D06, BLITZING NOW, OUT." "A06, THIS IS A21, PAPA LIMA GOAT, NOW, OUT." "B06, B21, SET [BRAVO PAPA] 23, OUT." <u>During training scenarios only</u>, in order to reduce the perception that SAF navigates and reports perfectly, a certain amount of "slop" is encouraged in reporting movement progress. Procedure: As a unit comes within 250 meters (1/4 grid square) of a reportable control measure, the RTO will render the report. The report may come early, late, or as the unit crosses the control measure. The RTO will vary the reporting criterion according to his own pattern, e.g: 250 m early, then 250 m late, then right on. Losing track of the pattern is not critical. Having a pattern is.

e. When any SAF unit loses vehicles to enemy action, the RTO notes the loss on his graphic job aid, and reports using the appropriate brevity code. E.g.: "A06, A11, two zapped." If the plt ldr is zapped, report as the platoon sergeant. If only one tank is alive in the plt, use its call sign. <u>Reports should not be immediate</u>. The RTO should draft the report in writing and have the operator verify which vehicles are down before reporting. This represents the time a plt ldr might spend trying to confirm a combat loss.

f. Only SAF Cos or the Scout plt will initiate Calls for fire from the SAF workstation.

g. In Baseline, when a unit closes in a BP, OBJ, or AA, and is out of contact, check the unit's status and render a SITREP, FUEL and AMMO REPORT based on the displayed information. E.g.: ". . . SITREP: FLOT [GRID] TO [GRID] NEGATIVE ENEMY CONTACT; EQUIPMENT AND PERSONNEL BLACK; DEFENDING." "AMMO: SABOT AMBER, HEAT BLACK." "FUEL: GREEN." In CVCC, routine SITREPs ae generated by the SAFOR program. Furthermore, most of the data that a Co XO or Cdr needs to generate a SITREP are available thru automated data.

h. NBC reports are transmitted verbally when indicated on the events list. foll'd by SEND on part net

3. Responses to requests for information:

a. Once an initial contact report has been rendered, if the superior commander asks for additional information, respond "WAIT, OUT" until the report comes up in the message display.

b. Any time the commander asks for a SITREP other than under the criteria at 2.g., report current activity (e.g.: MOVING TO BP32), number of operational vehicles, (e.g: 3 UP) and enemy action & activity level.

c. Previously reported information may be retransmitted on request. New information will not be introduced unless the appropriate conditions in paragraph 3 are met.

APPENDIX C

SAMPLE DATA COLLECTION INSTRUMENTS

Appendix C contains the following sections:

C-1

ROSTERS/PRIVACY ACT STATEMENT

Section C-1 contains the following:

Sign-Up Roster
Assignment Roster
Privacy Act Statement

Date: ____________

COMBAT VEHICLE COMMAND AND CONTROL

BATTALION FORMATIVE EVALUATION

SIGN-UP ROSTER

#	Name (please print)	Rank	SSN	Unit	Home phone

Date ____________

BATTALION FORMATIVE EVALUATION
(Covers all Exercises)

ASSIGNMENT ROSTER

Primary Assignment
(Alternate (DCE) Assignment)

Battalion Cdr		____________	Sim 3B
	Gunner	____________	
	Driver	____________	
Operations Ofcr		____________	Sim 2B
	Gunner	____________	
	Driver	____________	
A Company Cdr		____________	Sim 4A
(B Co Plt Ldr)	Gunner	____________	
	Driver	____________	
A Company XO		____________	Sim 4B
(B Co Plt Ldr Wing)	Gunner	____________	
	Driver	____________	
B Company Cdr		____________	Sim 2D
	Gunner	____________	
	Driver	____________	
B Company XO		____________	Sim 2C
	Gunner	____________	
	Driver	____________	
C Company Cdr		____________	Sim 4C
(B Co Plt Sgt)	Gunner	____________	
	Driver	____________	
C Company XO		____________	Sim 3C
(B Co Plt Sgt Wing)	Gunner	____________	
	Driver	____________	

NAME______________________________

DATE______________________________

PRIVACY ACT STATEMENT

AUTHORITY: Title 10, USC, Sec 4503

PRINCIPAL PURPOSE: The data collected with this form are to be used for research purposes only.

ROUTINE USE: This is an experimental personnel data collection activity conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences pursuant to its research mission as described in AR 70-1. When identifiers, name, social security number or videos individual actions while performing a task are requested, they are to be used for research purposes only. Full confidentiality of your responses or videotaping will be maintained in the processing of these data.

DISCLOSURE: Although your participation in this experiment is strictly voluntary, we encourage you to provide complete and accurate information in the interests of the research. There will be no effect on you for not providing all or any part of the information.

One thing I want to stress is that all of the data we collect will be for research purposes only. The videotaping may be used for training or briefing purposes but your individual identification confidentiality will be maintained. Your participation will make a big difference to this experiment. It's very important that you do your best.

By signing below, I am indicating that
I have been read the above privacy act statement and
understand the privacy rights it guarantees me.

____

C-2

Questionnaires

Section C-2 contains the following questionnaires:

Biographical Questionnaires
Situational Assessment Questionnaire - Battalion Commander/S3
Situational Assessment Questionnaire - Company Commander/XO

ADMIN: Date ______ Partic # _____ Dty Pos __________ Revised 1/14/92 PT 5832 (R)

* *

BIOGRAPHICAL QUESTIONNAIRE

Name ____________________________________ SSN_____-_____-______

1. Age _____ years 2. Current Army Rank __________

3. Current unit of assignment ______________________________

4. Military Specialty: 12A 12B 12C 19E 19K Other__________

5. Total time on active duty: ______ years/______ months

6. Total active duty time in Armor units (include Cavalry): ______ yrs/_____ months

7. How much experience as a crewmember have you had with the following families of vehicles?

   a. M1 _____ yrs / _____ mos
   b. M60 _____ yrs / _____ mos
   c. M113 _____ yrs / _____ mos
   d. M2/M3 _____ yrs / _____ mos

8. Circle your present Duty Position in your current unit:

   Plt Ldr   Co Cdr   Co XO   Bn S2   Bn S3   Bn XO   Student

   Driver   Loader   Gunner   Tank Cdr   Plt Sgt   Instructor

   Other ________________________________

9. How much experience do you have in each of the following TO&E (combat maneuver unit) positions?

   a. Driver _____ yrs / _____ mos
   b. Loader _____ yrs / _____ mos
   c. Gunner _____ yrs / _____ mos
   d. Tnk Cdr _____ yrs / _____ mos
   e. Plt Sgt _____ yrs / _____ mos
   f. Plt Ldr _____ yrs / _____ mos
   g. Spec Plt Ldr _____ yrs / _____ mos
   h. Co XO _____ yrs / _____ mos
   i. Co Cdr _____ yrs / _____ mos
   j. Bn S2 _____ yrs / _____ mos
   k. Bn S3 _____ yrs / _____ mos
   l. Bn Staff (S1, S4, BMO) _____ yrs / _____ mos
   m. Bn XO _____ yrs / _____ mos
   n. Bn Cdr _____ yrs / _____ mos

10. Which of the following formal military courses have you completed? (check all that apply)

a. ____	PLDC	d. ____	TCCC	g. ____	AOAC
b. ____	BNCOC	e. ____	SPLC	h. ____	CAS3
c. ____	ANCOC	f. ____	AOBC	i. ____	C&GSC

11. How long has it been since you participated as a **trainee** in an actual field training exercise (**not counting NTC and training support**)? _______ months

12. How many times have you participated as a member of a rotating unit in NTC or CMTC exercises? _______ times

13. How many days have you previously spent in CCTT (SIMNET-T)? ______days. In CCTB (SIMNET-D)? _______ days (if none, skip question 14)

14. In which of the following CCTB (SIMNET-D) equipment evaluations have you participated? (check all that apply)

    a. _____POSNAV b. _____IVIS c. _____CITV

    d. _____CVCC (Co Level) e. _____CVCC (Bn TOC)

    f. Other____________________

15. Check your previous experience with computers (do not count SIMNET experience):

    _____ no experience at all

    _____ limited experience (ie. limited word processing or computer games)

    _____ moderate experience (ie. some programming experience or frequent use of commercial computer programs)

    _____ considerable experience (ie. fluent in more than one programming language or extensive experience using commercial programs such as spreadsheats)

16. People commonly report feeling uncomfortable using computers. Please circle below the value that best describes how you feel (in general) about using computers.

1	2	3	4	5	6	7
Very Uncomfortable			Neutral			Very Comfortable

17. Highest civilian education level:

_____ High School Diploma/GED

_____ Some College

_____ College Degree (BA/BS)

_____ Postgraduate work

18. Total active duty time in combat maneuver units (for example, 194th AB, 2d AD): (Please list years/months)

CONUS _____ / _____ **USAREUR** _____ / _____ **KOREA**_____/_____

SITUATIONAL ASSESSMENT QUESTIONNAIRE - Test Scenario

BN CDRS & S3 SIM DUTY POS ____________
RA ____________________ DATE ____________
CONDITION __________ WEEK ____________

Please answer each question and rate your confidence in your answer using the scale below. Place the number from the scale in the space preceding each question.

1	2	3	4	5
Not at all Confident	Somewhat Confident	Moderately Confident	Very Confident	Completely Confident

Confidence Rating

_______ 1. During the last stage, how many enemy tanks did the battalion destroy?

Number of enemy tanks destroyed: _______

_______ 2. During the last stage, how many BMPs did the battalion destroy?

Number of BMPs destroyed: _______

_______ 3. During the last stage, did the battalion destroy any enemy vehicles after the order to delay was given?

Yes _______ No _______

_______ 4. During the last stage, how many tanks in your battalion were destroyed?

Number of battalion tanks destroyed: _______

_______ 5. In the last stage, how far (in km) were the initial BPs from the subsequent BPs (BP 25 to BP 11; BP 45 to BP 46; BP 35 to BP 36)

Average distance between BPs = _______ km

SITUATIONAL ASSESSMENT QUESTIONNAIRE - Test Scenario

CO CDRS & XOS
RA ______________________________
CONDITION ____________

SIM DUTY POS ____________
DATE ____________
WEEK ____________

Please answer each question and rate your confidence in your answer using the scale below. Place the number from the scale in the space preceding each question.

1	2	3	4	5
Not at all Confident	Somewhat Confident	Moderately Confident	Very Confident	Completely Confident

Confidence Rating

_______ 1. During the last stage, how many enemy tanks did your company destroy?

Number of enemy tanks destroyed: _______

_______ 2. During the last stage, how many BMPs did your company destroy?

Number of BMPs destroyed: _______

_______ 3. During the last stage, did your company destroy any enemy vehicles after the order to delay was given?

Yes _______ No _______

_______ 4. During the last stage, how many tanks in your company were destroyed?

Number of company tanks destroyed: _______

_______ 5. In the last stage, how far (in km) was your initial BP from your subsequent BP? Answer only for YOUR company:

A Co Distance from BP 25 to BP 11 = _______ km
B Co Distance from BP 45 to BP 46 = _______ km
C Co Distance from BP 35 to BP 36 = _______ km

Logs

Section C-3 contains the following logs:

Battlemaster Log
TOC Log
RA Defensive Log - CVCC

April 13, 1992

BATTLEMASTER LOG

DEFENSIVE SCENARIO

Formative Bn Evaluation

Date:__________________ **File: BFE_D_ _ _ _ _**

BattleMaster:____

Assistant BattleMaster:________________________________

Position	Sim*	Call Sign	Vehicle ID*
Bn Cmdr	3B	Y06	________
S3	2B	Y03	________
A Co Cmdr	4A	A06	________
A Co XO	4B	A05	________
B Co Cmdr	2D	B06	________
B Co XO	2C	B05	________
C Co Cmdr	4C	C06	________
C Co XO	3C	C05	________

* Be sure to note changes in Sim and Vehicle ID if there is a change in simulator(s) assignment.

DCA Notified to Turn DataLogger ON: ____:____:____ (Time) ________ (Flag)

TURN VIDEO CAMERAS ON

Stage 1:

_______ Bn Cdr calls in RedCon 1: Time: __________

OPFOR BEGINS MOVEMENT

_______ Bde TOC requests SitRep

_______ Bn TOC sends SitRep to Bde

_______ Bde issues Intel: "All source INTEL reports sighting of 2nd Ech MRB/1st Ech Regt, ES9756, moving N."

OPFOR ARTILLERY BARRAGE ON BPs 10, 20, 30

_______ On Bde Net: 1-92 Mech Cdr reports initiating delay to PL Club.

_______ If A Co has not requested to delay, Bde sends to Bn: "To prevent 1-92 Mech from becoming decisively engaged, all Bns delay to Phase II BPs."

<u>DATA ELEMENT</u>: Did Task Force prevent a decisive engagement?

YES _______ NO _______

1. How long did it take Co Cdrs to delay after order to do so?

____

2. Did at least 50% of front line vehicles successfully displace?

____

3. How quickly did Blufor controller react to delay order?

____

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

____

____

____

____

____

____

____

Stage 1

________ BDE: "DIVARTY Acquisition radar reports 144th RAG vic ES910725.

________ Bde issues Warning Order: "Suspected 2nd echelon of MRB of 144th moving NW in W sector of 1-10 AR AO....

________ Bde Cdr to Bn Cdr: "Concerned about enemy's direction of attack, which is more westerly than expected....

________ S11 reports SET screen line 1

________ FRAGO issued to Bn TOC

________ BDE requests FUEL report

________ Bn Toc reports crossing of PL JACK

________ Bn Toc reports crossing of PL CLUB

________ Bn Toc reports SET in BPs 11, 24, 34, CATK in progress

________ BDE requests AMMO report

________ S11 reports SET screen line 2

________ BDE requests SITREP

________ Bn TOC sends SitRep to Bde

________ TOC notifies BDE that FRAGO is complete OR BDE notifies TOC that prep time "is up." (Indicate which)

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

____

____

____

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____

Stage 1

DATA ELEMENT: Was Bn Bypassed by enemy?

YES ________ NO ________________

Did 13 or more enemy vehicles penetrate North of forward Cos?

____

_______ BREAK (End of Stage: Participants out of sims)

DATA ELEMENT: Measure distance between each company COM and scripted endpoint (use PVD ruler):

A Co:_____ B Co: _____ C Co: _____ D Co: _____

Reason(s) for distance from endpoints:__________________________

____

____

DO THE VCRS AND DATALOGGER NEED TO BE TURNED OFF?

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

____

____

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____

____

Stage 2:

_______ Bn Cdr calls in STARTEX: Time: ___________

_______ TOC directed to issue FRAGO Time: ___________

_______ Bn Cdr reports RedCon 1: Time: ___________

_______ Bde issues Intel: Division All source reports elements of 146th MRR vic ES9063, moving North."

_______ Bde issues Warning Order: "1-10 AR and 1-92 Mech be prepared to resume defensive after 1-10 AR counterattack."

_______ BDE requests FUEL report

_______ Bn TOC reports crossing LD: Time: ___________

_______ Bde issues FRAGO 2 to Bn TOC

_______ BDE requests AMMO report

LEAD ELEMENTS OF 2ND ECHELON MRB REACH VIC ES863815 (forward of Obj FOG)

OPFOR ARTILLERY ON A AND B COMPANIES

2ND ECHELON MRC+ REACHES OBJ SNOW

DATA ELEMENT: How many companies engaged the OPFOR main baody in the CATK? ____________

_______ Bde requests SitRep

_______ Bn TOC sends SitRep to Bde

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

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Stage 2

_______ TOC notifies BDE that FRAGO is complete OR BDE notifies TOC that prep time "is up." (Indicate which)

_______ BREAK (End of Stage: Participants remain in sims)

DATA ELEMENT: Measure distance between each company COM and scripted endpoint (use PVD ruler):

A Co:_____ B Co: _____ C Co: _____ D Co: _____

Reason(s) for distance from endpoints:____________________________

DO THE VCRS AND DATALOGGER NEED TO BE TURNED OFF?

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

Stage 3:

_______ Bn Cdr calls in STARTEX: Time: __________

_______ TOC directed to issue FRAGO Time: __________

_______ Bn Cdr reports RedCon 1: Time: __________

DATA ELEMENT: Time unit was told to be in BPs Time:________

_______ Send flag at time units SHOULD be in BPs (from above)

_______ Time Bn reports SET in BPs

OPFOR BEGINS MOVEMENT

_______ Bn TOC sends SitRep to Bde

OPFOR artillery barrage along PL ACE (on BPs 25, 45, &35)

_______ On Bde Net: 1-92 Cdr reports facing elements of 79th GTR.

PLATOON CONTROLLER FOR A CO REPORTS GAS TO A CO CDR

PLATOON CONTROLLER FOR C CO REPORTS GAS TO C CO CDR

_______ Bn TOC sends NBC warning (GAS) to Bde

_______ Bn TOC sends NBC report to Bde

_______ Bde issues Intel: "2nd echelon MRB+ sighted vicinity ES8673, moving North."

_______ Bde orders 1-10 AR to delay to PL Queen (if request has not yet been made)

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

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BattleMaster Log - Defensive Scenario

Stage 3

<u>DATA ELEMENT</u>: Did Task Force prevent a decisive engagement?

YES ________ NO ____________

1. How long did it take Co Cdrs to delay after order to do so?

____

2. Did at least 50% of front line vehicles successfully displace?

____

3. How quickly did Blufor controller react to delay order?

____

________ BDE requests AMMO report

________ BDE requests FUEL report

________ Bn TOC reports all companies SET on BPs

________ Bde requests SitRep

________ Bn TOC sends SitRep to Bde

<u>Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.</u>

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Stage 3

DATA ELEMENT: Was Bn Bypassed by enemy?

YES ________ NO ______________

Did 13 or more enemy vehicles penetrate North of forward Cos?

____

_______ END OF EXERCISE (Participants out of sims for SITUATIONAL ASSESSMENT)

DATA ELEMENT: Measure distance between each company COM and scripted endpoint (use PVD ruler):

A Co:_____ B Co: _____ C Co: _____ D Co: _____

Reason(s) for distance from endpoints:_______________________

____

____

____

____

CALL COMPUTER ROOM TO STOP TAPE

STOP VIDEO CAMERAS

Send Flags and Record: Breakdowns (who, what, start and stop times); Halt in Exercise (why, start and stop times); Equipment Problems; Anything Noteworthy or Out of the Ordinary.

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March 20, 1992

TOC LOG
DEFENSIVE SCENARIO

Date:_____________ Monitor: ________

Stage 1:

________ First CONTACT report from simulators
05 F Specify sender: ____________________

________ First SPOT Report from simulators
06 F Specify sender: ____________________

________ First CFF from simulators
07 F Specify sender: ____________________

________ A Co requests permission to delay to BP 13
08 F

________ Bn Cdr orders Bn to delay to BPs
09 F

________ Bn Cdr orders D Co to execute CATK
10 F

________ TOC requests FUEL report
11 F

________ TOC requests AMMO report
12 F

BREAK (End of Stage 1: Participants out of simulators)

Additional Notes/Flags:

____

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____

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H = Help F = Flag C = Comment

Stage 2:

________ LD reported
13 F

________ First CONTACT report from simulators
05 F Specify sender: ____________________

________ First SPOT Report from simulators
06 F Specify sender: ____________________

________ First CFF from simulators
07 F Specify sender: ____________________

________ TOC requests FUEL report
11 F

________ TOC requests AMMO report
12 F

<u>BREAK</u> (End of Stage 2: Participants remain in simulators)

Additional Notes/Flags:

H = Help F = Flag C = Comment

Stage 3:

______ First CONTACT report from simulators
05 F Specify sender: ____________________

______ First SPOT Report from simulators
06 F Specify sender: ____________________

______ First CFF from simulators
07 F Specify sender: ____________________

______ NBC warning sent to TOC
14 F

______ NBC report sent to TOC
15 F

______ Permission to delay is requested
16 F Specify requester: ____________________

______ Bn Cdr orders Bn to delay
09 F

______ TOC requests AMMO report
11 F

______ TOC requests FUEL report
12 F

END OF EXERCISE (Participants out of simulators: Administer SITUATIONAL ASSESSMENT)

Additional Notes/Flags:

H = Help F = Flag C = Comment

RA DEFENSIVE LOG
Formative Bn Evaluation - CVCC

Date:____________ RA: ____________ Sim Duty Position: ____________

Stage 1: Delay.

As the stage begins, 2 OPFOR recon Plts are advancing to establish the initial defensive positions. The BLUFOR along PL KING receive a 10 min OPFOR artillery barrage. A friendly tank company from the 1-52 Mech is continuing its movement rearward (N) past the D Co position. The OPFOR recon Plts establish contact with A and C Co's. Subsequently, the OPFOR attacks with 2 MRBs in the 1st echelon of the 144th MRR and 1 MRB in its 2nd echelon. Each MRB has 2 MRC+ in its 1st echelon and a 3rd MRC+ in its 2nd echelon.

As the battle progresses A Co is forced to delay due to OPFOR pressure and because the 1-92 Mech on the W (right) of 1-10 AR is being forced to delay. The Bn Cdr has the Bn delay to subsequent BPs. After movement to subsequent BPs is initiated, the Bde issues FRAGO 1 to 1-10 AR, a counterattack to the SW to destroy the 2nd echelon of the 144th MRR as it passes through the A Co sector. The Bn Cdr sends a Warning Order.

As C Co delays back toward PL JACK, contact is broken with the OPFOR. Shortly thereafter, B Co reports contact with OPFOR is broken and indicates the direction of OPFOR movement is towards BP 11. A Co continues in contact as it delays to BP 11. D Co displaces to BP 42. As this stage ends, the 1st echelon MRBs of the 144th MRR have either been eliminated or move out of the 1-10 AR sector to the NW. A, B, C, and D Cos are set in BPs 12, 24, 34, and 11, respectively, and are preparing to counterattack.

Stage 2: Counterattack.

As this stage begins, Bn FRAGO 1 is issued. D Co remains in defensive position in BP 11. A Co attacks along AXIS BETTY on the right flank (W) to secure Obj RAIN; B Co attacks along AXIS PAM in the center to secure Obj SNOW; and C Co attacks along AXIS LIZ on the left (E) flank to secure Obj FOG. After the Cos cross the LD, Bde issues FRAGO 2 to 1-10 AR, to resume delay after completion of the counterattack. The Bn Cdr sends a Warning Order. As A Co is reaching Obj RAIN, it makes contact with the 2nd echelon MRB of the 144th MRR. The battle is joined; the OPFOR turns to meet the BLUFOR attack. As this stage ends, the OPFOR has been eliminated and A, B, C, and D Cos are in the vicinity of Obj RAIN, SNOW, FOG, and BP 11, respectively.

Stage 3: Delay.

As this stage begins, FRAGO 2 is issued. The FRAGO 2 overlay establishes new BPs 25 (W sector), 45 (center sector), and 35 (E sector), along new PL ACE. FRAGO 2 also establishes BPs 46 (center sector) and 36 (E sector), along PL QUEEN. A, B, and C Cos move to establish defensive positions in BPs 25, 45, and 35, respectively. D Co moves to BP 46 and becomes the reserve. The OPFOR has element of the 2nd echelon of the 39th GMRD moving forward (N). The OPFOR in the 1-10 AR sector is the 146th MRR which has 2 MRBs forming the 1st echelon of the regiment. Each of the MRBs attack with 2 MRC+s in its 1st echelon and 1 MRC+ in its 2nd echelon. The battle is joined. After a period of fighting, the OPFOR deploys chemical munitions. 1-10 AR delays to subsequent BPs along PL QUEEN. As the stage ends, the Cos are set in position, have submitted SitReps, and are prepared to continue the delay mission.

Stage 1 (Def):

STARTING SITUATION: The Bn is set in BPs along PL KING; A Co is in BP 10, B Co is in BP 20, C Co is in BP 30. D Co is in reserve along PL CLUB in BP 40. The simulation is initiated by OPFOR movement.

Bde Net: "All Source Intel reports sighting of MRB, possibly 2nd echelon of MRR, moving ES940650."

OPFOR artillery barrage on BPs 10, 20, 30

Bde Net: 1-92 Mech Bn Cdr reports to Bde Cdr heavy contact along PL KING

S11 reports consolidated at CP10, moving to screen line 1.

Bde issues Intel: "210 ACR reports only light contact in their sector."

Bde issues Warning Order: "1-10 AR be prepared to counter attack to SW from vicinity PL Spade; 1-91 Mech be prepared to establish hasty defense along PL Club."

1-92 Mech Cdr requests permission to delay to PL Club.

Bde sends to Bn, "To prevent 1-92 Mech from becoming decisively engaged, all Bns delay to Phase II BPs." (if request to delay has not been made)

DIVARTY reports 144thRAG vic ES 910725.

Bde issues Warning Order: "Suspected 2nd echelon of MRB of 144th moving NW in W sector of 1-10 AR AO. 1-10 AR be prepared to establish hasty defense along PL CLUB.

Bde Cdr to Bn Cdr: "Concerned about enemy's direction of attack, which is more westerly than expected. Ensure that your eastern flank companies do not get bypassed.

A Co reports SET at BP 11; B Co reports SET at BP 24; C Co reports SET at BP 34;
D Co reports SET at BP 42

Report	Tally
Adjust Fire	
Ammo	
Call for Fire	
Contact	
Shell	
SitRep	
Spot	
Intel	
FRAGO	
NBC	
OTHER	

Stage 1 (Def):

Record:

Coordination between TC and crew
Problems with the Equipment
Anything Noteworthy or Out of the Ordinary.

Novel uses of the Equipment
Questions that the TC asked you

____

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____

BREAK (End of Stage 1: Participants out of simulators)

Did TC express dissatisfaction with the equipment? What was it?

____

____

____

What percentages of firings was done by TC? ______________

Use of Maps:

Tactical Map (CCD) _____ + Lap Map _____ = 100%

Use of Visual Devices:

VBs_______ + GPSE_______ + CITV_______ + CCD_______ = 100%

Additional Notes:

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Stage 2 (Def):

STARTING SITUATION: A Co is in BP 12; B Co is in BP 24; C Co is in BP 34; and D Co is in BP 11. D Co stays in reserve and A, B, and C advance to take Objectives RAIN, SNOW, AND FOG, respectively. Simulation is initiated when BattleMaster orders Bn Cdr to implement FRAGO 1.

Bde issues Intel: Division All Source reports elements of 146th MRR vic ES9063, moving North."

Bde issues Warning Order: "1-10 AR and 1-92 Mech be prepared to resume defensive after 1-10 AR counterattack."

S11 reports screening from CP5 to LD

Bn TOC requests SitRep from Companies; All companies consolidate on Obj's

Did TC transfer FRAGO to paper map (to what extent)?____________

Report	Tally
Adjust Fire	
Ammo	
Call for Fire	
Contact	
Shell	
SitRep	
Spot	
Intel	
FRAGO	
NBC	
OTHER	

Stage 2 (Def):

Record:

Coordination between TC and crew
Problems with the Equipment
Anything Noteworthy or Out of the Ordinary.
Novel uses of the Equipment
Questions that the TC asked you

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BREAK (End of Stage 2: Participants remain in simulators)

Did TC express dissatisfaction with the equipment? What was it?

____

____

____

What percentages of firings was done by TC? ____________________

Use of Maps:

Tactical Map (CCD) _____ + Lap Map _____ = 100%

Use of Visual Devices:

VBs_______ + GPSE_______ + CITV_______ + CCD_______ = 100%

Additional Notes:

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Stage 3 (Def):

STARTING SITUATION: A Co is on Obj RAIN; B Co is on Obj SNOW: C Co is on Obj FOG; D Co is at BP 11.

Simulation is initiated when BattleMaster orders Bn Cdr to implement FRAGO 2

D moves to BP 46; A, B, and C Co's move to establish defensive positions in BPs 25, 45, and 35, respectively.

OPFOR artillery barrage along PL ACE

On Bde net: 1-92 Cdr reports facing elements of 79th GTR.

A and C Cos report "GAS"

Bde issues Intel: "2nd echelon MRB+ sighted vicinity ES8673, moving North."

Bde orders 1-10 AR to delay to PL QUEEN (if request to delay has not been made)

Did TC transfer FRAGO to paper map (to what extent)?____________

____

Report	Tally
Adjust Fire	
Ammo	
Call for Fire	
Contact	
Shell	
SitRep	
Spot	
Intel	
FRAGO	
NBC	
OTHER	

Stage 3 (Def)

Record:

Coordination between TC and crew
Problems with the Equipment
Anything Noteworthy or Out of the Ordinary.

Novel uses of the Equipment
Questions that the TC asked you

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<u>END OF EXERCISE</u> (Participants out of simulators for SITUTIONAL ASSESSMENT)

Did TC express dissatisfaction with the equipment? What was it?

____

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____

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____

What percentages of firings was aone by TC? ____________

Use of Maps:

Tactical Map (CCD) _____ + Lap Map _____ = 100%

Use of Visual Devices:

VBs_______ + GPSE_______ + CITV_______ + CCD_______ = 100%

Additional Notes:

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EXAMPLES OF COORDINATION BETWEEN TC AND OTHER CREW MEMBERS

Designate was NOT clearly signalled to gunner.

Gunner tells TC to let go of palm switch--after designating a target.

TC asks gunner to input grids to reports.

TC forgets to switch to GPS mode so gunner can input grids to reports.

Driver requests next waypoint.

Driver requests clarification of waypoint(s).

APPENDIX D:

SAMPLE MEASURE DEFINITIONS AND DATA REDUCTION PROCEDURES

SAMPLE MEASURE DEFINITIONS AND DATA REDUCTION PROCEDURES

This Appendix contains the definitions of a sample of measures and includes collection, reduction and analysis summaries. The term "Standard DCA Output" refers to measures for which DCA routines exist as part of the standard DCA library. Documentation for these routines can be obtained from the senior LORAL analyst.

Measures Terminology

The following definitions provide a ready reference for terms which might be used uniquely in this appendix, or for which it might be helpful to have such reference.

BLUFOR	The entire friendly force; comprised of friendly SAFOR vehicles and manned simulators.
Diagnostic measures	Measures defined as diagnostic are comprised of CCD and CITV equipment usage measures. These measures apply only to the CVCC condition.
Duplicate report	Multiple copies of the same report.
Kill	Unless otherwise stated, refers to firepower and catastrophic kills; excludes mobility and communication kills.
Lase	Use of an LRF device to a target which returns a valid number not greater than 3500 m.
OPFOR	The entire enemy force; comprised of enemy SAFOR vehicles.
Relay	The transmission of a report by someone other than the sender and on a net other than the net on which it was received.
Report Type	Refers to all possible types of digital reports, (including overlays): ADJUST FIRE, FREE TEXT, AMMO STATUS, CALL FOR FIRE, CONTACT, SHELL, SITUATION, SPOT, INTELLIGENCE, NBC, and OVERLAY.
Send	The transmission of a report by the originator.

Stage	**The defensive test scenario consists of three stages. Each stage is thus defined from REDCON1 to completion of the last scripted event, minus any periods of breakdown. Data are analyzed for completed stages only.**
Transmission	**The sending of a report. For verbal reports refers to "appearance" of the sender on the radio net. For digital reports refers to pressing of the CCD SEND button.**
Unique report	**The original report for which duplicates exist or a report with no duplicates.**

SAMPLE PERFORMANCE MEASURES

Maneuver BOS

1.1.1: Distance between BLUFOR and OPFOR center of mass (CoM), average per Bn (Stages 1 and 3)

Operational Definition: Distance, in meters, between each non-reserve company's CoM and the nearest OPFOR company's CoM at end of delay stages; averaged across three companies in each stage. During stages 1 & 3, after the last OPFOR firing: CoM may include dead vehicles (OPFOR or BLUFOR) but will not include vehicles greater than 500 m from computed CoM.

Collection & Reduction Summary: At last OPFOR firing: Compute CoM for A, B, and C BLUFOR companies and OPFOR companies; determine linear distance between each BLUFOR company and its nearest OPFOR company; compute average per stage across three companies.

ANOVA Summary: Condition

Expected N (per Cell): 1/stage/week

1.4.6: Percent OPFOR vehicles killed by all manned vehicles

Operational Definition: Of the total number of OPFOR vehicles killed (catastrophic and firepower) by direct fire during the stage, the proportion killed by the manned vehicles combined.

Collection & Reduction Summary: Standard DCA routine

ANOVA Summary: Condition

Expected N (per cell): 1/stage/week

Fire Support BOS

2.1.1 Mean accuracy of CFF locations

Operational Definition: Deviation, in meters, of nearest three OPFOR vehicles to reported OPFOR location. For descriptive purposes a tally of the number of CFFs which could not be scored (due to missing locations) will be kept. Only CFFs with grid locations will be analyzed; objectives, pre-planned fires, and final protective fires will not be included.

Collection/Reduction Summary: Baseline: Record CFF sender, send time, and contents from playback tapes, enter into database for input to RS/1 table. CVCC: Essential report elements are input directly to RS/1 table via DCA.

For each report location, determine the OPFOR vehicles (of any type) intervisible with the original vehicle for at least 6 seconds. If this is not the first CFF for the originating vehicle (do not score relays), the search backward extends to the previous CFF. If this is the first CFF, the search backward extends to stage start.

Of those OPFOR vehicles having intervisibility with the originating vehicle, determine direct distance between reported location and the CoM of the three OPFOR vehicles closest to that reported location.

ANOVA Summary: Condition

Expected N (per Cell): Occurrence dependent

2.1.2 Percent of CFFs with correct type

Operational Definition: Percent of scorable CFF reports for which the reported type of OPFOR vehicle was found to be visible to the reporting vehicle. Scorable reports are those which contain grid locations and type.

Collection/Reduction Summary: Baseline: Record CFF sender, send time and contents from playback tapes, enter into database for input to RS/1 table. CVCC: Essential report elements are input directly to RS/1 table via DCA.

For each reported location, determine the type of OPFOR vehicles with which the original reporting vehicle (do not score relays) had intervisibility lasting at least 6 seconds (regardless of location). If this is not the first CFF for the reporting vehicle, the search backward extends to the previous CFF. If this is the first CFF, the search backward extends to stage start.

Of those OPFOR vehicles having intervisibility, compare the type of visible vehicles with the reported vehicles. If there are vehicles of that type, score the report "correct." If there are not vehicles of that type, score the report "incorrect." Divide the number of correct reports by the total number of reports scored for the reporting vehicle.

ANOVA Summary: Condition

Expected N (per Cell): Occurrence dependent

Command and Control BOS

3.3.1: Mean time to transmit SITUATION report full net: lowest manned net to Bn TOC

Operational Definition: The elapsed time, in minutes, from the lowest manned net transmission of the SITUATION report to the time the Bn TOC receives the company SITREP.

Collection/Reduction Summary: Baseline: Record SITREP sender, send times (start of transmission), receive times (end of transmission), and contents from audio playback of Bn Cmd/Bn O&I nets, enter into database for input to RS/1 table. CVCC: Essential report elements are input to RS/1 table via DCA.

For each report, compute transmission time for each net: From initiation at lowest net until company report received by the TOC; cumulate across nets. For Baseline compute transmission times from start of transmission to acknowledgement on the receiving net. For CVCC compute transmission times from SEND time until report arrives in receiving queue.

ANOVA SUMMARY: Condition

Expected N (per Cell): Occurrence dependent

3.4.1: Average length of voice radio transmissions, by echelon

Operational Definition: The average duration of voice radio transmissions, as defined by keying the microphone. Compute average per vehicle.

Collection/Reduction Summary: DCA routine determines duration of radio transmissions between microphone key events.

ANOVA Summary: Condition X echelon

Expected N (per Cell):

Bn Cmd echelon: 2/stage/week
Co echelon: 6/stage/week

3.1.1 Elapsed time from Bn transmission of FRAGO to receipt by Co Cdr/XO (Stages 2 and 3)

Operational Definition: The total elapsed time between the time the Bn TOC initiates transmission of a FRAGO to the time the last Co Cdr/XO receives (reception completed includes time to last clarification, if any) the FRAGO. For CVCC condition, FRAGO consists of FREE TEXT message containing FRAGO and accompanying overlay.

Collection/Reduction Summary: Baseline: Record from audio playback of Bn Cmd/Bn O&I nets: Bn TOC, send time (start of transmission) of FRAGO; acknowledge time by Co Cdr/XO (includes all time in request for clarification). Subtract battalion send time from last Co Cdr/XO acknowledge time.

CVCC: (a) Subtract battalion send time of FREE TEXT message containing "FRAGO" as first word, from arrival time in last Co Cdr/XO receive queue. Add appropriate clarification time recorded from audio playback. (b) Subtract battalion send time of overlay (names of overlays provided below) from arrival time in last Co Cdr/XO receive queue. Add appropriate clarification time recorded from audio playback. (c) Indicate longer of the two, a or b, for comparative analysis. All three will be provided, as a and b provide diagnostic information.

Overlay Names

Stage 2 - BNFRAGO1
Stage 3 - BNFRAGO2

ANOVA Summary: Condition

Expected N (per Cell): 1/stage/week

Intelligence BOS

4.1.1: Accuracy of SPOT report locations

Operational Definition: Deviation, in meters, of nearest OPFOR vehicle to reported OPFOR location. Any report containing more than one location will be treated as separate reports. The "observed" and "destroyed" elements of the SPOT report will be scored independently. For descriptive purposes a tally (%) will be kept of reports which could not be scored (due to missing locations).

Collection/Reduction Summary: Baseline: Record SPOT sender, send time and contents from playback tapes, enter into database for input to RS/1 table. CVCC: Essential report elements are input to RS/1 table via DCA.

To score the "SPOT-Observed Report:"

For each report location, at report create time (or AS OF time, whichever is applicable), determine the OPFOR vehicles having intervisibility lasting at least 6 seconds (regardless of type). If this is not the first SPOT report for the original reporting vehicle (do not score relays), the search backward extends to the previous SPOT. If this is the first SPOT, the search backward extends to the start of the stage.

Of those OPFOR vehicles having intervisibility, determine distance from reported location to location of the OPFOR vehicle closest to that reported location.

To score the "SPOT-Destroyed Report:"

For each report location, at report create time (or AS OF time, whichever is applicable), determine the OPFOR vehicles having intervisibility lasting at least 6 seconds (regardless of type). If this is not the first SPOT report for the original reporting vehicle (do not score relays), the search backward extends to the previous SPOT. If this is the first SPOT, the search backward extends to the start of the stage.

Of those OPFOR vehicles having intervisibility, determine those which have suffered catastrophic kills; of those, determine distance from reported location to location of dead OPFOR vehicle closest to that reported location.

ANOVA Summary (for each SPOT report type): Condition

Expected N (per cell): Occurrence dependent

4.1.5: Percent CONTACT reports with correct type

Operational Definition: Percent of scorable CONTACT reports for which the reported type of OPFOR vehicle was found to be visible to the reporting vehicle. Reports containing more than one location will be treated as separate reports. Scorable reports are those which contain grid location(s) and type.

Collection/Reduction Summary: Baseline: Record CONTACT sender, send time and contents from playback tapes, enter into database for input to RS/1 table. CVCC: Essential report elements are input directly to RS/1 table via DCA.

For each reported location, determine the type of OPFOR vehicles with which the original reporting vehicle (do not score relays) had intervisibility lasting at least 6 seconds. If this is not the first CONTACT for the reporting vehicle, the search backward extends to the previous CONTACT. If this is the first CONTACT, the search backward extends to stage start.

Of those OPFOR vehicles having intervisibility, compare the type of vehicles (regardless of location) with the reported vehicles. If there are vehicles of the type reported, score the report "correct." If there are not vehicles of that type, score the report "incorrect." Divide the number of correct reports by the total number of reports scored for the reporting vehicle.

ANOVA Summary: Condition

Expected N (per cell): Occurrence dependent

SMI Objective

D1.6: Number of reports received, by report type, a) total reports received and b) unique reports received

Operational Definition: (a) Total number of reports received (unique and duplicate) on the CCD via all radio nets. (b) Number of unique reports received on the CCD via all radio nets. Both measures computed by report type and averaged across the three defensive stages.

Collection & Reduction Summary: Standard DCA routine

ANOVA Summary: Echelon

Expected N (per Cell): Battalion echelon: 2/week
Company echelon: 6/week

D1.15: Mean time to retrieve reports, a) overall and b) by report type

Operational Definition: Elapsed time from report arrival in Receive Queue until it is retrieved (first retrievals only); excludes duplicate reports. Computed for (a) all reports and (b) by report type. Averaged across the three defensive stages.

Collection & Reduction Summary: Standard DCA routine

ANOVA Summary: Echelon

Expected N (per Cell): Battalion echelon: 2/week
Company echelon: 6/week

APPENDIX E

DATA TABLES[1]

[1] Data tables E-1 through E-34 are structured to capitalize on SPSS/PC+™, V 2.0 analytic routine output.

Table E-1

Distance Between BLUFOR and OPFOR CoM (Hypothesis 1.1) by Condition and Stage (in Meters)

Stage	Condition	Distance between BLUFOR and OPFOR CoM
1	Baseline	
	N	2
	Mean	--
	S.D.	--
	Minimum	3804.00
	Maximum	7346.00
	CVCC	
	N	2
	Mean	--
	S.D.	--
	Minimum	10129.00
	Maximum	10448.00
2	Baseline	
	N	2
	Mean	--
	S.D.	--
	Minimum	1978.00
	Maximum	9819.00
	CVCC	
	N	2
	Mean	--
	S.D.	--
	Minimum	9792.00
	Maximum	10641.00

Table E-2

Time (in Minutes) to Reach LD and Objective (Hypothesis 1.1) by Condition (Defensive Stage 2)

Condition	Time to Reach LD	Time to Reach Objective
Baseline		
N	2	2
Mean	--	--
S.D.	--	--
Minimum	4.68	15.37
Maximum	22.03	47.13
CVCC		
N	2	2
Mean	--	--
S.D.	--	--
Minimum	11.50	17.85
Maximum	20.70	26.38

Table E-3

Exposure Index (Hypothesis 1.1) by Condition and Stage (Number of Non-Dead OPFOR Vehicles)

Stage	Condition	Echelon	Exposure Index - 1500m	Exposure Index - 2000m	Exposure Index - 2500m
1	Baseline	Bn Command			
		N	4	4	4
		Mean	3.50	3.50	3.50
		S.D.	3.00	3.00	3.00
		Minimum	0.00	0.00	0.00
		Maximum	6.00	6.00	6.00
		Company			
		N	12	12	12
		Mean	9.83	9.83	9.83
		S.D.	5.20	5.20	5.20
		Minimum	3.00	3.00	3.00
		Maximum	20.00	20.00	20.00
	CVCC	Bn Command			
		N	4	4	4
		Mean	4.50	4.50	4.50
		S.D.	.58	.58	.58
		Minimum	4.00	4.00	4.00
		Maximum	5.00	5.00	5.00
		Company			
		N	12	12	12
		Mean	8.17	8.17	8.17
		S.D.	9.54	9.54	9.54
		Minimum	1.00	1.00	1.00
		Maximum	37.00	37.00	37.00

(Table continues)

Table E-3

Exposure Index (Hypothesis 1.1) by Condition and Stage (Number of Non-Dead OPFOR Vehicles) (Cont'd)

Stage	Condition	Echelon	Exposure Index - 1500m	Exposure Index - 2000m	Exposure Index - 2500m
2	Baseline	Bn Command			
		N	4	4	4
		Mean	4.50	4.50	4.50
		S.D.	2.65	2.65	2.65
		Minimum	2.00	2.00	2.00
		Maximum	8.00	8.00	8.00
		Company			
		N	12	12	12
		Mean	7.08	4.08	4.50
		S.D.	4.78	4.19	4.96
		Minimum	1.00	0.00	0.00
		Maximum	15.00	15.00	17.00
	CVCC	Bn Command			
		N	4	4	4
		Mean	12.50	12.50	12.50
		S.D.	10.72	10.72	10.72
		Minimum	3.00	3.00	3.00
		Maximum	27.00	27.00	27.00
		Company			
		N	12	12	12
		Mean	7.58	7.33	6.83
		S.D.	7.94	8.49	8.75
		Minimum	0.00	0.00	0.00
		Maximum	24.00	25.00	25.00

Table E-4

Navigate Measures (Hypothesis 1.2) by Condition and Stage

Stage	Condition	Echelon	Distance traveled (meters)	Fuel used (gallons)
1	Baseline	Bn Command		
		N	4	4
		Mean	19973.25	30.50
		S.D.	12153.35	16.42
		Minimum	7093.00	14.00
		Maximum	31003.00	47.00
		Company		
		N	12	12
		Mean	11007.17	19.75
		S.D.	5196.00	7.28
		Minimum	3151.00	8.00
		Maximum	18332.00	29.00
	CVCC	Bn Command		
		N	4	4
		Mean	15027.50	23.75
		S.D.	5283.40	8.02
		Minimum	10500.00	16.00
		Maximum	22638.00	35.00
		Company		
		N	12	12
		Mean	13030.17	19.58
		S.D.	4818.88	6.30
		Minimum	6397.00	11.00
		Maximum	19305.00	31.00

(Table continues)

Table E-4

Navigate Measures (Hypothesis 1.2) by Condition and Stage (Cont'd)

Stage	Condition	Echelon	Distance traveled (meters)	Fuel used (gallons)
2	Baseline	Bn Command		
		N	4	4
		Mean	7251.75	15.00
		S.D.	1381.46	2.58
		Minimum	6170.00	12.00
		Maximum	9065.00	18.00
		Company		
		N	12	12
		Mean	11158.17	18.75
		S.D.	3024.85	5.82
		Minimum	5679.00	9.00
		Maximum	14940.00	28.00
	CVCC	Bn Command		
		N	4	4
		Mean	8189.75	12.75
		S.D.	3266.64	3.59
		Minimum	6514.00	10.00
		Maximum	13089.00	18.00
		Company		
		N	12	12
		Mean	9586.00	16.75
		S.D.	2614.58	5.05
		Minimum	4983.00	10.00
		Maximum	13536.00	27.00

Table E-5

Time (in Minutes) to Complete Exercise (Hypothesis 1.2) by Condition and Stage

Stage	Condition	Time to Complete Stage
1	Baseline	
	N	2
	Mean	--
	S.D.	--
	Minimum	75.10
	Maximum	87.28
2		
	N	2
	Mean	--
	S.D.	--
	Minimum	58.87
	Maximum	67.15
1	CVCC	
	N	2
	Mean	--
	S.D.	--
	Minimum	63.38
	Maximum	66.55
2		
	N	2
	Mean	--
	S.D.	--
	Minimum	40.53
	Maximum	40.88

Table E-6

Process Direct Fire Targets Measures (Hypothesis 1.3) by Condition and Stage

Stage	Condition	Echelon	Maximum lase range (meters)	Number of fratricide hits by manned vehicles
1	Baseline	Bn Command		
		N	3	4
		Mean	2964.67	0.00
		S.D.	375.51	0.00
		Minimum	2588.00	0.00
		Maximum	3339.00	0.00
		Company		
		N	12	12
		Mean	3002.17	0.00
		S.D.	639.32	0.00
		Minimum	1175.00	0.00
		Maximum	3435.00	0.00
	CVCC	Bn Command		
		N	4	4
		Mean	3162.75	0.00
		S.D.	185.62	0.00
		Minimum	3008.00	0.00
		Maximum	3381.00	0.00
		Company		
		N	12	12
		Mean	3184.83	.08
		S.D.	175.64	.29
		Minimum	2875.00	0.00
		Maximum	3456.00	1.00

(Table continues)

Table E-6

Process Direct Fire Targets Measures (Hypothesis 1.3) by Condition and Stage (Cont'd)

Stage	Condition	Echelon	Maximum lase range (meters)	Number of fratricide hits by manned vehicles
2	Baseline	Bn Command		
		N	3	4
		Mean	3073.00	.25
		S.D.	594.30	.50
		Minimum	389.00	0.00
		Maximum	3463.00	1.00
		Company		
		N	10	12
		Mean	2811.10	.08
		S.D.	517.88	.29
		Minimum	1806.00	0.00
		Maximum	3493.00	1.00
	CVCC	Bn Command		
		N	4	4
		Mean	2958.75	0.00
		S.D.	345.83	0.00
		Minimum	2464.00	0.00
		Maximum	3256.00	0.00
		Company		
		N	11	12
		Mean	2680.73	0.00
		S.D.	468.72	0.00
		Minimum	2105.00	0.00
		Maximum	3438.00	0.00

Table E-7

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition and Stage

Stage	Condition	% OPFOR killed	% BLUFOR killed	%OPFOR killed, manned veh	# manned vehs killed	Losses/kill Ratio
1	**Baseline**					
	N	2	2	2	2	2
	Mean	--	--	--	--	--
	S.D.	--	--	--	--	--
	Minimum	75.49	34.38	6.76	22.00	.23
	Maximum	92.16	40.63	12.77	26.00	.34
	CVCC					
	N	2	2	2	2	2
	Mean	--	--	--	--	--
	S.D.	--	--	--	--	--
	Minimum	81.37	18.75	12.05	12.00	.14
	Maximum	83.33	37.50	22.35	24.00	.29
2	**Baseline**					
	N	2	2	2	2	2
	Mean	--	--	--	--	--
	S.D.	--	--	--	--	--
	Minimum	65.57	10.94	3.28	7.00	.11
	Maximum	100.00	15.63	7.50	10.00	.25
	CVCC					
	N	2	2	2	2	2
	Mean	--	--	--	--	--
	S.D.	--	--	--	--	--
	Minimum	100.00	1.56	6.56	1.00	.02
	Maximum	100.00	6.20	11.29	4.00	.06

Table E-8

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition and Stage

Stage	Condition	Echelon	Mean hit range (meters)	Mean kill range (meters)	Hits/round ratio, manned vehicles
1	Baseline	Bn Command			
		N	3	2	3
		Mean	2512.07	--	.44
		S.D.	250.35	--	.11
		Minimum	2225.35	2522.62	.33
		Maximum	2687.36	2687.36	.56
		Company			
		N	9	7	11
		Mean	2300.76	2375.07	.19
		S.D.	270.86	259.83	.16
		Minimum	1885.14	1985.95	0.00
		Maximum	2647.71	2702.54	.46
	CVCC	Bn Command			
		N	3	2	4
		Mean	2301.74	--	.20
		S.D.	249.91	--	.14
		Minimum	2040.54	1657.80	0.00
		Maximum	2538.59	2365.01	.31
		Company			
		N	8	8	12
		Mean	2307.06	2275.74	.20
		S.D.	311.76	400.51	.18
		Minimum	1902.85	1562.12	0.00
		Maximum	2751.91	2694.56	.47

(Table continues)

Table E-8

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition and Stage (Cont'd)

Stage	Condition	Echelon	Mean hit range (meters)	Mean kill range (meters)	Hits/round ratio, manned vehicles
2	Baseline	Bn Command			
		N	1	1	1
		Mean	--	--	--
		S.D.	--	--	--
		Minimum	428.31	428.55	1.00
		Maximum	428.31	428.55	1.00
		Company			
		N	7	6	8
		Mean	1838.44	1715.51	.34
		S.D.	609.18	706.64	.26
		Minimum	1028.27	1050.34	0.00
		Maximum	2788.03	2788.03	.71
	CVCC	Bn Command			
		N	1	0	2
		Mean	--	--	--
		S.D.	--	--	--
		Minimum	777.92	--	0.00
		Maximum	777.92	--	.40
		Company			
		N	6	5	9
		Mean	1469.99	1262.71	.35
		S.D.	591.22	504.35	.35
		Minimum	594.87	557.71	0.00
		Maximum	2242.93	1885.17	.82

Table E-9

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition and Stage

Stage	Condition	Echelon	Kills/hit ratio, manned vehicles	Kills/round ratio, manned vehicles	# rounds fired, manned vehicles
1	Baseline	Bn Command			
		N	3	3	4
		Mean	.47	.19	6.00
		S.D.	.50	.17	5.48
		Minimum	0.00	0.00	0.00
		Maximum	1.00	.33	12.00
		Company			
		N	9	11	12
		Mean	.34	.08	16.33
		S.D.	.24	.07	9.36
		Minimum	0.00	0.00	0.00
		Maximum	.67	.17	33.00
	CVCC	Bn Command			
		N	3	4	4
		Mean	.26	.06	18.25
		S.D.	.32	.09	12.04
		Minimum	0.00	0.00	7.00
		Maximum	.63	.19	31.00
		Company			
		N	8	12	12
		Mean	.44	.10	17.58
		S.D.	.29	.15	5.66
		Minimum	.13	0.00	7.00
		Maximum	.88	.41	27.00

(Table continues)

Table E-9

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition and Stage (Cont'd)

Stage	Condition	Echelon	Kills/hit ratio, manned vehicles	Kills/round ratio, manned vehicles	# rounds fired, manned vehicles
2	Baseline	Bn Command			
		N	1	1	4
		Mean	--	--	1.00
		S.D.	--	--	2.00
		Minimum	0.00	0.00	0.00
		Maximum	0.00	0.00	4.00
		Company			
		N	7	8	12
		Mean	.34	.05	7.00
		S.D.	.46	.05	7.37
		Minimum	0.00	0.00	0.00
		Maximum	1.00	.13	21.00
	CVCC	Bn Command			
		N	1	2	4
		Mean	--	--	3.25
		S.D.	--	--	3.95
		Minimum	0.00	0.00	0.00
		Maximum	0.00	0.00	8.00
		Company			
		N	6	9	12
		Mean	.25	.09	7.00
		S.D.	.20	.12	7.36
		Minimum	0.00	0.00	0.00
		Maximum	.50	.25	20.00

Table E-10

Engage Direct Fire Targets Measures (Hypothesis 1.4) by Condition (Stage 1)

Condition	# OPFOR killed S PL King	# OPFOR killed S PL Club
Baseline		
N	2	2
Mean	--	--
S.D.	--	--
Minimum	64.00	82.00
Maximum	102.00	105.00
CVCC		
N	2	2
Mean	--	--
S.D.	--	--
Minimum	66.00	92.00
Maximum	84.00	96.00

Table E-11

Fire Support Measures (Hypothesis 2.1) by Condition and Stage

Stage	Condition	Accuracy CFFs (meters)	% CFFs with correct type
1	Baseline		
	N	10	10
	Mean	1882.20	28.10
	S.D.	2518.76	21.10
	Minimum	100.00	0.00
	Maximum	8087.00	50.00
2			
	N	1	1
	Mean	--	--
	S.D.	--	--
	Minimum	1201.00	50.00
	Maximum	1201.00	50.00
1	CVCC		
	N	8	8
	Mean	530.75	88.75
	S.D.	550.89	21.00
	Minimum	138.00	50.00
	Maximum	1846.00	100.00
2			
	N	3	3
	Mean	1199.00	100.00
	S.D.	1603.02	0.00
	Minimum	268.00	100.00
	Maximum	3050.00	100.00

Table E-12

Elapsed Time (in Minutes) for Bn Transmission of FRAGO Measure and Consistency of Relayed FRAGOs (Hypothesis 3.1) (Baseline only)

	From Bn TOC to XO	% FRAGO Elements Correctly Relayed (Stage 2 Only)
N	2	6
Mean	--	15.72
S.D.	--	8.20
Minimum	16.33	4.16
Maximum	18.15	29.16

Table E-13

Duration (in Minutes) of Request by Co Cdr/XO to Clarify FRAGO/Overlay (Hypothesis 3.1) by Condition (Stage 2 Only)

Condition	Position	Clarification Duration
Baseline	Co Cdr	
	N	3
	Mean	.44
	S.D.	.04
	Minimum	.40
	Maximum	.48
	Co XO	
	N	2
	Mean	--
	S.D.	--
	Minimum	.32
	Maximum	.60

Table E-14

Time (in Seconds) to Transmit INTEL Full Net (Hypothesis 3.2) (Baseline only)

		From Bn TOC to XO
	N	11
	Mean	42.99
	S.D.	22.06
	Minimum	9.00
	Maximum	81.00
Stage 1		
	N	1
	Mean	--
	S.D.	--
	Minimum	100.00
	Maximum	100.00
Stage 2		
	N	1
	Mean	--
	S.D.	--
	Minimum	25.00
	Maximum	25.00

Table E-15

Consistency of Relayed INTEL (Hypothesis 3.2) by Stage (Baseline Only)

Stage	% INTEL Elements Correctly Relayed
1	
N	1
Mean	--
S.D.	--
Minimum	100.00
Maximum	100.00
2	
N	1
Mean	--
S.D.	--
Minimum	25.00
Maximum	25.00

Table E-16

Receive and Transmit Friendly Troop Information (Hypothesis 3.3) by Condition and Stage

Stage	Condition	Deviation of BLUFOR Location Reported in SITREP	Difference between Observed & Reported PL/LD/FCL Crossings	Difference between Observed BP Arrival and Reporting SET
1	Baseline			
	N	0	4	5
	Mean	--	.95	9.76
	S.D.	--	1.09	12.62
	Minimum	--	.22	1.93
	Maximum	--	2.57	32.22
	CVCC			
	N	2	3	5
	Mean	--	.31	4.14
	S.D.	--	.17	5.41
	Minimum	918.00	.15	.17
	Maximum	1592.00	.48	11.93
2	Baseline			
	N	1	1	1
	Mean	--	--	--
	S.D.	--	--	--
	Minimum	--	1.95	9.22
	Maximum	--	1.95	9.22
	CVCC			
	N	2	3	2
	Mean	--	2.17	--
	S.D.	--	1.71	--
	Minimum	427.00	.22	.13
	Maximum	614.00	3.35	2.05

Table E-17

Mean Duration (in Seconds) of Voice Commo Between TOC & Bn Cdr/S3 (Hypothesis 3.3) by Condition

Condition	Duration of Voice Commo
Baseline	
N	133
Mean	27.60
S.D.	26.40
Minimum	.48
Maximum	212.00
CVCC	
N	22
Mean	36.20
S.D.	31.50
Minimum	1.00
Maximum	128.00

Table E-18

Average Length of Voice Radio Transmissions, by Echelon (Hypothesis 3.4) by Condition and Stage (in seconds)

Stage	Condition	Trans-mission Time Bn Net	Trans-Mission Time Co Net
1	Baseline		
	N	8	6
	Mean	4.02	3.79
	S.D.	.75	.69
	Minimum	.04	.05
	Maximum	28.66	19.70
	Mean # transmissions	140.40	159.80
	CVCC		
	N	8	6
	Mean	3.87	2.90
	S.D.	.88	.34
	Minimum	.03	.13
	Maximum	66.05	13.40
	Mean # transmissions	76.63	86.00
2	Baseline		
	N	8	6
	Mean	3.83	4.14
	S.D.	.48	1.35
	Minimum	.04	.11
	Maximum	22.27	23.64
	Mean # transmissions	100.50	128.50
	CVCC		
	N	8	6
	Mean	3.42	3.04
	S.D.	.61	.55
	Minimum	.24	.13
	Maximum	15.89	9.90
	Mean # transmissions	47.50	58.00

Table E-19

Number of CATK companies Engaging OPFOR (Hypothesis 3.5) by Condition (Stage 2)

Condition	# of counterattacking Cos Engaging OPFOR
Baseline	
N	2
Mean	--
S.D.	--
Minimum	1
Maximum	3
CVCC	
N	2
Mean	--
S.D.	--
Minimum	2
Maximum	3

Table E-20

Direct and Lead Subordinate Forces Measures (Hypothesis 3.5) by Condition and Stage

Stage	Condition	% BLUFOR intact (Stage 1)	% Bn Met Cdr's Intent
1	Baseline		
	N	2	2
	Mean	--	--
	S.D.	--	--
	Minimum	52.00	80.86
	Maximum	63.00	84.77
	CVCC		
	N	2	2
	Mean	--	--
	S.D.	--	--
	Minimum	63.00	82.81
	Maximum	69.00	94.53
2	Baseline		
	N	--	2
	Mean	--	--
	S.D.	--	--
	Minimum	--	95.22
	Maximum	--	99.12
	CVCC		
	N	--	2
	Mean	--	--
	S.D.	--	--
	Minimum	--	99.90
	Maximum	--	99.90

Table E-21

Situational Assessment Questionnaire - How Many OPFOR Tanks Did Unit Destroy?

Condition	Echelon	% Correctly Identified	Confidence Rating
Baseline			
	Battalion		
	N	4	4
	Mean	25.00	3.00
	S.D.	36.32	1.41
	Minimum	0	2.00
	Maximum	77.00	5.00
	Company		
	N	12	12
	Mean	49.50	4.17
	S.D.	45.10	1.27
	Minimum	0	1.00
	Maximum	100.00	5.00
CVCC			
	Battalion		
	N	4	4
	Mean	52.75	1.50
	S.D.	43.93	.58
	Minimum	0	1.00
	Maximum	100.00	2.00
	Company		
	N	11	11
	Mean	23.18	3.00
	S.D.	25.86	.77
	Minimum	0	2.00
	Maximum	89.00	4.00

Table E-22

Situational Assessment Questionnaire - How Many BMPs Did Unit Destroy?

Condition	Echelon	% Correctly Identified	Confidence Rating
Baseline			
	Battalion		
	N	4	4
	Mean	14.50	3.50
	S.D.	16.54	1.73
	Minimum	0	2.00
	Maximum	38.00	5.00
	Company		
	N	12	12
	Mean	28.58	4.17
	S.D.	40.37	1.27
	Minimum	0	1.00
	Maximum	100.00	5.00
CVCC			
	Battalion		
	N	4	4
	Mean	58.00	2.00
	S.D.	41.27	.82
	Minimum	0	1.00
	Maximum	89.00	3.00
	Company		
	N	11	11
	Mean	36.09	2.73
	S.D.	26.30	.65
	Minimum	0	2.00
	Maximum	77.00	4.00

Table E-23

Situational Assessment Questionnaire - How Many in Your Unit Were Destroyed?

Condition	Echelon	% Correctly Identified	Confidence Rating
Baseline			
	Battalion		
	N	4	4
	Mean	17.50	3.50
	S.D.	11.90	1.29
	Minimum	0	2.00
	Maximum	25.00	5.00
	Company		
	N	12	12
	Mean	62.50	5.00
	S.D.	47.07	0
	Minimum	0	5.00
	Maximum	100.00	5.00
CVCC			
	Battalion		
	N	4	4
	Mean	55.75	3.00
	S.D.	31.06	0
	Minimum	25.00	3.00
	Maximum	83.00	3.00
	Company		
	N	12	12
	Mean	58.33	4.25
	S.D.	27.79	.97
	Minimum	25.00	3.00
	Maximum	100.00	5.00

Table E-24

Situational Assessment Questionnaire - How Far Was Initial BP from Later BP?

Condition	Echelon	Deviation between True & Reported Distance	Confidence Rating
CVCC			
	Battalion		
	N	4	4
	Mean	.38	3.75
	S.D.	.26	.96
	Minimum	.23	3.00
	Maximum	.77	5.00
	Company		
	N	12	12
	Mean	1.44	3.67
	S.D.	2.22	.98
	Minimum	0.00	2.00
	Maximum	7.40	5.00

Table E-25

Collect Threat Information Measures (Hypothesis 4.1) by Condition and Stage

Stage	Condition	Accuracy SPOT report (observed)	Accuracy SPOT report (destroyed)	% SPOTs correct (observed)	% SPOTs correct (destroyed)
1	Baseline				
	N	12	2	12	3
	Mean	351.17	--	58.42	21.00
	S.D.	272.62	--	31.84	36.37
	Minimum	11.00	236.00	0.00	0.00
	Maximum	1020.00	1393.00	100.00	63.00
2					
	N	4	1	5	1
	Mean	708.00	--	66.60	--
	S.D.	1003.83	--	47.20	--
	Minimum	31.00	121.00	0.00	0.00
	Maximum	2201.00	121.00	100.00	0.00
1	CVCC				
	N	12	12	12	12
	Mean	456.17	455.50	77.25	79.67
	S.D.	573.93	586.92	23.79	27.01
	Minimum	1.00	1.00	25.00	25.00
	Maximum	1700.00	1700.00	100.00	100.00
2					
	N	8	8	8	8
	Mean	404.63	467.25	100.00	91.63
	S.D.	397.86	465.69	0.00	17.84
	Minimum	2.00	54.00	100.00	50.00
	Maximum	1101.00	1229.00	100.00	100.00

(Table continues)

Table E-25

Collect Threat Information Measures (Hypothesis 4.1) by Condition and Stage (Cont'd)

Stage	Condition	Accuracy SHELL report (meters)	Accuracy CONTACT reports (meters)	% CONTACT w/ correct type
1	Baseline			
	N	9	11	11
	Mean	1701.56	982.36	58.36
	S.D.	982.74	1106.73	42.01
	Minimum	207.00	122.00	0.00
	Maximum	3373.00	3510.00	100.00
2				
	N	3	3	2
	Mean	1070.67	252.00	--
	S.D.	78.50	173.49	--
	Minimum	984.00	52.00	0.00
	Maximum	1137.00	362.00	100.00
1	CVCC			
	N	4	9	9
	Mean	1461.75	875.89	87.22
	S.D.	996.51	873.04	20.17
	Minimum	327.00	33.00	50.00
	Maximum	2649.00	2044.00	100.00
2				
	N	4	8	8
	Mean	1262.00	1050.75	56.25
	S.D.	702.58	1072.42	49.55
	Minimum	325.00	97.00	0.00
	Maximum	2028.00	3037.00	100.00

Table E-26

Input Measures, by Echelon

Echelon	% Input by Touch Screen	% Input to Reports by Laser
Battalion		
N	4	4
Mean	100.00	45.79
S.D.	0.00	19.58
Minimum	100.00	17.00
Maximum	100.00	60.67
Company		
N	12	12
Mean	99.78	34.00
S.D.	.57	20.43
Minimum	98.00	9.00
Maximum	100.00	61.33

Table E-27

Percent Time each Map Scale in Effect, by Echelon

Echelon	25K	50K	125K	250K
Battalion				
N	4	4	4	4
Mean	10.92	51.83	36.50	.08
S.D.	15.12	36.84	42.14	.17
Minimum	1.67	7.67	1.67	0.00
Maximum	33.33	95.67	89.67	.33
Company				
N	12	12	12	12
Mean	25.92	68.94	4.17	.31
S.D.	29.04	31.07	4.23	.86
Minimum	0.00	9.00	0.00	0.00
Maximum	83.67	98.33	13.67	3.00

Table E-28

Percent Time each Map Terrain Feature in Effect, by Echelon

Echelon	Contour	Grid	River	Road	Vegetation
Battalion					
N	4	4	4	4	4
Mean	99.33	99.33	99.33	99.33	74.42
S.D.	.27	.27	.27	.27	49.61
Minimum	99.00	99.00	99.00	99.00	0.00
Maximum	99.67	99.67	99.67	99.67	99.33
Company					
N	12	12	12	12	12
Mean	79.67	99.39	99.39	99.39	68.92
S.D.	37.99	.19	.19	.19	41.50
Minimum	0.00	99.00	99.00	99.00	0.00
Maximum	99.67	99.67	99.67	99.67	99.67

Table E-29

Percent Time each Map Scroll Function in Effect, by Echelon

Echelon	Follow	Jump	Move
Battalion			
N	4	4	4
Mean	48.67	49.25	1.50
S.D.	36.05	37.40	1.48
Minimum	7.67	14.67	0.00
Maximum	82.33	91.33	3.33
Company			
N	12	12	12
Mean	46.14	52.00	1.14
S.D.	29.61	30.40	1.87
Minimum	0.00	16.00	0.00
Maximum	82.33	99.33	6.33

Table E-30

Number of Reports (All) Received, by Echelon

Echelon	ADJ FIRE	NBC	FREE TEXT	CFF	CONTACT
Battalion					
N	4	4	4	4	4
Mean	6.08	.83	8.33	5.17	7.50
S.D.	5.49	.19	.77	2.12	3.09
Minimum	1.33	.67	7.67	3.33	4.67
Maximum	11.00	1.00	9.00	7.00	10.33
Company					
N	12	12	12	12	12
Mean	5.42	.81	9.36	5.36	9.39
S.D.	4.62	.30	1.77	2.68	3.34
Minimum	.33	.33	7.67	1.00	4.00
Maximum	11.33	1.33	13.67	8.67	13.67

	SHELL	SITREP	SPOT	INTEL	Total
Battalion					
N	4	4	4	4	4
Mean	5.75	8.50	10.58	.67	53.42
S.D.	3.20	2.89	1.13	.27	5.03
Minimum	3.00	6.00	9.67	.33	49.00
Maximum	9.00	11.00	12.00	1.00	59.00
Company					
N	12	12	12	12	12
Mean	10.75	22.00	11.19	.92	75.19
S.D.	2.72	3.78	.72	.32	4.60
Minimum	7.00	15.33	10.33	.67	66.67
Maximum	15.67	29.33	12.67	1.67	82.00

Table E-31

Number of Unique Reports Received, by Echelon

Echelon	ADJ FIRE	NBC	FREE TEXT	CFF	CONTACT
Battalion					
N	4	4	4	4	4
Mean	6.08	.83	8.25	5.17	7.33
S.D.	5.49	.19	.69	2.12	2.89
Minimum	1.33	.67	7.67	3.33	4.67
Maximum	11.00	1.00	9.00	7.00	10.00
Company					
N	12	12	12	12	12
Mean	5.36	.72	8.33	5.28	8.92
S.D.	4.57	.28	.70	2.73	2.94
Minimum	.33	.33	7.67	1.00	4.00
Maximum	11.33	1.33	9.00	8.67	12.67

	SHELL	SITREP	SPOT	INTEL	Total
Battalion					
N	4	4	4	4	4
Mean	5.58	8.50	10.08	.58	52.42
S.D.	3.39	2.89	.50	.17	4.76
Minimum	2.67	6.00	9.67	.33	48.33
Maximum	9.00	11.00	10.67	.67	57.33
Company					
N	12	12	12	12	12
Mean	10.36	21.86	10.50	.67	72.00
S.D.	2.71	3.55	.56	0.00	4.92
Minimum	6.67	15.33	9.67	.67	63.67
Maximum	15.00	28.00	11.67	.67	80.67

Table E-32

Percent Reports Retrieved, by Echelon

Echelon	ADJ FIRE	NBC	FREE TEXT	CFF	CONTACT
Battalion					
N	4	4	4	4	4
Mean	15.00	58.25	91.42	16.33	64.83
S.D.	17.80	50.06	36.30	21.14	34.49
Minimum	0.00	0.00	49.00	2.67	16.67
Maximum	35.00	100.00	137.67	47.67	93.33
Company					
N	12	12	12	12	12
Mean	.83	38.92	78.75	11.81	37.86
S.D.	1.81	44.02	20.97	17.36	22.75
Minimum	0.00	0.00	41.00	0.00	8.33
Maximum	6.00	100.00	113.00	50.00	83.33

	SHELL	SITREP	SPOT	INTEL	Total
Battalion					
N	4	4	4	4	4
Mean	8.33	51.33	61.42	100.00	51.00
S.D.	9.62	29.70	30.27	0.00	26.32
Minimum	0.00	9.00	16.33	100.00	13.33
Maximum	16.67	78.33	80.33	100.00	72.00
Company					
N	12	12	12	12	12
Mean	16.97	30.72	32.89	83.33	33.14
S.D.	19.57	27.01	25.54	32.57	19.70
Minimum	0.00	1.00	2.00	0.00	9.00
Maximum	65.33	80.00	87.67	100.00	76.33

Table E-33

Percent Time in Operating Mode, by Echelon

Echelon	% time CITV in Manual Search mode	% Time in Autoscan mode	% Time in GLOS mode	% Time in GPS mode
Battalion				
N	4	4	4	4
Mean	37.10	13.04	.17	49.70
S.D.	24.36	24.20	.33	37.94
Minimum	14.39	0.00	0.00	7.14
Maximum	68.57	49.29	.66	85.61
Company				
N	12	12	12	12
Mean	43.91	6.21	0.00	49.88
S.D.	24.66	10.32	0.00	25.56
Minimum	14.43	0.00	0.00	8.28
Maximum	86.16	36.09	0.00	81.32

Table E-34

Number of Times CITV Laser and Designate Function Used, by Echelon

Echelon	# Times CITV laser used	# Times Designate used
Battalion		
N	4	4
Mean	6.25	1.17
S.D.	7.73	1.17
Minimum	1.33	0.00
Maximum	17.67	2.33
Company		
N	12	12
Mean	6.94	1.42
S.D.	6.41	.67
Minimum	.67	.67
Maximum	24.00	2.33

Table E-35

Evaluation Items from CCD SMI Questionnaire

	Totally Unacceptable	Very Unacceptable	Somewhat Unacceptable	Borderline	Somewhat Acceptable	Very Acceptable	Totally Acceptable	N Mean S.D.
TOUCH SCREEN								
								16
Frequency	--	1	2	--	6	5	2	5.13
Percent	--	6.3	12.5	--	37.5	31.3	12.5	1.41
THUMB CURSOR								
								15
Frequency	1	2	4	6	2	--	--	3.40
Percent	6.7	13.3	26.7	40.0	13.3	--	--	1.12
ABILITY TO NAVIGATE WITH POSNAV								
								16
Frequency	--	--	--	--	--	3	13	6.81
Percent	--	--	--	--	--	18.8	81.3	.40
CREATING ROUTES								
								16
Frequency	--	--	--	--	--	5	31.3	6.69
Percent	--	--	--	--	--	11	68.8	.48
CHANGING WAYPOINTS IN A ROUTE								
								16
Frequency	--	--	--	--	2	3	11	6.56
Percent	--	--	--	--	12.5	18.8	68.8	.73
SENDING WAYPOINTS TO DRIVER								
								16
Frequency	--	--	--	--	--	3	13	6.81
Percent	--	--	--	--	--	18.8	81.3	.40
ALLOCATING MORE RESPONSIBILITY TO THE DRIVER								
								16
Frequency	--	--	--	--	--	9	7	6.44
Percent	--	--	--	--	--	56.3	43.8	.51
SCROLLING THE MAP								
								16
Frequency	--	--	--	1	2	8	5	6.06
Percent	--	--	--	6.3	12.5	50.0	31.3	.85

(Table continues)

Table E-35

Evaluation Items from CCD SMI Questionnaire (Cont'd)

	Totally Unacceptable	Very Unacceptable	Somewhat Unacceptable	Borderline	Somewhat Acceptable	Very Acceptable	Totally Acceptable	N Mean S.D.
AGGREGATION								
								16
Frequency	--	--	--	--	3	9	4	6.06
Percent	--	--	--	--	18.8	56.3	25.0	.68
OVERALL RATING OF TACTICAL MAP								
								16
Frequency	--	--	--	2	1	11	2	5.81
Percent	--	--	--	12.5	6.3	68.8	12.5	.83
NUMBER OF REPORTS RECEIVED								
								16
Frequency	1	3	--	4	4	4	--	4.19
Percent	6.3	18.8	--	25.0	25.0	25.0	--	1.64
CREATING REPORTS								
								16
Frequency	1	2	--	1	5	6	1	4.81
Percent	6.3	12.5	--	6.3	31.3	37.5	6.3	1.72
AUTOMATIC ADVANCE OF INPUT FIELDS								
								16
Frequency	--	--	--	1	3	10	2	5.81
Percent	--	--	--	6.3	18.8	62.5	12.5	.75
REPORT FORMATS								
								14
Frequency	--	--	--	1	7	6	--	5.36
Percent	--	--	--	7.1	50.0	42.9	--	.63
REPORT ICONS								
								15
Frequency	--	--	--	--	3	11	1	5.87
Percent	--	--	--	--	20.0	73.3	6.7	.52
AUDITORY SIGNALS OF RECEIVED MESSAGES								
								15
Frequency	1	1	1	1	2	7	2	5.07
Percent	6.7	6.7	6.7	6.7	13.3	46.7	13.3	1.79

(Table continues)

Table E-35

Evaluation Items from CCD SMI Questionnaire (Cont'd)

	Totally Unacceptable	Very Unacceptable	Somewhat Unacceptable	Borderline	Somewhat Acceptable	Very Acceptable	Totally Acceptable	N Mean S.D.
				VISUAL SIGNALS OF RECEIVED MESSAGES				
								16
Frequency	--	1	1	--	5	7	2	5.38
Percent	--	6.3	6.3	--	31.3	43.8	12.5	1.31
				CAPABILITY TO SEND AND RECEIVE OVERLAYS				
								16
Frequency	--	--	1	1	3	5	6	5.88
Percent	--	--	6.3	6.3	18.8	31.3	37.5	1.20

Table E-36

Evaluation Items from CITV SMI Questionnaire

	Totally Unacceptable	Very Unacceptable	Somewhat Unacceptable	Borderline	Somewhat Acceptable	Very Acceptable	Totally Acceptable	N Mean S.D.
				IFF				
								16
Frequency	1	1	--	6	4	3	1	4.50
Percent	6.3	6.3	--	37.5	25.0	18.8	6.3	1.51
				LOCATION OF CONTROLS				
								16
Frequency	--	1	1	--	5	8	1	5.31
Percent	--	6.3	6.3	--	31.3	50.0	6.3	1.25
				DESIGNATE FUNCTION				
								16
Frequency	--	--	--	--	--	5	11	6.68
Percent	--	--	--	--	--	31.3	68.8	.48
				OVERALL RATING OF CITV				
								16
Frequency	--	--	--	--	1	11	4	6.18
Percent	--	--	--	--	6.3	68.8	25.0	.54

Table E-37

CVCC Vehicle Commander Training Evaluation - Operational Concepts

DID THE CLASSROOM INSTRUCTOR PROVIDE ENOUGH INFORMATION ABOUT THE OPERATIONAL CONCEPTS UNDERLYING THE NEW EQUIPMENT?	Yes	No
Percent	87.5	12.5

Table E-38

CVCC Vehicle Commander Training Evaluation - CITV Classroom Training

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
OVERALL RATING						16
Frequency	--	--	5	7	4	3.94
Percent	--	--	31.3	43.8	25.0	.77
INSTRUCTOR						16
Frequency	--	--	2	7	7	4.31
Percent	--	--	12.5	43.8	43.8	.70
VIEWGRAPHS						16
Frequency	--	--	5	8	3	3.88
Percent	--	--	31.3	50.0	18.8	.72
HANDOUTS						16
Frequency	--	1	5	5	5	3.88
Percent	--	6.3	31.3	31.3	31.3	.96
TACTICAL EXAMPLES						14
Frequency	--	--	5	4	5	4.0
Percent	--	--	35.7	28.6	35.7	.88

Table E-39

CVCC Vehicle Commander Training Evaluation - CITV Hands-On Training

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			OVERALL RATING			
						16
Frequency	--	--	1	8	7	4.38
Percent	--	--	6.3	50.0	43.8	.62
			RA EXPLANATIONS			
						16
Frequency	--	1	3	7	5	4.00
Percent	--	6.3	18.8	43.8	31.3	.89
			CITV SKILLS TEST			
						16
Frequency	--	--	4	9	3	3.94
Percentage	--	--	25.0	56.3	18.8	.68

Table E-40

CVCC Vehicle Commander Training Evaluation - CCD Demonstration

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			OVERALL RATING			
						16
Frequency	--	--	4	8	5	4.13
Percent	--	--	18.8	50.0	31.3	.72
			INSTRUCTOR			
						16
Frequency	--	--	1	8	7	4.38
Percent	--	--	6.3	50.0	43.8	.62
			HANDOUTS			
						15
Frequency	--	1	4	6	4	3.87
Percentage	--	6.7	26.7	40.0	26.7	.92

Table E-41

CVCC Vehicle Commander Training Evaluation - CCD Hands-On Training

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			OVERALL RATING			
						16
Frequency	--	--	2	7	7	4.31
Percent	--	--	12.5	43.8	43.8	.70
			RA EXPLANATIONS			
						16
Frequency	--	--	5	7	4	3.94
Percent	--	--	31.3	43.8	25.0	.77
			CCD SKILLS TEST			
						16
Frequency	--	--	4	8	4	4.00
Percentage	--	--	25.0	50.0	25.0	.73
			REFRESHER DEMONSTRATION			
						14
Frequency	--	--	8	2	4	3.71
Percent	--	--	57.1	14.3	28.6	.91
			REFRESHER TASKS			
						16
Frequency	--	1	4	7	4	3.88
Percent	--	6.3	25.0	43.8	25.0	.89

Table E-42

CVCC Vehicle Commander Training Evaluation - Adequacy of Basic Simulator Training

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
HOW ADEQUATE WAS THE BASIC INFORMATION ON HOW TO USE THE SIMULATOR?						
						16
Frequency	--	--	3	9	4	4.06
Percent	--	--	18.8	56.3	25.0	.68

Table E-43

CVCC Vehicle Commander Training Evaluation - Adequacy of Training Exercises to Prepare for CITV Use in a Tactical Situation

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			CREW EXERCISE			
						16
Frequency	--	2	6	5	3	3.56
Percent	--	12.5	37.5	31.3	18.8	.96
			COMPANY STX			
						16
Frequency	--	1	3	11	1	3.75
Percent	--	6.3	18.8	68.8	6.3	.68
			BATTALION STX			
						16
Frequency	--	--	4	7	5	4.06
Percentage	--	--	25.0	43.8	31.3	.77
			BATTALION TRAINING SCENARIO			
						16
Frequency	--	--	2	7	7	4.31
Percent	--	--	12.5	43.8	43.8	.70

Table E-44

CVCC Vehicle Commander Training Evaluation - Adequacy of Training Exercises to Prepare for CCD Use in a Tactical Situation

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			CREW EXERCISE			
						16
Frequency	--	2	4	7	3	3.69
Percent	--	12.5	25.0	43.8	18.8	.95
			COMPANY STX			
						16
Frequency	--	1	4	6	5	3.94
Percent	--	6.3	25.0	37.5	31.3	.93
			BATTALION STX			
						16
Frequency	--	--	4	6	6	4.13
Percentage	--	--	25.0	37.5	37.5	.81
			BATTALION TRAINING SCENARIO			
						16
Frequency	--	--	3	5	8	4.31
Percent	--	--	18.8	31.3	50.0	.79

Table E-45

CVCC Vehicle Commander Training Evaluation - Opportunity for Hands-On Practice During Training Scenarios

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			CITV			
						16
Frequency	--	--	2	7	7	4.31
Percent	--	--	12.5	43.8	43.8	.70
			CCD			
						16
Frequency	--	--	4	7	7	4.31
Percent	--	--	12.5	43.8	43.8	.70

Table E-46

CVCC Vehicle Commander Training Evaluation - Preparedness for Final Battalion Training Exercise

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
						16
Frequency	--	1	2	9	4	4.00
Percent	--	6.3	12.5	56.3	25.0	.82

Table E-47

CVCC Vehicle Commander Training Evaluation - CVCC Equipment Not Used During Final Battalion Training Exercise

WERE THERE ANY CITV OR CCD FUNCTIONS THAT YOU DIDN'T USE DURING THE FINAL BATTALION TRAINING EXERCISE?

	No	Yes
Percent	68.8	31.3

Table E-48

CVCC Vehicle Commander Training Evaluation - Clarity of CITV Training Objectives and Feedback During Training

	Very Unclear	Somewhat Unclear	Neutral	Somewhat Clear	Very Clear	N Mean S.D.
			CITV TRAINING OBJECTIVES			
						16
Frequency	--	--	2	5	9	4.44
Percent	--	--	12.5	31.3	56.3	.73
			CITV FEEDBACK DURING TRAINING			
						16
Frequency	--	2	4	3	7	3.94
Percent	--	12.5	25.0	18.8	43.8	1.12

Table E-49

CVCC Vehicle Commander Training Evaluation - Clarity of CCD Training Objectives and Feedback During Training

	Very Unclear	Somewhat Unclear	Neutral	Somewhat Clear	Very Clear	N Mean S.D.
			CCD TRAINING OBJECTIVES			
						16
Frequency	--	--	1	6	9	4.50
Percent	--	--	6.3	37.5	56.3	.63
			CCD FEEDBACK DURING TRAINING			
						16
Frequency	--	2	5	2	7	3.88
Percent	--	12.5	31.3	12.5	43.8	1.15

Table E-50

CVCC Vehicle Commander Training Evaluations - Quality of Training Exercise Debriefs

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			FIRST BATTALION TRAINING EXERCISE DEBRIEF			
						16
Frequency	--	1	5	9	1	3.63
Percent	--	6.3	31.3	56.3	6.3	.72
			FINAL BATTALION TRAINING EXERCISE DEBRIEF			
						16
Frequency	--	1	3	9	3	3.88
Percent	--	6.3	18.8	56.3	18.8	.81

Table E-51

CVCC Vehicle Commander Training Evaluation - Potential Contribution of Using SAFOR as a Training Tool

	Poor	Below Average	Average	Above Average	Excellent	N Mean S.D.
			FIRST BATTALION TRAINING EXERCISE DEBRIEF			
						16
Frequency	--	--	5	6	5	4.00
Percent	--	--	31.3	37.5	31.3	.82

APPENDIX F

ACRONYM LIST

<u>Acronym List</u>

ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
BLUFOR	Blue Forces
BMP	Soviet Infantry Fighting Vehicle
BOS	Battlefield Operating System
BP	Battle Position
C3	Command, Control, and Communication
CATK	Counterattack
CCD	Command and Control Display
CCTB	Close Combat Test Bed
CFF	Call for Fire
CIG	Computer Image Generation
CITV	Commander's Independent Thermal Viewer
COA	Course of Action
COFT	Conduct of Fire Trainer
CoM	Center of Mass
CRT	Cathode Ray Tube
CSS	Combat Service Support
CVCC	Combat Vehicle Command and Control
DBMS	Database Management System
DCA	Data Collection and Analysis System
DCD	Directorate of Combat Development
DCE	Data Collection Exercise
DIS	Distributed Interactive Simulation
ECR	Exercise Control Room
FCL	Fire Coordination Line
FLOT	Forward Line of Own Troops
FRAGO	Fragmentary Order
GARB	Green, Amber, Red, Black
GLOS	Gun Line of Sight
GPS	Gunner's Primary Sight
GPSE	Gunner's Primary Sight Extension
HEAT	High Explosive Anti-Tank
IDC	Interactive Device Controller
IFF	Identification Friend or Foe
INTEL	Intelligence
IVIS	Intervehicular Information System
LD	Line of Departure
LOS	Line of Sight
LRF	Laser Range Finder
MCC	Management, Command and Control System
MWTB	Mounted Warfare Test Bed
N	Number of Observations
NBC	Nuclear, Biological, Chemical
NCS	Net Control Station
NTC	National Training Center
OBJ	Objective
OE	Operational Effectiveness
OPFOR	Opposing Forces
OPORD	Operations Order
PL	Phase Line

Acronym List (Cont'd)

POSNAV	Position Navigation
PVD	Plan View Display
REDCON	Readiness Condition
S2	Intelligence Staff Officer
S3	Operations Staff Officer
SA	Situational Awareness
SAFOR	Semiautomated Forces
SCC	SIMNET Control Console
SD	Standard Deviation
SIMNET	Simulation Network
SIMNET-D	Simulation Network--Developmental
SIMNET-T	Simulation Network--Training
SINCGARS	Single Channel Ground/Air Radio System
SitDisplay	Situation and Planning Display
SITREP	Situation Report
SME	Subject Matter Expert
SMI	Soldier-Machine Interface
SOP	Standard Operating Procedure
STX	Situational Training Exercise
TACOM	Tank Automotive Command
TF	Task Force
TO	Task Organization
TOC	Tactical Operations Center
TRP	Target Reference Point
TTP	Tactics, Training, and Procedures
VBs	Vision Blocks
XO	Executive Officer