COMBAT VEHICLE
COMMAND & CONTROL (92)
INNOVATIVE TRAINING METHODS

Research Product 2 (Draft)

Submitted By:
Coral Systems Company
ADST Program Office
Orlando, Fl

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ELECTE
S AUG 2 3 1994
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Prepared For:
United States Army
Simulation, Training & Instrumentation Command
Orlando, Fl

In Response To:
Contract N61339-91-D-0001
Delivery Order D006
CDRL Item A00F

BEST AVAILABLE COPY

94-26782

22 March 1993

DTIC QUALITY INSPECTED 1

94 8 22 108

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION	1b. RESTRICTIVE MARKINGS
UNCLASSIFIED	

2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	Approved for public release; distribution is unlimited. A

4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
	ARI Research Product

6a. NAME OF PERFORMING ORGANIZATION	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
BDM International, Inc. BBN Technologies, Inc.		U.S. Army Research Institute

6c. ADDRESS (City, State, and ZIP Code)	7c. ADDRESS (City, State, and ZIP Code)
1801 Randolph Rd. SE Albuquerque, NM 87106	ATTN: PERI-1K Fort Knox, KY 40121-J620

8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
U.S. Army Research Institute	PERI-I	

8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS			
	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
5001 Eisenhower Avenue Alexandria, VA 22333-5600				

11. TITLE (Include Security Classification)
Innovative Training Concepts for Use in Distributed Interactive Simulation Environments

12. PERSONAL AUTHOR(S)
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13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 91/9 TO 93/2	93 Feb 9	

16. SUPPLEMENTARY NOTATION
Contracting Officer's Representative, Dr. Kathleen A. Quinkert

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Innovative Training Concepts, Information Management Exercises, Distributed Interactive Simulation, Simulation-Based Training, Automated Command, Control and Communication, Training Tools

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report describes innovative approaches for conducting training using emerging simulation technology. It is intended as a forward looking reference for training developers and trainers interested in conducting specific types of training exercises within a Distributed Interactive Simulation (DIS) environment. The report characterizes major trends in training requirements within the Army community, presents five innovative training concepts that can be structured within a DIS environment for delivery of five types of training exercises, and describes the implementation and tryout of one of these five concepts, an Information Management Exercise (IMEX).

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☒ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
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DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted.
All other editions are obsolete.

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Research Product XXX

Innovative Training Concepts for Use in

Distributed Interactive Simulation (DIS) Environments

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Accesion For		
NTIS CRA&I		☒
DTIC TAB		☒
Unannounced		☐
Justification		
By		
Distribution /		
Availability Codes		
Dist	Avail and / or Special	
A-1		

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January 1993

Army Project Number	Training Simulation
XXXXXXXXXXXXX	

FOREWORD

The Army Research Institute (ARI) is charged with conducting basic and applied behavioral and social research that will contribute to the Army's capability to meet the solider performance challenges of today and tomorrow. As part of ARI's training research program, the objective of the Future Battlefield Conditions team at Fort Knox is to enhance soldier preparedness by identifying future battlefield conditions and developing training methods that assure effective soldier performance under these conditions.

As the Army moves toward the greater use of simulation environments for training, particularly distributed interactive simulation (DIS) environments, innovative training concepts are needed to capitalize fully on the capabilities of simulation environments for training. This product characterized emerging training requirements within the Army community, presents five innovative training concepts for structuring simulation-based exercises and describes the implementation an tryout of one of these concepts, an Information Management Exercise. It is intended as a reference for training developers and trainers with an interest in using advanced simulation technologies for training.

ARI's research on training requirements and methods for future automated C3 systems is supported by the Memorandum of Agreement (MOA) between USARI-Knox and the Tank Automotive Command (TACOM) on Combat Vehicle Command and Control (CVCC) dated 22 March 1989 and the MOA between USARI-Knox and the U.S. Army Armor Center (USAARMC) and Fort Knox titled Research in Future Battlefield Conditions, 12 April 1989.

The results of this effort were briefed to . . . . .

EDGAR M. JOHNSON
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INNOVATIVE TRAINING CONCEPTS FOR USE IN DISTRIBUTED INTERACTIVE SIMULATION (DIS) ENVIRONMENTS

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INNOVATIVE TRAINING CONCEPTS FOR USE IN
DISTRIBUTED INTERACTIVE SIMULATION (DIS) ENVIRONMENTS

Introduction

This Research Product describes innovative approaches for conducting training using emerging simulation technology. These concepts are innovative in two senses. First, they address training requirements which are presently being articulated within the Army community in response to current policy decisions, particularly the downsizing of the force, the fielding of increasingly sophisticated technological equipment and the shrinking budgets. Second, they use Distributed Interactive Simulation (DIS) as the environment within which training is delivered. Advanced simulation technologies such as DIS provide opportunities for unit and leader training which up until recently required expensive field training. DIS offers a cost effective alternative by allowing soldiers to participate in training exercises through interactive combat vehicle simulators engaged in a simulated battlefield environment.

This Research Product is one of two products derived from a program of research on innovative training sponsored by the U.S. Army Research Institute's Field Unit at Fort Knox (ARI-Knox). As part of ARI-Knox's training research mission, the Future Battlefield Conditions (FBC) Team has been engaged in research on emerging training requirements, the role of simulation technology in addressing these requirements and the development and tryout of specific concepts and tools. This product focuses on the development of emerging training concepts and the tryout of one specific approach in the form of an Information Management Exercise (IMEX). The other describes specific tools and products which have been used to support training over the course of the larger FBC research program (Atwood & Winsch, in preparation).

The two research products are intended as companion documents. The present document is intended as a forward looking reference for those readers interested in conducting specific types of training exercises within a DIS environment. The other is intended as a current catalog of existing training tools and capabilities within the DIS environment which can be called upon for a variety of training purposes. Since the two documents grew out of the same research effort, some of the text describing the background of the effort has been incorporated into both documents. This strategy has been adopted to facilitate the understanding of the reader and has been endorsed by the authors of both reports.

Overview of the Research Product

The purpose of this Research Product is two-fold. The first is to characterize the major trends in training requirements within the Army community and to present five innovative training concepts which can be structured within a DIS environment for delivery of five types of training exercises. The second is to describe the implementation and tryout of one of these five concepts, an Information Management Exercise (IMEX).

The primary audience for this product is training developers and trainers with an interest in the use of simulation environments for delivering leader and collective training. Training developers may wish to consult this document as they update and extend training doctrine, such as Army Training and Evaluation Plans (ARTEPs) and Army Mission Training Plans (AMTPs), to incorporate emerging training requirements and to include simulation based exercises. Trainers within institutional and unit settings may wish to examine this document for concepts and materials which can be incorporated into their Program of Instruction (POI) or training plans, particularly as their access to DIS environments (such as the Army's Close Combat Tactical Trainer [CCTT]) increases.

This Research Product is organized into five major sections and an appendix. The remainder of this section describes the background for ARI's program of research on innovative training. The second section highlights emerging training requirements on which consensus is growing within the Army community. The third section presents five concepts for addressing emerging training requirements within a DIS environment. Sections 4 and 5 focus on the implementation and tryout of one specific concept, the Information Management Exercise (IMEX). The Appendix includes all of the materials used to deliver and evaluate the IMEX. Training developers and trainers may find these materials particularly helpful as they design or structure their own exercises focused on information management skills.

Background

ARI-Knox's FBC Team is charged with conducting research to forecast conditions on the future battlefield and to develop training methods to prepare soldiers to perform effectively under these conditions. The FBC Team has used the Army's DIS facility at Fort Knox, the Close Combat Test Bed (CCTB) as a focal point for this research. The present effort aimed at the development and tryout of innovative training concepts grew out of this research program. The following discussion is intended to provide a short synopsis of the larger training research program and to describe the architecture and components of the DIS environment in which it was conducted as background for the reader.

The ARI-Knox Training Research Program. The FBC Team has been engaged in an ongoing program of research and development aimed at supporting the Army's requirements for future C3 systems. A major thrust of this work has focused on future Combat Vehicle Command and Control (CVCC) systems. As part of the CVCC program, ARI-Knox has been conducting simulation-based research on future C3 system configurations and the training requirements associated with these configurations.

The research program has included a series of simulation-based, soldier-in-the-loop evaluations of future tank systems and their associated training requirements. These efforts have proceeded in a bottom-up fashion from assessments of crew and platoon performance using a digitized position navigation (POSNAV) system (DuBois and Smith, 1989) and an automated Command and Control Display (CCD) for the tank commander (DuBois and Smith, 1991). A subsequent investigation examined the integration of the CCD and POSNAV with the Commander's Independent Thermal Viewer (CITV), a digitized target acquisition tool for tank commanders (Quinkert, 1990). These efforts were followed by a series of investigations of company performance including: a company level evaluation of the operational effectiveness of companies equipped with CVCC systems including integrated POSNAV, CCD and CITV capabilities (Leibrecht et al., 1992); an examination of the training requirements associated with the system (Atwood et al., 1991); and research on soldier-machine interface (SMI) issues associated with the design of CVCC user interfaces and controls (Ainslie, et al., 1991).

More recent evaluations are focusing on the extension of future C3 capabilities to the battalion level. These efforts include an evaluation of automated workstations to support a battalion Tactical Operations Center (TOC) (Leibrecht et al., in preparation) and an evaluation of battalion level performance currently in progress.

The impetus for the innovative training concepts described here lay in the increased understandings of training requirements projected for the future battlefield and of the powerful role that simulation environments can play in training derived from the FBC research program. These concepts were formulated to capitalize on the capabilities of the DIS environment which are described below.

The DIS Environment. The Army, along with the other military services, is currently engaged in the design of a Distributed Interactive Simulation (DIS) architecture. The DIS architecture is intended to provide a blueprint to guide the development of a general purpose simulation system which will meet the needs of a wide range of users, as shown in Figure 1 (from Beaver et al., 1992).
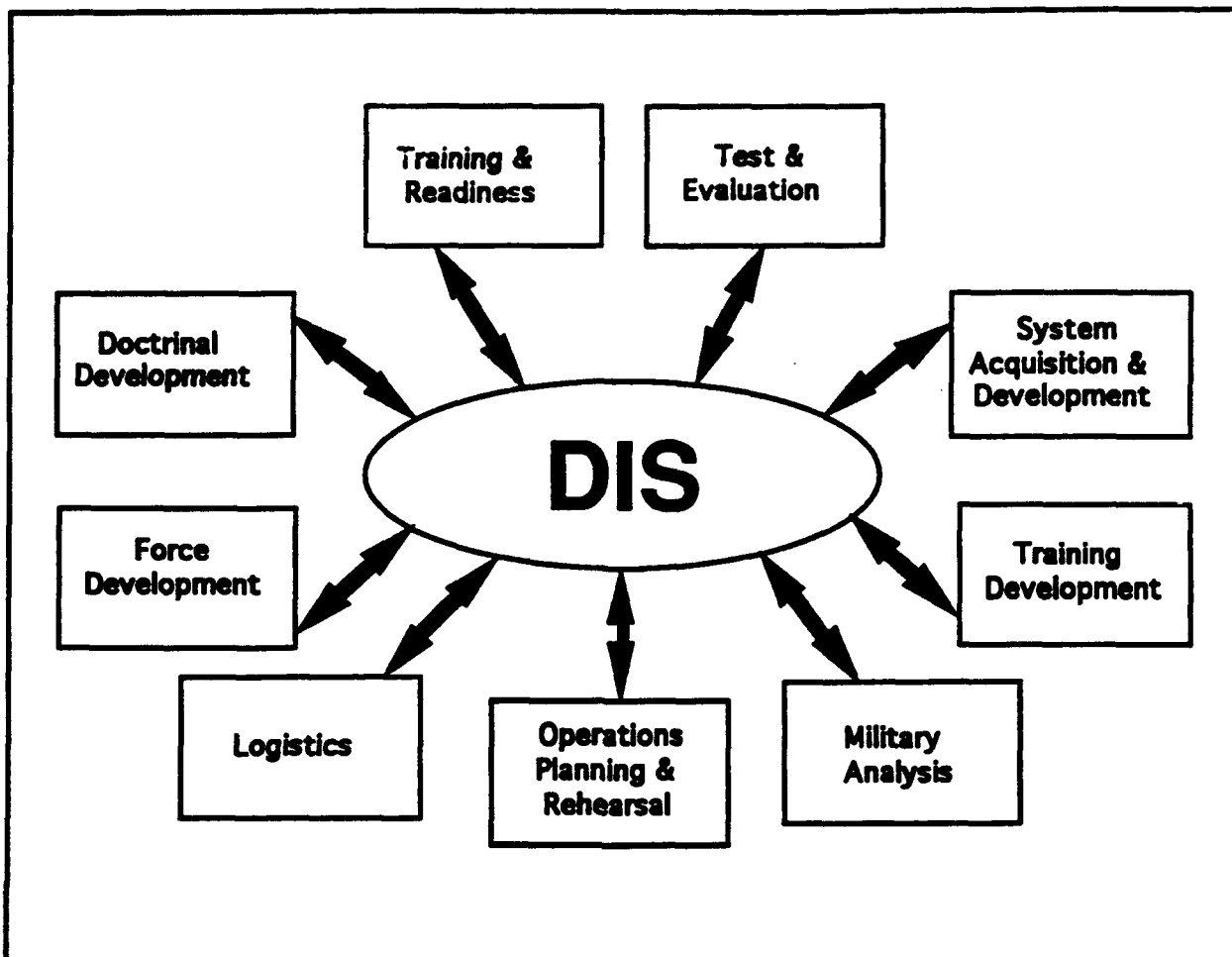
Figure 1. User Needs to be Met by Distributed Interactive
Simulation (DIS) (From Beaver et al, 1992)

The DIS architecture is being structured to satisfy a large set of user objectives. Most notable here are "Training Development" and "Training & Readiness". In implementing an architecture to address such diverse needs, the most pervasive and general principle is to implement a man-in-the-loop simulation which simulates battlefield interaction between multiple warfighters at levels of fidelity that are sufficient to invoke realistic decision making behavior by the participants.

DIS is a direct descendent of simulation networking (SIMNET) technology. SIMNET was initiated in 1983 as a project on large-scale simulator networking by the Defense Advanced Research Projects Agency (DARPA). It was a proof-of-principle technology demonstration of interactive networking for real-time, person-in-the-loop battle engagement simulation and wargaming suitable for a broad range of applications (Alluisi, 1991).

The FBC team initiated its CVCC research and development program in the SIMNET facility established at Fort Knox in May, 1986. The facility includes standard SIMNET combined arms simulators routinely used for tactical training, particularly in the area of command, control and communications, housed at the Fort Knox Combined Arms Tactical Training Center (CATTC). An adjacent facility also includes developmental simulators designed to serve as reconfigurable weapon systems in which selected system characteristics can be modified to emulate conceptual weapon system configurations and their associated soldier-machine interfaces. These

simulators are housed in the Fort Knox Close Combat Test Bed (CCTB) located adjacent to the CATTC. The CCTB is the site of the FBC Team's research program.

Figure 2 illustrates the SIMNET architecture which has supported the ARI program. These components provide the environment within which the training concepts described in this Research Product are intended to be implemented and evaluated.
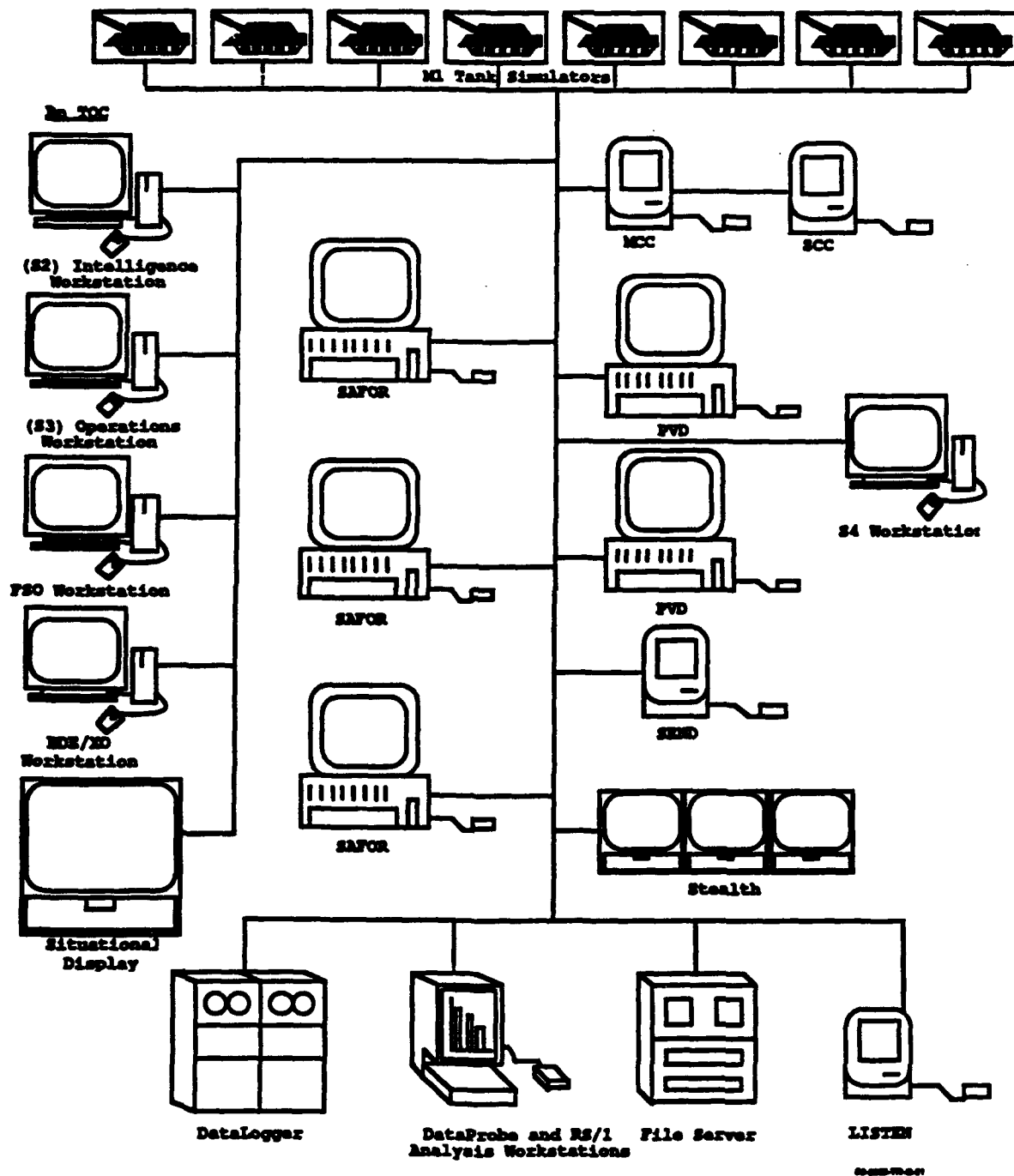
Figure 2. The Distributed Interactive Simulation (DIS) Architecture

More specifically, the architecture includes five major classes of components. The first class includes the simulators themselves shown at the top of the figure. As noted earlier, these M1 simulators are capable of being reconfigured to operate with CVCC prototype systems (including an integrated POSNAV, CCD, CITV capability) or as standard baseline M1 simulators. The second class includes the automated Tactical Operations Center which includes workstations for battalion staff including an Intelligence Workstation, Operations Workstation, a Fire Support Workstation, a workstation which an be used as a Brigade or an Executive Officer Workstation, a Combat Service Support (S4) workstation, and a large screen Situation Display.

A third major component identified in Figure 2 is the Stealth. The Stealth is a phantom vehicle which can be used to traverse the battlefield without detection by battlefield participants. The Stealth has been used for a wide variety of purposes including terrain analysis, reconnaissar and After Action Reviews (AARs).

A fourth class of components reside in or adjacent to the Exercise Control Room. They include: a Management, Command and Control (MCC) system for controlling and monitoring manned simulators and implementing fire support; a SIMNET Control Console (SCC) for initializing an exercise and setting battlefield parameters, Semi-Automated (SAFOR) stations for creating and controlling unmanned vehicles and aircraft, both friendly (BLUFOR) and enemy (OPFOR); a Plan View Display (PVD) for providing a "birds eye view" of the battlefield which can be used to monitor exercises and flag key events; a SEND station for transmitting automated messages; and radio nets for monitoring simulated SINCGARS radio traffic and communicating between control stations and manned simulators. Finally, the computer room contains a set of components for use in data recording and analysis including: a file server, a Data Collection and Analysis System (DCA) for on-line recording of automated data and exercise playbacks (DataLogger) and off-line reduction and analysis (Data Probe and RS/1 Analysis Workstations), and a LISTEN station to record digital messages.

Taken together, the components forming this architecture provides the structure within which the innovative training exercises described here are intended to be implemented and evaluated. It provides the larger picture for interpreting how the specific exercises described in subsequent sections can be delivered within a DIS environment.

As a first step in conceptualizing innovative training concepts, this effort focused on characterizing the nature of emerging training requirements within the Army community and understanding the projected role of simulation environments, such as DIS, in future training strategies. Two approaches were adopted to examine these issues. First, doctrinal literature on future training requirements and strategies was reviewed. Second, interviews were conducted with representatives of key agencies in the Armor community and the Combined Arms community to elicit their priorities and perceptions in these areas. An integrative analysis was then conducted to identify pivotal training requirements and to articulate the projected role of simulation environments in addressing these requirements. The following discussion summarizes these activities and their results.

Doctrinal Views of Future Training Requirements

The U.S. Army has institutional mechanisms in place for identifying training requirements. These requirements emerge from two primary sources: examinations of past performance or "lessons learned" to identify areas requiring attention and projections of future trends and their implications for training requirements.

The principal Army agency charged with examining lessons learned is the Center for Army Lessons Learned (CALL) at Fort Leavenworth, Kansas. As part of a larger study of the availability of land for Army field training, the General Accounting Office (GAO, 1991) summarized the common training shortfalls identified by CALL based on their analysis of lessons learned from the Army's Combat Training Centers and other major training exercises (such as Reforger). CALL's analysis revealed requirements for improved performance in the following areas: battlefield planning by commanders and their staffs, use of intelligence data in developing plans of operations (intelligence preparations of the battlefield), conduct of reconnaissance and counter reconnaissance, maintenance of communications and conduct of rehearsals. Follow-up interviews of key Army leaders by GAO staff suggested that many believed that the key to addressing these areas is increased emphasis on individual and small unit training. Many of these training requirements have also emerged from published observations and interviews during Desert Storm (see, for example, Kolcum, 1991).

While several Army agencies have charters to examine future requirements, the Army's overall view of future training requirements is well characterized in a draft pamphlet currently under coordination by the Army's Training and Doctrine Command (Draft TRADOC PAM 525-5B). This pamphlet recognizes the unprecedented changes which the Army is facing including downsizing of the force, the budget on which it depends, and available land for maneuver and ranges. At the same time, the Army is fielding high technology devices and weapon systems that enhance lethality on the battlefield but demand: (a) considerably greater command and control skills from leaders; (b) more precise, complex performance from soldiers; and (c) greater space for training. The global environment and the changing nature of the threat from a U.S. - Soviet balance of power to a multipolar world order with new centers of regional power further complicate the situation. This threat calls for versatile forces which can perform their missions under a variety of conditions and circumstances, can project units to carry out contingency operations and can operate in conjunction with coalition forces.

The Draft TRADOC PAM 525-5B calls for training as a cornerstone for developing and maintaining a smaller Army capable of effectively accomplishing its mission and countering the threats to U.S. interests. It is based on a concept for AirLand Operations for a Strategic Army which describes how Army forces will operate as the land component of military power in joint, combined and interagency operations in the future. TRADOC recognizes tough, realistic training

as a prerequisite for successful implementation of this strategic concept. TRADOC leaders expect the principles of training inherent in the Army's capstone training doctrine manual, FM 25-100, to remain valid and to drive evolving tactics, techniques, and procedures. (See Figure 3.) This approach will be supplemented by the Combined Arms Training Strategy (CATS) currently under development by each proponent school. CATS will serve as a training and resource management tool to "squeeze every bit of value from every training event and program" to meet the challenging training requirements of the future.

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│            PRINCIPLES OF TRAINING             │
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│                                               │
│   Train as Combined Army and Service Teams    │
│   Train as You Fight                          │
│   Use Appropriate Doctrine                    │
│   Use Performance-Oriented Training           │
│   Train to Challenge                          │
│   Train to Sustain Proficiency                │
│   Train Using Multi-echelon Techniques        │
│   Train to Maintain                           │
│   Make Commanders the Primary Trainers        │
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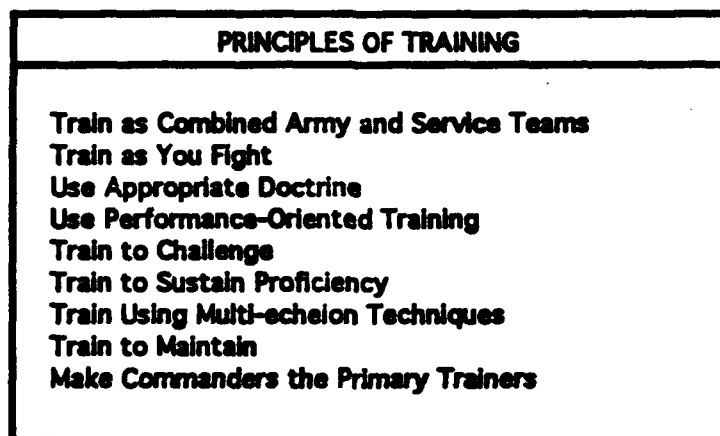
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Figure 3. Training Principles from FM 25-100

The Armor community has formulated the Armor 2000 strategy and the Armor portion of CATS to articulate projected requirements for the Armor force and strategies for delivering training to meet these requirements. The Armor 2000 strategy views training as the cornerstone of mobility and lethality of the Armor force. Given an era of resource constraints, Armor is moving to a device and simulation based training strategy coupled with live fire and maneuver field exercises. This training strategy emphasizes realistic simulations, combined and integrated simulators and modern training devices which can be used to train soldiers, vehicle crews and units on nearly all required battlefield tasks under demanding conditions.

In summary, the majority of high priority, future training requirements center on needs for high quality command, control and communications (C3) and precise, fine tuned collective performance by units throughout all phases of a mission from planning through preparation and execution. In order to address these requirements, the Army intends to hold fast to its basic principles of training (as outlined in the capstone training manual, FM 25-100); however, simulation is expected to play an increasingly greater role in training.

Interviews with Selected Representatives of the Army Training Community

To elaborate our understanding of emerging training requirements, interviews were conducted with representatives of key Army agencies at the U.S. Army Armor Center and School (USAACS) at Fort Knox, Kentucky and the Combined Arms Command (CAC) at Fort Leavenworth, Kansas. Given the varying missions of these agencies, tailored interview protocols were produced to focus questions appropriately. The interviews were intended to provide input into our front end analysis of training requirements and were not intended to elicit data that were necessarily comparable across respondent groups. Thus, our analysis of the interview responses was descriptive in nature with attention to commonality of views across respondents; however, no

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attempt was made to quantify responses or to conduct a rigorous content analysis. Our approach to the interviews at each site and key findings emerging from the discussions are summarized below for Fort Knox and Fort Leavenworth, respectively.

The Armor Training Community at Fort Knox. This series of interviews at the U.S. Army Armor Center was structured and focused on the use of DIS capabilities to address current and emerging Armor training requirements in the areas of command and control, intelligence, and maneuver.

Table 1 shows the agencies that participated in the interviews at Fort Knox. Typically, several representatives from an agency participated in a single interview session. No response in this section will be presented in such a way to allow for identification of the interviewee, since all participates were guaranteed anonymity. Each interviewee received an interview packet containing a copy of each question and diagrams of the Command and Control, Intelligence, and Maneuver Battlefield Operating Systems (BOSs) to use as a reference in responding to questions. Interviewees gave verbal responses to questions which were recorded and with permission, audio taped. Interview sessions ran from 1.5 to 2.5 hours, depending on the interviewees' availability. While attempts were made to adhere to the interview structure, most participants had expertise in a segment of the interview such as current rather than future training needs. This required a more flexible approach resulting in some interviewees not responding to all components of the interview.

- Unit Performance Assessment Team (ARI)
- New Systems Training
- New Equipment Training Team (NETT)
- Futures Group
- Directorate of Combat Developments (DCD)
- Close Combat Test Bed (CCTB)
- Combined Arms Tactical Training Center (CATTC)
- Combined Arms Training Strategy (CATS)
- Armor Officer Advance Corps (AOAC)
- U.S. Army Armor Center and School (USAACS)

Table 1. Participating Ft. Knox Agencies

It is important to note that most of the current and emerging training needs cited by interviewees can be addressed using simulation environments such as DIS. Table 2 shows the interviewees' responses when asked to identify current and emerging training needs for command and control skills. For instance, SOP training can be accomplished by using DIS to train to standard a wide variety of tasks and correct procedures such as the correct organization of a seized objective or adherence to a set of criteria for displacement. This training can be augmented by use of the STEALTH and PVD for playbacks during AARS, minicameras for behavioral observation, and utilities such as SEND, LISTEN, and Checkpointing. For a full description of these and all of the training tools available within the CCTB facility, see Atwood and Winsch (1993).

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Current
- SOP training
- Combined arms training
- Mass casualty training
- Synchronization of forces
- Cross-training
- Transition between maneuvers
- Train to ARTEP standards
- More iterations of training
- NBC training

Emerging
- Communication management
- Retainment of manual command and control skills
- Collective training
- SOPs for information management

Table 2. Ways that DIS can Support Command and Control Training Needs

Table 3 shows areas that interviewees offered as candidates for current and future intelligence training. Again, the DIS resources currently available within facilities such as those at Fort Knox would support training of most of these tasks (some would require software development). For instance, a leader's reconnaissance innovative training concept (discussed in a later section) has been developed.

Current
- Simulate a library of data bases
- Simulate different types of enemy doctrine
- Conduct IPB
- Replay scenarios in AARs
- Conduct leader's reconnaissance

Emerging
- Develop an automated templating capability for S3
- Develop a trafficability map
- Collective training

Table 3. Ways that DIS can Support Intelligence Training Needs

Table 4 shows examples of current and future training needs for maneuver tasks offered by the interviewees. Many of these training needs could be aptly addressed with the current DIS capabilities of the CCTB.

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Current
- Formation training
- Decrease fratricide
- Simulate weather and terrain obstacles
- Collective training
- Provide objective feedback

Emerging
- Retainment of map reading skills
- Division of attention between maneuvering and automated C3 equipment

Table 4. Ways that DIS can Support Training Maneuver Needs

Additional training needs identified by the interviewees that are particularly suitable for DIS environments included collective training, standardization of training, hands-on training, situational awareness, and interpretation of Commander's intent. Many interviewees expressed concern over how to ensure the retainment of skills necessary to support a manual mode of tasks expected to be automated in the future. Interviewees were unanimous in their agreement of the need for continued training of manual skills such as map reading. Given this, they felt that the introduction of automated C3 equipment would increase overall training time but significantly increase combat effectiveness.

Another commonly expressed concern dealt with an anticipated increase in information load associated with automated C3 equipment. To address this training need, interviewees suggested more cross-training of tasks. It was felt that the increased information load experienced by a Vehicle Commander or Tactical Operations Center (TOC) staff member would necessitate that support staff alleviate the load by receiving cross-training on tasks.

In addition to more cross-training, interviewees believed that the information load associated with automated C3 equipment would necessitate the development of information management SOPs and training programs directed at information management skills. Questions such as when to use voice rather than digital communications, how to filter incoming information, when to relay information and to whom, and how to divide attention between automated C3 devices such as the Intervehicular Information System (IVIS) and vision blocks were voiced as key concerns. Suggestions on how to train information management skills generally were expressed in terms of table top in-basked exercises designed to be conducted in a classroom setting. The Information Management Exercise (IMEX) training option described in the Innovative Training Concepts section and the remainder of this report was developed to address this training need.

The Combined Arms Training Community at Fort Leavenworth. The interviews conducted at Fort Leavenworth were structured to gather participants' views of current training needs and emerging training requirements, particularly in the area of command, control and communications (C3). The C3 area is a focal area of CAC and has been recognized as a particularly important area in published reports of training requirements and one which lends itself well to simulation-based training.

Agencies participating in the interviews are identified in Table 5. While we have not identified specific individuals to maintain privacy and confidentiality, most interviewees were field grade officers or above or senior civilians at the rank of GS-12 or above. In some cases, one

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representative from an agency was interviewed. In other cases, group interviews were conducted generally with two or three individuals, although two interview sessions numbered six participants due to the high level of interest by the agencies participating in the interview.

• Center for Army Lessons Learned (CALL)
• Combined Arms Training Integration Division (CTID)
• Future Battle Laboratory (FBL)
• National Simulation Center (NSC)
• School for Advanced Military Studies (SAMS)
• Tactical Commander's Development Course (TPDC)

Table 5. Participating Ft. Leavenworth Agencies

Respondents from the CAC community shared considerable commonality in their views of emerging C3 training requirements. Requirements identified in these interviews are summarized in Table 6.

• Continued stress on fundamentals (communications over secure and nonsecure radios, timely situation awareness, information downlink)
• Planning Skills of Battalion Staff and Orders Process
• Coordination of Battalion Battle Staff
• An Effective Rehearsal Process
• Discipline for Managing and Orchestrating Execution of Battle
• Integration of Combat Assets to Achieve Battle Synchronization
• Leadership Handoffs (XO as 2IC, S3 as Commander's replacement if KIA or WIA)
• Management of Information Overload
• Reinforce Manual Skills Given Automation
• Better SOPs
• The Human Dimension of Command (Operating under Stress, Conveying Leadership, Filtering Information, Making Decisions)

Table 6. Emerging C3 Training Requirements

There was a strong view that the fundamentals of C3 as currently laid out in doctrine will continue to be important and must be mastered. In addition, the planning process and the need for effective coordination among battalion staff was emphasized. The rehearsal process and mission execution skills including combat management, battle synchronization and leadership transition also received attention. Respondents also recognized the role of automated C3 devices in influencing future training requirements observing that automation will require explicit training for managing information effectively, improved SOPs which address information management issues and sustainment training so that manual skills are not eroded through the use of technology. Finally, one respondent in particular highlighted that the human dimension of command must not be neglected as technology's role on the battlefield increases.

To further understand the potential impacts of technology, interviews also focused on the nature of C3 technologies which are currently being examined and can be expected to influence how C3 is conducted and trained in the future. Technologies viewed as particularly promising by CAC representatives are identified in Table 7. These technologies have the potential to strengthen the C3 process through more robust messaging, additional media to refine situation awareness, automated tracking of logistics data and more powerful navigational aids.

• Voice Interface Technology (Voice Input and Output)
• Sensors for Automatic Logistics Tracking (e.g., ammo, fuel)
• Frequency Management through Bit-Oriented Commo Pipes
• Video Capture and Transmission
• Technology for Combat Identification (IFF)
• Interoperability of Systems
• Electronic Map
• Embedded GPS

Table 7. Promising C3 Technologies

Finally, discussions at CAC also addressed how training needs to be delivered in the future for maximum efficiency and effectiveness. Training delivery requirements emerging from these interviews are highlighted in Table 8.

• Hands-on Simulation Training
• Automated Vignettes for Staff Training
• Operational C3 Devices which can "Plug-In" to Simulations for Training
• "Seamless Simulation"
• Standardized Training
• Embedded Training
• Explicit Command Training under Extreme Stress
• Objective Performance Feedback
• Quality Assessment through AARs
• Evaluation Based on Documented Evidence

Table 8. Future Training Delivery Requirements

There was general agreement that simulation needs to play an increased role in future training. The use of simulations and simulators offers multiple advantages including the opportunity for hands-on experience and structured vignettes which can be used establish standardized training exercises. Respondents also viewed the use of actual C3 devices as part of simulation training as desirable. Their concept was for "plug in" devices which could be used in conjunction with simulation based training exercises. An extended view of these interconnections focused on the use of "seamless simulation" for training in which simulations, simulators and

actual operational equipment (either in use in the field or "plugged in" to a simulation environment) could be simultaneously used in a training exercise.

Other requirements for training delivery perceived as important by the Combined Arms community centered on the embedded training for device operators and training for commanders under realistic, stressful conditions. Finally, requirements for improved evaluation and performance feedback were emphasized with needs for more objective data and better After Action Reviews (AARs).

In sum, our interviews with the Armor and Combined Arms communities yielded considerable agreement about emerging training requirements and the need to address them with more flexible, realistic and cost-effective training delivery strategies. Focal areas for future training include improving the capability of leaders to manage large amounts of information effectively (given the emergence of digital communications) and emphasizing mission fundamentals including skilled planning, careful preparation and rehearsal and disciplined performance of well practiced tactical procedures.

An Enhanced Role for Simulation Environments in Training. The need to counter a wide variety of diverse threats at a time of manpower and budget reduction has placed increased priority on training generally and on simulation as a strategy for delivering training in particular. Simulation offers a cost-effective strategy for providing training on a widespread basis under a variety of conditions. This growing recognition of the increasing use of simulation for training is apparent in recent doctrinal literature on training such as CATS and Armor 2000 and was a consistent thread in our interviews with members of the Armor and Combined Arms communities.

This trend was also recognized by the keynote speaker at the 1992 Armor Conference. As part of his remarks, COL Molinari, Director of Training Development at Fort Knox, offered seven compelling reasons for training using simulation. They centered on the capabilities of simulation, especially distributed interactive simulation, to provide:

- greater frequency of training events;
- more in-depth analyses of tasks;
- better training of collective tasks;
- objective feedback;
- realistic scenarios;
- training efficiency;
- training standardization; and
- training under more varied conditions.

It is clear that simulation as a training strategy is receiving increasing recognition in the Army community. This trend is also occurring in the other military services as they face similar challenges. For example, the Navy is currently developing a tactical combat training system that will enable surface, air and submarine participants to train with real and simulated forces using current and future weapon systems (Kolcum, 1991). Similarly, the Air Force has been examining training uses of multiplayer air combat simulations for training pilots on tactics in a combat environment (Houck, Thomas, & Bell, 1989). Furthermore, combined arms exercises which include participants from multiple services are also being viewed as a critical element of the military's future training strategy (Gorman, 1992). As the technological issues allowing linkage of instrumented ranges and maneuver areas, combat simulations and manned simulators operating in computer-simulated battle environments are resolved, the new paradigm for tactical engagement simulation (TES), "seamless simulation", is likely to take on increasing prominence in training leaders and units across the armed forces.

As the projected use of simulation for training becomes increasingly recognized and accepted, the problem facing training developers and trainers becomes one of determining how to plan and structure simulation environments to maximize their capability to provide realistic and effective training exercises. The concepts presented in this Research Product are intended to illustrate some innovative approaches to capitalizing on the capabilities of an interactive simulation environment to train leaders and units on high priority training requirements.

Innovative Training Concepts

Overview of Five Innovative Training Concepts Using DIS

Our primary focus in this section is on describing five innovative training concepts which are capable of implementation within a DIS environment. These concepts were specifically formulated to address training requirements which are growing in prominence within the Army community as the nature of the future battlefield is projected. They were also conceptualized for delivery within a simulation training environment in light of current trends toward the increased use of simulation for training, reduced budgets and areas for field training, and the capability to simulate emerging technology to be fielded (such as automated command and control devices) within this type of environment.

Figure 4 provides an overview of the five training concepts formulated and the driving training requirements behind them. As shown in the figure, the requirement to integrate emerging technology within current procedures--particularly automated devices to aid in command, control and communications (C3)--led to the development of an Information Management Exercise (IMEX). The IMEX is aimed at developing skills in managing digital information received using a prototype C3 device.

The remaining four training concepts are all mission-oriented and related to a specific battle phase: planning, preparation and execution. These exercise concepts were driven by three broad training requirements which cut across the battle phases as shown in Figure 4. These requirements were repeatedly stressed in our interviews with the Army community and are being incorporated into many emerging documents on training requirements. They call for increased attention to the fundamentals of the C3 process and to the procedures for ensuring battle synchronization by effectively coordinating combat assets. The third requirement stressed the need for prerequisite training so that scarce time and resources for field exercises can be optimally used.

Finally, training requirements specific to each of the three battle phases also guided our thinking as shown in Figure 4. Thus, we have formulated concepts for two exercises focused on mission planning: a Battle Staff Planning Exercise and a Leaders Reconnaissance Exercise; one focused on mission preparation: a Mission Rehearsal Exercise (Electronic Sandtable); and one focused on mission execution: a Mission Execution Exercise (Electronic Sandbox).

The following sections present descriptions of each of the training concepts identified above. They are intended to provide training developers and trainers with possible approaches to consider as they plan and implement simulation-based training. They also provided a framework of options for the FBC Team at ARI-Knox to select from in identifying a candidate exercise for subsequent development, implementation and tryout.

However, before introducing these concepts in more depth, we wish to highlight the design principles used in formulating these concepts. These principles guided the substance and format of the concepts below. Some of these principles are embedded in the Army's capstone training doctrine manual, FM 25-100; others emerged in our interviews with members of the Army community as particularly important considerations in future training design. In brief, our training design principles included:

(1) design performance-oriented training;

(2) set the training concept in the appropriate institutional and/or unit training setting;

(3) provide a foundation for developing standardized, replicable training events;
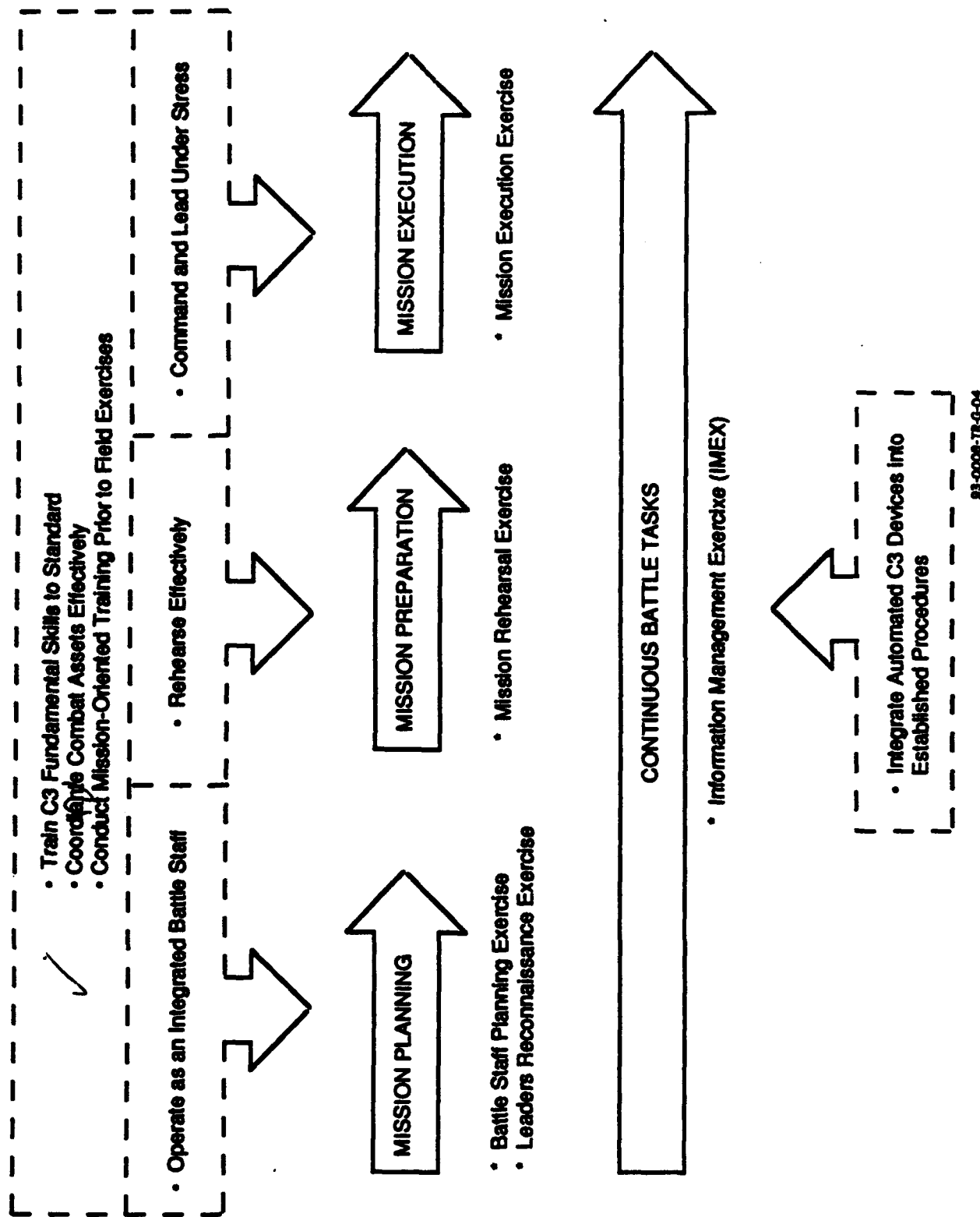
Figure 4. Driving Training Requirements for Innovative Training Concepts

MISSION EXECUTION

MISSION PREPARATION

MISSION PLANNING

CONTINUOUS BATTLE TASKS

- Train C3 Fundamental Skills to Standard
- Coordinate Combat Assets Effectively
- Conduct Mission-Oriented Training Prior to Field Exercises

- Command and Lead Under Stress
- Rehearse Effectively
- Operate as an Integrated Battle Staff

- Mission Execution Exercise
- Mission Rehearsal Exercise
- Battle Staff Planning Exercise
- Leaders Reconnaissance Exercise

- Information Management Exercise (IMEX)
- Integrate Automated C3 Devices into Established Procedures

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(4) build in hands-on experience to the extent possible;

(5) allow multiple opportunities for practice;

(6) make the training concept as realistic as possible, with particular attention to features that influence performance;

(7) formulate a strategy for capturing objective performance data;

(8) plan for incorporating feedback to trainees into the exercise through a structured After Action Review (AAR); and

(9) explicitly identify the resources required to develop the training concept including existing hardware and software and development of training materials and training software.

More specifically, descriptions of the five training concepts which follow are organized into eight parts. These parts address: the training audience for the exercise, the training context in which the exercise might appropriately be delivered, the operational concept for training delivery, the operational concept for training feedback, the hardware and software required to support the exercise, recommendations for implementation and tryout, requirements for development of training materials and requirements for software development or modification.

One of these concepts, the IMEX, was subsequently implemented and tried out. The implementation, including operation of the training delivery and training feedback software, is described in a later section of this Research Product. Two of the other concepts, the Battle Staff Planning Exercise and the Mission Execution Exercise, were final candidates for implementation. As such, more detailed functional software specifications were prepared for these exercises and they are also included in the description of these two training concept.

An Information Management Exercise (IMEX)

The purpose of the IMEX is to train small unit leaders to manage incoming information efficiently and effectively. The exercise draws on a prototype automated C3 device to support receiving, processing and sending digital messages.

Training Audience. The recommended training audience is Company Commanders and Platoon Leaders. Given the Army's plans to field vehicle-based automated C3 devices in future tanks, leaders at the platoon and company level will be directly affected and they will need to learn to incorporate handling digital messages into their C3 procedures. Participating Company Commanders and Platoon Leaders may be presently serving in these positions or completing training in advance of such an assignment. In the Armor community, Company Commanders would most appropriately be drawn from the Armor Officer Advanced Course (AOAC) and Platoon Leaders from the Armor Officer Basic Course (AOB).

Training Context. There are two primary institutional training contexts for this exercise within the Armor community. They include AOAC and AOB.

As noted above, the primary focus of this exercise is information management of automated digital communications. Currently, automated command and control devices are not included in the Programs of Instruction (POIs) for AOAC or AOB. However, as such devices become fielded, it will be necessary to revise the POIs to include instruction on the use of automated digital communications. Thus, this exercise provides an example of one approach for addressing such training within the curriculum. If implemented at this time, this exercise would familiarize students

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with a prototype automated command and control device and provide initial training on information management skills for digital messages.

The training tasks associated with this exercise can be conceptualized as future Enabling Learning Objectives (ELOs) associated with the current Terminal Learning Objectives (TLOs) in the POI. More specifically, for AOAC these ELOs would come under the purview of the Command and Staff Department in the Small Group Instruction portion of the POI. The specific point in the AOAC POI would depend on whether the Command and Staff Department chooses to treat automated command and control devices as an introductory topic prior to Test Point I or within the context of a specific type of operation. In the latter case, the exercise would most appropriately occur prior to Test Point III for offensive operations or prior to Test Point IV for defensive operations.

For AOB, the information management tasks addressed in this exercise address future ELOs for the TLO related to mounted tactical training. This TLO, identified as "SA.609160 - Mounted Tactical Training (Armor)" is stated as follows: "The student, during day and night conditions, will conduct platoon techniques of movement and offensive/defensive operations."

In either case, the following training tasks would constitute the ELOs supporting the above TLOs currently embedded in the AOAC and AOB POI. The ELO subsumes three primary training tasks as shown below.

- Using a prototype automated command and control device, the student will:

(1) receive digital reports;

(2) process information received by posting information to the map display and/or preparing new reports;

(3) relay digital reports to higher, lower or adjacent units as appropriate.

Operational Concept for Training Delivery. The operational concept for this training exercise is drawn from Lickteig (1991). Lickteig used vignettes systematically varying in number of messages and relevance of messages to examine communications handling. This concept capitalizes on Lickteig's approach and extends it in two main ways by:

(1) systematically increasing information load over sequence of training vignettes for a progressive increase in training difficulty; and

(2) providing performance feedback to students and an After Action Review (AAR) structure for feedback from a Training Coordinator and group discussion and exchange.

More specifically, students from AOAC or AOB would participate in this exercise in small groups up to four in size. Each student would be assigned the position of Company Commander (AOAC students) or Platoon Leader (AOB students).

Each student would be assigned a Student Workstation on which to complete the exercise. The workstation would be loaded with software for a prototype automated C3 device developed by ARI-Knox called the Command and Control Display (CCD). Each student would use the CCD to complete the exercise without any communication with other students or workstations. However, at the end of the exercise, students would participate in an AAR feedback discussion as a small group (described in the following section on operational concept for training feedback).

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The exercise itself would be organized into two major parts. The first part would focus on familiarization with the operation of the CCD. Students would receive an introductory briefing, demonstration, training and practice on the use of the CCD software. This training is envisioned to include review of self-paced training materials and practice exercises including use of a job aid on CCD operations. This job aid would serve as a reference during the training session and be available to the student during the exercise as needed. The practice session would also include a simple practice vignette similar to the training vignettes followed by a small group question and answer session.

The second part of the exercise would be organized to provide students with three vignettes of progressive difficulty. Each vignette would begin with the provision of an extract of an Operations Order (OPORD), a paper map and graphic overlay to set the context. Students would be given time to familiarize themselves with these materials before moving to the workstations. The map display on each CCD would be initialized to correspond to the given OPORD. For a 10 minute segment, the student would be directed to manage his message traffic using the CCD. Messages, including Spot, Contact and Intelligence reports, would be transmitted to the student at predetermined intervals. This transmission would be accomplished using an existing software program for transmitting messages developed by ARI-Knox, the SEND utility. Students would be directed to handle the message traffic appropriately given the tactical situation. These actions would include receiving messages, processing information contained in messages and taking appropriate action including posting information to his map display, deleting messages, relaying messages to higher or lower units and taking no action. To conclude the vignette, each student would be asked to prepare a situation report (SITREP) identifying current location, degree and type of enemy activity, critical shortages and a decision of whether to attack, defend or delay.

Each student would complete three vignettes of increasing difficulty which would be structured and sequenced to systematically increase the information load placed on the student. Load would be enhanced by increasing the number of messages transmitted to the student and reducing the interval between message transmissions.

Operational Concept for Training Feedback. The primary approach to training feedback envisioned would be self-assessment by students. This self-assessment would take two main forms. First, students would be provided a summary of their individual performance and a "preferred" strategy (derived from Armor Subject Matter Experts [SMEs]). They would have an opportunity to compare their performance to the expert approach.

Second, students would participate in an After Action Review (AAR) session after they have had an opportunity to review their feedback package and the expert package. The Training Coordinator would lead the discussion using a set of guiding questions. The AAR would focus on sharing self-assessments of message handling strategies and their relationship to the expert approach and on identifying improvements.

The AAR sessions would occur after each of the three vignettes. In addition to feedback to trainees on their performance, the AAR sessions would also focus on identifying additional improvements that could be made in handling digital communications. Finally, hard copy feedback packages would be prepared for students at the conclusion of the exercise so that they have a record of their performance for subsequent reference and study.

Required Hardware/Software Configuration. Somewhat different equipment is required for IMEX exercise development and exercise delivery as outlined below. (Descriptions of each of these components can be found in the first section of this Research Product which describes the architecture of the DIS environment.)

In order to develop this training exercise, the following equipment is needed:

- a Management, Command and Control System (MCC);

- 1 SPARCS Workstation with CCD software;

- a SEND station;

- a LISTEN station;

- a Plan View Display; and

- a SINCGARS radio.

For delivery of the training exercise, requirements include:

- 4 networked SPARCS workstations with CCD software, each operating in an ISOLATE mode to serve as Student Workstations;

- 1 SPARCS workstation networked with the Student Workstations with the SEND utility to serve as the Training Coordinator Workstation;

- a LISTEN station and printer;

- a Plan View Display;

- SINCGARS radios; and

- a large screen display for use during the demonstration.

Recommendations for Initial Implementation and Tryout of Option. To facilitate training development, it is recommended that the initial implementation of this exercise be structured using one mission and duty position. More specifically, to simplify the tactical situation but yet provide enough complexity to make the exercise challenging, a defense mission aimed at the Company Commander is recommended. This would serve as a useful starting point for implementing and trying out the IMEX. If successful, the IMEX could then be extended to other types of missions and to platoon leaders.

We expect that CCD familiarization, completion of the three vignettes, and conduct of the AAR sessions after each vignette would take approximately one and a half days. More specifically, we would anticipate devoting the first half day to CCD familiarization and practice. The second day would be focused on the completion of the practice vignette, the three training vignettes and the associated AAR discussions.

Training Materials Development Required. The following materials would need to be created. In some cases, these could be adapted from existing materials (1); in others, they would need to be developed (2) as shown below:

- (1) Initial context setting materials for vignettes including Operations Order (OPORD) extract, paper map and graphic overlay;

- (1) Accompanying messages for each vignette structured to vary information load and organized into appropriate files for use by the SEND utility ;

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- (1) Training materials for workstation familiarization;

- (1) Performance measures and summary formats for use in feedback package;

- (2) Introductory materials to introduce trainees to purpose of the exercise, training objectives, expectations for their behavior, and administrative/logistical issues;

- (2) Exercises to be used in conjunction with Workstation job aid for training;

- (2) Specification of doctrinal rules and teaching points associated with vignettes;

- (2) Elicitation of "preferred" strategies for information handling by Armor SMEs for use in feedback package for each vignette;

- (2) Guidelines for discussion leaders to be used in AAR sessions.

Software Modifications Required. Two types of software modifications would be required to support this exercise. The first type relates to exercise delivery, the second to training feedback.

First, delivery of this exercise is predicated on the use of four SPARCS workstations which are used by students operating individually. This configuration would require that:

- 4 networked SPARCS workstations are capable of running CCD software, and receiving messages from the SEND station without rotation of the center icon; and

- the above workstations must be capable of operating in parallel in the ISOLATE mode so that the CCD software can be operated without affecting the presentation to another student.

Second, to support training feedback, software modifications would be required to the LISTEN station in order to provide students with feedback on their performance. More specifically, the station would be required to generate and print measures of performance by message as well as summary measures. These measures might include those identified below.

Individual Message Handling:

- Report Identifiers

    - message source
    - message content

- Actions Taken

    - nature of action taken (including post to map, delete, relay, no action)
    - direction of relay

- SME Recommended Actions

    - recommended action
    - accompanying rationale.

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Exercise Summary:

- Student Actions by Type of Report

- SME Recommended Actions by Type of Report

- Discrepancy between Student and SME Actions with discrepant reports identified.

Situation Report Generation:

- Student SITREP

- SME SITREP

- SME Rationale.

It would be necessary that the software could identify and distinguish responses of individual students and prepare summaries of the above types of measures for each student.

Ideally, a hard copy report would also be available 15 minutes after completion of the vignette. In addition to tabular summaries, it may be desirable to present some summaries in graphical format.

The IMEX training materials and software for training delivery and feedback described above were subsequently developed and tried out in a small scale formative evaluation. Descriptions of the implementation and key findings from the try out can be found in subsequent sections of this Research Product. The Appendix to this product contains copies of the actual materials used in the exercise.

A Battle Staff Planning Exercise

This Planning Exercise is aimed at training planning skills of Battalion staff members and providing them the opportunity to work together in an integrated manner. Students would be provided a Brigade Operations Order and directed to work together in accordance with their Tactical Standard Operating Procedures (SOP) to develop a Battalion Operations Order and graphics, as well as the interim products. Each Battalion staff member would be provided a workstation with appropriate software to use in the exercise. Students would receive feedback in the form of annotated solutions and doctrinally correct examples.

Training Audience. The recommended training audience for this exercise is the Battalion Command Group and Staff. Four positions are recommended for inclusion: the Battalion Commander, the Battalion Executive Officer (XO), the Battalion Operations Officer (S3) and the Battalion Intelligence Officer (S2). Students enrolled in institutional training in preparation for these positions would be appropriate candidates. These individuals could all be drawn from the Armor Officer Advanced Course (AOAC). Or, the Battalion Commander could be drawn from the Pre Command Course (PCC) and participate with AOAC students as command group and staff members. Members of Battalion Command groups and staff in Active Units would also be an appropriate training audience given access to a DIS facility.

Training Context. As noted above, two institutional training settings within the Armor community are most appropriate for this exercise. They include AOAC and PCC. Unit training at Battalion is also an appropriate context. These contexts are highlighted below.

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For **AOAC**, the exercise would fall within the Small Group Instruction component of the course. This part of the POI is led by the Command and Staff Department. The specific point in the POI where it would be appropriate to include this exercise would depend on the specific mission selected. Options would include:

- Battalion Deliberate Attack (prior to Test Point II);

- Battalion Movement to Contact (Prior to Test Point III);

- Battalion Defense [Sector or Battle Position] (Prior to Test Point IV).

The specific AOAC training tasks for each of these missions to which this exercise applies are outlined below.

Battalion Deliberate Attack -

HC. 35008 - Battalion Task Force Deliberate Attack Estimate:
Student will discuss and apply the mission analysis process, preparing and issuing warning orders, and operations estimate as they pertain to Battalion/Task Force level.

HC.36008 - Battalion/Task Force Maneuver Planning:
Student will discuss and apply comparison of courses of action and developing a tentative plan.

HC. 37008 - Battalion/Task force Breaching Operations and Tentative Plan:
Student will discuss and apply making a tentative plan, considerations involved in breaching operations when planning Battalion/Task Force operations.

HC.38206 - Battalion/Task Force Deliberate Attack Reconnaissance:
Student will plan, perform and discuss leader's reconnaissance to confirm the tentative plan, considering METT-T factors, passage of lines and selection of attack position.

HC.39008 - Battalion/Task Force Roadmarch and Passage of Lines:
Student will update his tentative plan based on results of the reconnaissance TEWT, prepare and brief his finalized plan.

HC.44008 - Battalion Deliberate Attack (OPORD):
Students will develop and discuss a Task Force OPORD.

HC.45208 - Battalion/TF Deliberate Attack:
Students will plan, perform, prepare, present and discuss directing a deliberate attack and issuing a hasty attack FRAGO.

Battalion Movement to Contact -

HC.57008 - Battalion/Brigade Movement to Contact:
Students will discuss and plan a Battalion/Task Force Movement to Contact, Hasty Attack, consider courses of action, and brief an operations estimate.

HC.58204 - Battalion/Task Force Movement to Contact:
Students will plan, perform and discuss directing Battalion/Task Force Movement to Contact to include confirming the tentative plan and preparing and issuing FRAGOs.

HC.58004 - Battalion/Task Force Movement to Contact OPORD:
   Students will finalize, present and discuss their OPORDs.

Battalion Defense -

HC. 67007 - Defensive Operations:
   Students will discuss and apply principles of defensive operations, with concentration on preparing mission analysis.

HC.69009 - Defensive Intelligence Preparation of the Battlefield (IPB):
   Students will discuss and apply principles and techniques of conducting IPB including preparing templates and overlays.

HC.70008 - Develop a Tentative Plan for Battalion Defense in Sector:
   Students will prepare and brief their estimate of the situation and tentative plan as they pertain to defense in sector missions.

HC.71008 - Engineer Support and Counter-Attack Planning:
   Students will discuss and apply principles of Counterattack with Engineer Support. Prepare/complete the tentative plan for conducting a defense in sector mission. Students will prepare an obstacle plan in a computer assisted simulated wargame.

HC.72204 - Battalion/Reconnaissance (TEWT):
   Students will prepare a brief reconnaissance plan to verify the tentative plan.

HC.73008 - Defensive OPORD:
   Students will prepare and brief their Defensive OPORD.

HC.72004 - Obstacle Planning and Defensive OPORD Preparation:
   Students will plan, perform and discuss Battalion/Task Force defensive reconnaissance consisting of leaders reconnaissance plan, finalize obstacle plan preparing Task Force OPORD.

HC.74008 - Battalion/Task Force Battle Position Planning:
   Students will discuss and apply key considerations when planning a Battalion/Task Force Battle Position, preparing mission analysis, and a tentative plan and brief them to the team leader.

   For PCC, the exercise would fall within Annex A section of the course conducted by the Command and Staff Department. The specific point in the POI where it would be appropriate to include this exercise would depend on whether offensive or defensive operations are selected or whether the exercise was included as part of coordination with AOAC or familiarization with battlefield simulations. The training tasks to which this exercise would apply are identified below.

Offensive Operations -

SJ.24004 - Offensive Planning:
   Students will review and discuss troop-leading procedures from receipt of mission to issuance of OPORD. The students will be taught the IPB process and the commander's guidance required to execute an offense mission. The commander's role in the orders process will be emphasized.

<u>Defensive Operations</u> -

SJ.73004 - Defensive Planning/Synchronization:
Students will discuss the command estimate process, IPB and commander's guidance required to conduct defensive operations.

<u>Coordination with AOAC</u> -

SJ.61002 - SGI Interactions:
Students will observe/participate in AOAC small group instruction. The emphasis is on familiarizing students with the current AOAC environment and instruction, and on giving the PCC students the benefit of interacting with future company commanders and staff officers. This exercise provides an additional instructional opportunity for this interaction.

<u>Familiarization with Battlefield Simulations</u> -

SJ.61004 - Battlefield Simulation:
Students will review and discuss Battlefield Simulations. Discussion will focus on how to use simulations to identify training weaknesses and correct them. Students will receive an orientation/familiarization of SIMNET and an overview of the JANUS and ARTBASS systems. This exercise provides a concrete example of use of simulation for training.

In the unit training context, appropriate training tasks for this exercise can be found in the Battalion level Army Mission Training Plan (AMTP). These tasks are outlined below. (Standards are not provided for brevity but can be found in the AMTP.)

<u>Battalion Task Force (ARTEP 71-2-MTP)</u> -

TASK: Command and Control the Battalion Task Force (TF).

Subtasks: TF leaders issue the warning order.
             TF commander analyzes mission and gives initial guidance.
             TF accomplishes reconnaissance and other actions to gather needed
              information.
             TF commander develops and war games courses of action, and selects one.
             Staff develops an OPORD from the commander's guidance.
             TF commander and staff issue implementing FRAGOs.
             TF commander and staff issue the OPORD/FRAGO.

<u>Operational Concept for Training Delivery.</u>   In the institutional training context, students from AOAC would participate in the exercise in small groups up to four (although threesomes, pairs or individuals could be accommodated). Each student would be assigned the duty position of Battalion Commander, Battalion XO, Battalion S3 or Battalion S2 and a workstation. Alternatively, the Battalion Commander for this exercise could be drawn from PCC with other duty positions filled by AOAC students. In the unit training context, the Battalion Command group and staff (Battalion Commander, XO, S3 and S2) would participate in the exercise. Students would review training materials and the job aid on workstation operations and familiarize themselves with the workstation. Students would also be provided with a Tactical Operations Center Standing Operation Procedure (TOC SOP) for their review and use in the exercise.

A Brigade Operations Order and associated graphics (with Intelligence Annex and associated overlay) would be provided to the Battalion Commander for his review and study. These materials would be provided in hardcopy and entered into the workstation for his use. (In the latter case, the Brigade Operations Order would be sent to the workstation using an existing software

program developed under the auspices of ARI-Knox, the SEND utility. Graphics would be entered into the workstation beforehand.) The Battalion Commander would be directed to prepare to brief the mission and issue his planning guidance to his staff. After an appropriate amount of time, the XO, S2 and S3 would convene with the Battalion Commander to receive his mission briefing and planning guidance. The Battalion Commander may use the workstation to brief his mission as he deems appropriate.

The task of the students operating as Battalion Command Group and Staff would be to work together in accordance with the TOC SOP to prepare:

- Commander's planning guidance;

- a Warning Order;

- IBP templates and overlays;

- an operations estimate;

- a tentative plan;

- a leader's reconnaissance;

- an updated plan;

- the Battalion Operations Order and graphics.

Trainees would be expected to operate as a normally functioning TOC during the planning phases of a mission using the provided SOP. However, in addition to voice communication, they would receive and send information using their workstations.

Operational Concept for Training Feedback. The primary approach to training feedback would be self-assessment by students. This self-assessment is anticipated to take two main forms. First, students would compare their products to annotated solutions and doctrinally correct examples. Second, students would be presented textual descriptions of key teaching points. One or both forms may be provided as the basis for self-assessment depending on the specific product.

For example, after a Warning Order is prepared, the student would click the mouse on a done option. Then a doctrinally correct example would be presented and students would be directed to compare their product to the doctrinally based example. The doctrinally correct example would be presented as one acceptable approach, not the ONE right answer. When there are discrepancies, students would be directed to consider whether they would make a change and if so, how. If they would not make a change, they will be asked to formulate their rationale. On-line feedback would also include a message center containing explanatory text windows which would include major teaching principles.

For products requiring graphic overlays such as tentative or updated Operations Plans, on-line feedback would include sets of doctrinally correct graphic overlays which would be placed over the developed overlay. The doctrinally correct overlay would be in a different color such as green. This approach would allow the student to compare this overlay with a doctrinally correct overlay to examine the correspondence between, for example, sets of control measures.

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Required Hardware/Software Configuration. This training exercise would require:

- 4 networked SPARCS workstations with TOC software (previously developed under the auspices of ARI-Knox) and a terrain database;

- 1 networked (lesser capability) SPARCS workstation to operate the SEND utility; and

- large screen for Situation Display.

Recommendations for Initial Implementation and Tryout of Option. Our recommendations for structuring the initial implementation of this option is to use a Defense in Sector mission so as not to complicate planning with tactical movement. Duty positions would include: Battalion Commander, XO, S3, and S2.

We expect that workstation familiarization and completion of the planning exercise would take approximately two days.

Training Materials Development Required. The following materials would need to be adapted from existing materials (1) or developed (2) in order to implement this exercise:

- (1) Mission scenario including Brigade OPORD and accompanying messages organized into appropriate files for use by the SEND utility;

- (1) Graphic overlay corresponding to Brigade OPORD entered into the workstations;

- (1) Intelligence Annex and overlay for Brigade OPORD containing Brigade inputs to the Battalion IPB;

- (1) Specifications for terrain database corresponding to scenario;

- (1) Modifications to existing Battalion TOC SOP as needed;

- (1) Training materials for workstation familiarization;

- (2) Introductory materials to introduce trainees to purpose of exercise, training objectives, expectations for their behavior, and administrative/logistical issues;

- (2) Exercises to be used in conjunction with workstation job aid for training;

- (2) Specification of doctrinally correct overlays and associated teaching principles/rationale; and

- (2) Input for storyboards for message center feedback system to include text windows conveying teaching principles, explanatory rationales.

Software Modifications Required. Two types of software modifications would be required to implement this exercise. The first type would be needed for training delivery, the second for training feedback.

For training delivery: three types of software modifications would be required:

(1) In order to train the leader reconnaissance task, it would be desirable to introduce two functions into the workstation software. The first function is the capability to draw a profile of terrain between two selected points. This capability would allow the

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leader to examine the terrain in more depth as part of his reconnaissance. The second is an intervisibility function which would allow assessment of the map reconnaissance conducted on the work station as part of the Battalion Commander's leaders reconnaissance. Desired functions for the workstation represent current capabilities on the Plan View Display (PVD). (See initial section of this Research Product for a discussion of the components and capabilities within the DIS environment.)

(2)   Modifications would also be required to workstation software to add the graphics and symbology required to generate IPB templates and overlays.

(3)   Students would also need to be able to send and receive messages from other training participants using the workstation. Workstation software must support communication among the Battalion Commander, XO, S3 and S2.

For training feedback, primary software modifications would center on implementing routines for providing feedback to students on-line in a timely manner (i.e., within 15 minutes of completion of a given product). Feedback would be specific to each of the products generated by students as appropriate. Two types of feedback are anticipated. For products involving graphics, feedback is expected to include a set of overlays of doctrinally correct graphics that can be laid on top of graphics developed by students. The doctrinally correct overlay would be in a different color such as green and would allow the students to assess key similarities and differences between their product and one doctrinally correct approach.

The second type of feedback is expected to include textual descriptions. For example, the workstation screen might be divided into three parts. The first part would provide participants with an onscreen format for a given product. When this product is completed, a second part of the screen would display a doctrinally correct product. A third part of the screen would list major teaching points associated with the product. A two-level system for this part is envisioned with a first level overview of key teaching points and a capability to click on any point which then brings up a second explanatory screen with more detailed information.

Specific requirements are anticipated for each product listed below. These generally include a specified format for the students to use in generating the product, a doctrinally correct example in the same format, and a list of key learning points at two levels of detail as outlined below.

Commander's Planning Guidance -

(1)   Restated mission.

(2)   Additional information/guidance to be considered by staff in planning process.

Warning Order - Format is variable and dependent on type of mission but may include one or more of the following paragraphs:

(1)   Heading.

(2)   Situation.

(3)   Attachments/Detachments.

(4)   Earliest time of move.

(5)   Nature and time of the operation.

(6)   Time and place of orders group.

(7)   Administrative/logistical information.

(8)   Acknowledgment.

IBP templates and overlays - Templates and template manipulation tools to perform:

(1)   Battlefield area evaluation;

(2)   Terrain analysis;

(3)   Weather analysis;

(4)   Threat evaluation;

(5)   Threat integration.

Operations Estimate - Format currently exists on workstations.

Tentative Plan - Current OPORD format with a section labeled "Assumptions" added.

Leader's Reconnaissance - Intervisibility function will provide mechanism for examining the quality of the map reconnaissance.

Updated Plan - Same format as tentative plan with capability to change the label and revise content.

Battalion Operations Order and graphics - Currently exists as OPORD format on workstation.

The following section describes required software modifications in more detail.

Functional Requirements for Software. This section outlines the functional software modifications to the CVCC TOC workstation software to permit the use of CVCC SPARCS workstations in the training of Armor Officer Advanced Course Students as a Battalion Commander, Battalion Executive Officer, an S2 (Intelligence Officer), and an S3 (Operations Officer).

The required hardware network configuration is as shown in Figure 5 below. The components of the network are: four networked SPARCs workstations for the student's use, one networked SPARC workstation capable of operating the SEND utility and the overlay module, and a large screen monitor for the situation display.

In general, the intent is to build upon the software already available for the TOC workstations with changes/modifications held to the minimum required to support the training mission. CVCC software currently available will require some modification to permit its use in a workstation planning exercise. In the training network, both message and overlays must be capable of being sent and received over the network and discrete destination addressing for message and overlays must be implemented. Currently, TOC workstations can "pull" files and overlays from other workstations; it is desired that message and overlays be capable of being "sent" between workstations. The specific modifications desired are discussed below.
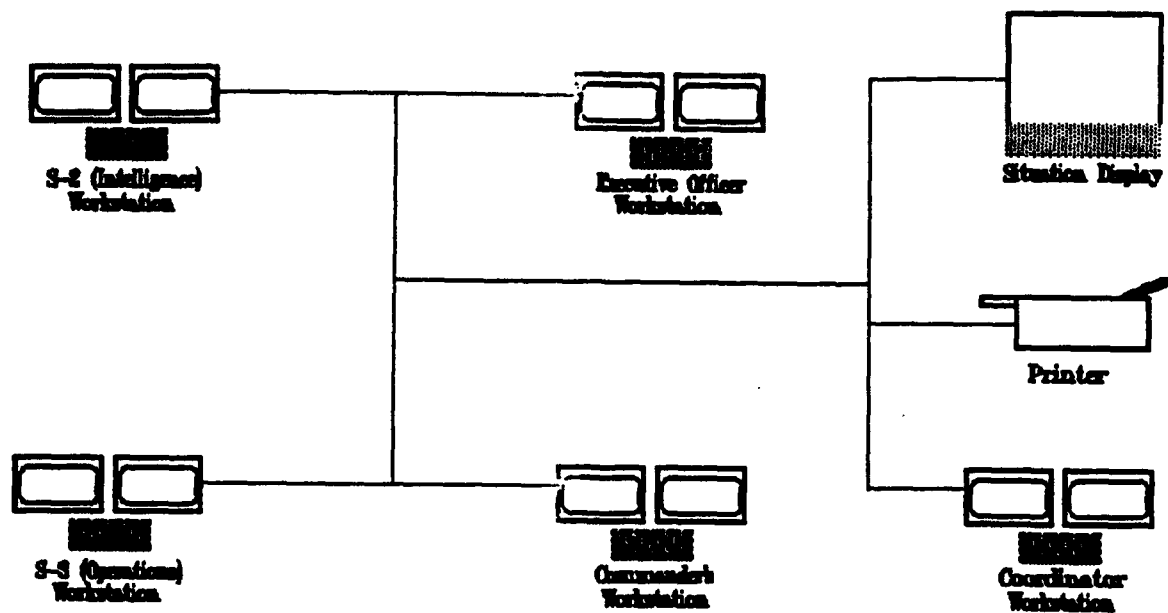
Figure 5. The Planning Exercise Network

In addition to the current capabilities, the TOC workstation must be capable of receiving and displaying brigade operation plans/orders including overlays and full page free text formats dispatched (sent) from the COORDINATOR workstation (The COORDINATOR station will emulate the Brigade Headquarters workstation). Overlays are a common part of Brigade Operations Plans/Orders. In addition, intelligence overlays are often forwarded down to the battalion as a part of Intelligence Summaries (INTSUMS). As these overlays are received and displayed the battalion task force staff WILL BE ALLOWED to edit the overlays (even though the battalion task force is not the originator) however, when editing is done, the edited overlay must be renamed. This will allow the staff to build upon the picture as it is seen by the higher headquarters and to add the additional symbology and information which is of concern to the battalion task force.

For the purposes of providing training feedback, there are two categories of Preferred Solution Examples (PSE) which will be utilized. These are: (a) Individual PSE which are prepared by the individual student and are primarily the product of individual work; and (b) PSEs which are the product of collaborative effort on the part of the commander and the staff.

Certain preferred solution overlays and formats will be dispatched from the COORDINATOR workstation for storage at the battalion task force workstations. These will be protected from display until the officer-student finishes preparing a required action (e.g. preparing warning order). The student will click the mouse on a "COMPLETE" button to indicate that he has completed the requirement. This action will release the corresponding Preferred Solution Example and its "POINTS" file which had been protected from display so that the students can compare their solution to the Preferred Solution Example. In the case of an overlay, the preferred example may be displayed (in a contrasting color) over the student prepared solution on the map display. In the case of a text-based type requirement (e.g., a written intelligence annex) the preferred solution example will be displayed beside the student's solution on the righthand workstation screen. The preferred solutions presented will be "locked" with "read only" attributes.

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In addition to the release of Preferred Solution Examples, discussed above, there are some staff actions which are group coordinated actions which can best be addressed as a collaborative Preferred Solution Example. In this case, as each component of the collaborative solution is completed by the commander and his staff and they indicate "COMPLETE" a screen (as an alternate to the "POINTS" screen) should appear which indicates that the Preferred Solution Example will be presented when all components of the staff action have been indicated as complete. This message will indicate that, when the collaborative action is complete, the students will gather as a small group to review the component parts of the PSE and participate in group discussion. This will generally be done by projecting map and overlay data on a large screen display for review and reviewing the text data at the appropriate workstation. The screen shown at Figure 6 is prepared and input from the COORDINATOR Workstation and is unique to each requirement which calls for a group solution. As each component of the group solution is indicated as "COMPLETE", an indicator will appear in the ( ) shown in Figure 6. When all components of the collaborative solution are complete the PSEs for all of the components will be released at the appropriate workstations for use by the student and for the small group review. If the student "clicks" on NEXT on Figure 6, the notice in Figure 7 appears. The Figure 7 notice will be a standard notice which appears for group collaborative requirements.

```
+-------------------------------------------------+
|                  POINTS                         |
|                  (OPLAN)                         |
|                                                 |
|   IPB Template                        ( )       |
|   Intell Annex                        ( )       |
|   Opns Estimate                       ( )       |
|   Opns Overlay                        ( )       |
|   OPLAN Draft                         ( )       |
+----------------+----------------+---------------+
|     EXIT       |     BACK       |    NEXT       |
+----------------+----------------+---------------+
```

Figure 6. Points (OPLAN)

```
+-------------------------------------------------+
|               GROUP REVIEW                      |
|                  (OPLAN)                         |
|                                                 |
|  NOTICE:  Upon completion of all components of  |
|  the group collaborative effort, the Preferred  |
|  Solution Examples for all portions of this     |
|  requirement will be made available at each cmdr|
|  or staff officer's workstation.                |
+----------------+----------------+               |
|     EXIT       |     BACK       |               |
+----------------+----------------+---------------+
```

Figure 7. Group Review (OPLAN)

The S2 Workstation will utilize the current S-2 workstation software with some additional capabilities. Intelligence Preparation of the Battlefield (IPB) using doctrinal templates is described in the workstation documentation (BBN, 1989) and in Chapter 4-7 of FM 71-2. If time and resources permit it is desired to implement a Template Module on the S-2 Workstations. If resource or time constraints do not permit the implementation of the Template Module, a work around using the ability to edit incoming overlays from the COORDINATOR (Brigade) workstation can be used. The workaround will require that the overlay tools permit movement and

rotation to any angle of symbols. In addition, the ability to prepare and place opposing force (Red) symbols which are of a distinct type will be ...eded. It will be necessary to be able to identify opposing force unit symbols and icons which are placed as a template of opposing forces from the unit symbols and icons placed on the map as a result of battlefield reports. This would require that the software support three distinct types of opposing force (OPFOR) symbols as shown in Figure 8.
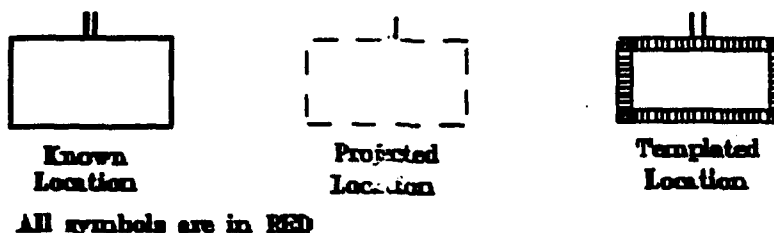
Figure 8. Required OPFOR Symbols

The S3 Workstation will be configured with the normal S3 CVCC modules with the addition of the Concept of Operations Module, a full page free text format, and the additional map tools described below.

The CO and the XO Workstations will be configured with the normal CO/XO workstation modules with the addition of additional map tools to expedite the workstation use for map reconnaissance and with the addition of a full page free text format.

The additional map tools desired to assist the CO/XO use of the workstation for map reconnaissance are the tools which will allow determination of battlefield intervisibility. These tools may function similarly to the intervisibility tools on the Plan View Display (PVD) currently in use. Specifically these tools must:

(1)   Display the status of intervisibility, using a color code, along a line of sight between two selected points on the battlefield. The first point selected will be the location of the observer with the second point selected representing the terminal point (target) being viewed.

.   (2)   Display the status of intervisibility, using a color code along rays extending from a point in a 360° circle (at 15° intervals) for a range of 3500 meters from the selected point.

(3)   Display a profile of the terrain along a line of sight selected between two battlefield points.

The full page free text format will allow the CO/XO to use the workstation in preparing notes and guidance, restatement of his mission and for other notation uses. This full page free text format will be used between the TOC workstations. There is difficulty in identifying free text messages in the incoming message queues at the present time. It is desired to change the message queue functioning on all workstations to display the first few words of the text message in addition to the current information in order to facilitate identification of the message contents.

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The Coordinator Workstation (CW) is used by the instructor to input scenario information and to set the situation for the training exercise. The workstation also will have the tools required for the instructor to insert teaching "POINTS" down through the third level text screens. In order to emulate several different brigade communication channels (i.e.: Bde Cmd Net, Bde O & I Net, etc.) discrete addressing to the four other workstations on the net is required.

The following modules will be required on the coordinating display:

(1)   The SEND utility (front and or entire module);

(2)   The overlay module;

(3)   The format module (with full page free text format added);

(4)   The Map Module including the intervisibility tools described above;

(5)   A new module, the "SOLUTION" module, will be required to permit the entry of the preferred solutions and the "feedback" screens. Three levels of linked "feedback" screens will be planned for, although three levels may not be required in all cases.

The "Preferred Solution" is a doctrinally based solution which has been prepared by the training instructor using the modules available on the CW. It is the initial stage of feedback to the student and is revealed only after the student has indicated that he has finished an action required by the scenario and the staff interaction. The student indicates that the action (e.g., overlay or text format) is finished by "clicking" on a 'COMPLETED" button. The "Preferred Solution" linked to that action is released and automatically displayed on the screen. At the same time a "POINTS" menu specifically tailored and "linked" to the completed action is displayed. (This menu may be displayed on the same screen or on the opposite screen.)

The tools in the "SOLUTION" module will allow the instructor to enter a series of related screen menus which provide feedback and explanation to the student on demand. These screens successively provide three levels of specificity to the feedback.

The "SOLUTION" module must also be capable of preparing and storing certain "standard" explanatory screens similar to those shown in Figures 5 and 6. These will allow the instructor to prepare screens ahead of time for use in a variety of scenarios and will not require inputs from the keyboard each time they are needed.

The first level of the SOLUTION module, the "POINTS" menu, designates the key teaching points associated with the overlay or format which the student has prepared, as required by the scenario being utilized. When the "COMPLETED" button has been activated, in the case of an action involving an overlay, the "Preferred Solution" overlay would automatically be placed over the student's overlay. The "Preferred Solution" overlay would be in a contrasting color to assist the student in identifying differences between his solution and the "Preferred Solution." The "POINTS" menu would also be presented on the map display at a location which did not obscure either the student's solution or the preferred solution. When the "COMPLETED" BUTTON has been activated, in the case of an action which is textually based, (e.g., prepared using the Format Module) the "Preferred Solution" would automatically be presented side-by-side with the student prepared solution. Again the "POINTS" menu would be displayed in a location which did not obscure either the student's solution or the "Preferred Solution."
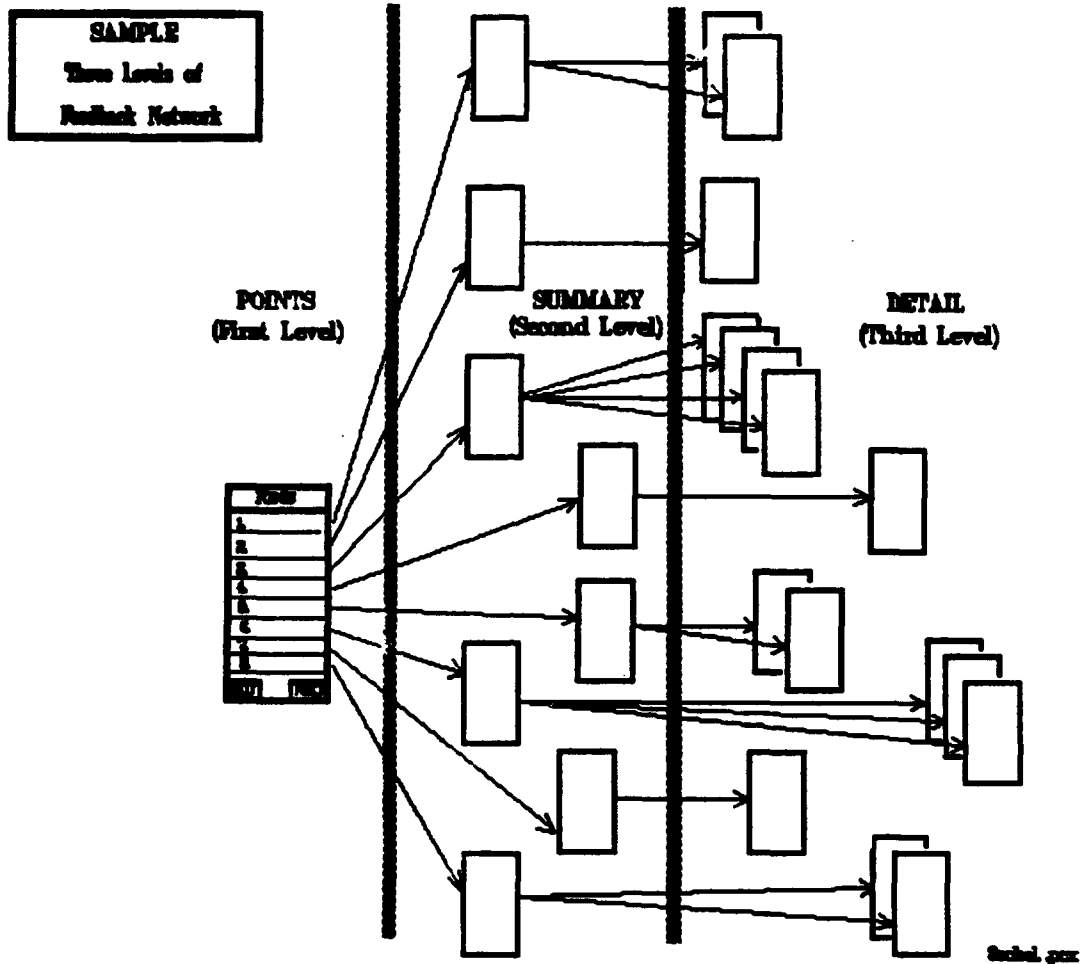
Figure 9. The POINTS Menu

As each of the "solutions" are presented a "POINTS" menu will also be revealed presenting no more than eight "POINTS." The "POINTS" listed on the menu are each word titles relating to key attributes of the overlay or text-based format and have previously been prepared and input by the Instructor from the "COORDINATOR" workstation. Each POINT is an active button. When it is "clicked" on, it will call to the screen a short second level text screen with an summary explanation of the "POINT" listed. The second level screen will contain text which also has been previously prepared and entered by the instructor. An example of the first level "POINTS" menu is shown in Figure 10.

POINTS

1.	Techniques
2.	Scales
3.	Boundaries
4.	Phase Lines
5.	Battle Positions
6.	Routes
7.	Reserve
8.	Counterattack

EXIT		NEXT

Figure 10. Example of a First Level POINTS Menu

Each of these "POINTS" menus are unique to the particular example displayed and are each a part of the specific "preferred solution" file. Each of the words describing a "POINT" is an active button and when "clicked" upon calls the corresponding Summary Screen to view. As an example, if the button labeled 3 BOUNDARIES is "clicked" on, the corresponding Summary Screen, headed "BOUNDARIES" would be called to view. If the student "clicks" NEXT without selecting a numbered button, the Summary Screen labeled "TECHNIQUES" would be called to view. If the student is viewing the Summary Screen "BOUNDARIES" and clicks NEXT, then the Summary Screen for "PHASE LINES" (#4) would be called to view.

The second level is a summary of the individual points presented on the "POINTS" menu as shown in Figure 11. It is a textual explanation which is doctrinally based. Certain "keywords" in the textual explanation are highlighted and are sensitive (read "buttons") to be clicked upon to "call" the third level Detail screen which provides more in depth explanation of the "keyword." If the explanatory material exceeds one page in length, a scroll bar will be available on the right side of the screen.

Figure 11. Sample Summary

The third level of feedback (the Detail level) will be the final level to be displayed and provides further detailed information on the linked highlighted "Keyword" selected from the second (Summary) feedback level. The third level is generally textually based with no highlighted words. It is a free text screen with a heading corresponding to the "Keyword" selected on the Summary Screen. It has two action buttons at the bottom; BACK and EXIT. If the explanatory material exceeds one page in length, a scroll bar will be available on the right side of the screen.

As each "Preferred Solution" is prepared by the instructor and is entered into the Coordinator's Workstation, the supporting feedback POINTS, Summary, and Detail screens will be segregated into separate files. As the Preferred Solution is called up (by the student entering "Completed") all of the supporting screens are then ready to be called for display as the student reviews and compares the solution he has prepared. When the requirement is an individual one, the three level feedback system is immediately available, at the student's request, to provide further doctrinally-based explanation on the key teaching points associated with the particular overlay or format under consideration. Preferred solution files will be protected by "read only" attributes so that they may not be inadvertently corrupted.

The SEND utility is currently used to batch load files which set the situation on the simulation network. The requirement to preload the files and, in this case, the preferred solution files, require that the preferred solution files be able to be saved to floppy disks for archiving purposed and to permit rapid loading when the workstations have been utilized for other purposes.

The situation display will be utilized for briefing purposes by the staff officers and by the commander as he announces his decision and explains his concept of operations. It also is used during the After Action Review to display overlays for discussion purposes. Each of the networked workstations should be capable of posting to the situation display.

The printer is in the network to permit hard copy to be printed out for discussion purposes and to allow the students to take away copies of their work for further study. Printouts of both the Map Screen and overlays (Left-hand Screen) as well as both the Map Screen and overlays (Left-hand Screen) as well as the Message and Format Screen (Right-hand Screen) are required.

In summary, the training concept for the Battle Staff Planning Exercise has been described. Specifications for software functions have also been formulated and are currently ready for implementation.

A Leaders Reconnaissance Exercise

This exercise can be used as an adjunct to the Battle Staff Planning Exercise described above. In the planning exercise, leader reconnaissance is conducted as a map reconnaissance on the workstation. In this companion exercise, a more detailed and realistic leader reconnaissance can be conducted at the STEALTH.

If used in conjunction with the Battle Staff Planning Exercise, the Battalion Commander would leave the Tactical Operations Center (TOC) and go to the STEALTH to conduct his reconnaissance. After the reconnaissance, the quality of his reconnaissance would be examined through replay on the Plan View Display (PVD) and use of the intervisibility function. The Commander would then return to the TOC and use information gained during his reconnaissance as inputs for updating the tentative plan.

Training Audience. The recommended training audience for this exercise is the Battalion Commander. Preferably, the Battalion Commander would be operating as the leader of the Battalion Command Group and Staff participating in the Planning Exercise (although this exercise

could be used independently to train leader reconnaissance). As suggested for the planning exercise, in the institutional training context this individual could be drawn from the Armor Officer Advanced Course (AOAC) along with other students participating as members of the command group or staff. Or, he could be drawn from the Armor Pre-Command Course (PCC) and participate with students from AOAC. In the unit training context, the Battalion Commander along with key staff would participate.

Training Context. As with the Planning Exercise described earlier, there are two primary institutional training settings within the Armor community which are appropriate contexts for this exercise. They include AOAC and PCC. Unit training is also an appropriate context given access to a DIS facility.

For AOAC, the exercise would fall within the portion of the course conducted by the Command and Staff Department. This part of the Program of Instruction (POI) is entitled "Small Group Instruction" and is outlined in Annex C. As with the planning exercise, the specific point in the curriculum would depend on the specific mission selected. Candidates include:

- Battalion Deliberate attack (prior to Test Point II);

- Battalion Movement to Contact (Prior to Test Point III);

- Battalion Defense [Sector or Battle Position] (Prior to Test Point IV).

More specifically, the AOAC training tasks for each of these missions which could be addressed by the Leaders Reconnaissance Exercise are identified below.

Battalion Deliberate Attack -

HC.38206 - Battalion/Task Force Deliberate Attack Reconnaissance:
Student will plan, perform and discuss leader's reconnaissance to confirm the tentative plan, considering METT-T factors, passage of lines and selection of attack position.

HC.39008 - Battalion/Task Force Roadmarch and Passage of Lines:
Student will update his tentative plan based on results of the reconnaissance TEWT, prepare and brief his finalized plan.

Battalion Movement to Contact -

HC.58204 - Battalion/Task Force Movement to Contact:
Students will plan, perform and discuss directing Battalion/Task Force Movement to Contact to include confirming the tentative plan and preparing and issuing FRAGOs.

Battalion Defense -

HC.72204 - Battalion/Reconnaissance (TEWT):
Students will prepare a brief reconnaissance plan to verify the tentative plan.

HC.72004 - Obstacle Planning and Defensive OPORD Preparation:
Students will plan, perform and discuss Battalion Task Force defensive reconnaissance consisting of leaders reconnaissance plan, finalizing obstacle plan and preparing Task Force Operations Order (TF OPORD).

For PCC, this exercise would also fall within the purview of the Command and Staff Department as outlined in Annex A of the POI. As with the planning exercise, the specific point in

the POI where it would be appropriate to include this exercise depends on whether offensive or defensive operations are selected or whether the exercise is included as part of coordination with AOAC or familiarization with battlefield simulations. The training tasks addressed by this exercise are highlighted below.

Offensive Operations -

SJ.24004 - Offensive Planning:
Students will review and discuss troop-leading procedures from receipt of mission to issuance of OPORD. The students will be taught the IPB process and the commander's guidance required to execute an offense mission. The commander's role in the orders process will be emphasized. (Leader's reconnaissance is one task within this process.)

Defensive Operations -

SJ.73004 - Defensive Planning/Synchronization:
Students will discuss the command estimate process, IPB and commander's guidance required to conduct defensive operations. (Leader's reconnaissance is one task within this process.)

Coordination with AOAC -

SJ.61002 - SGI Interactions:
Students will observe/participate in AOAC small group instruction. The emphasis is on familiarizing students with the current AOAC environment and instruction, and on giving the PCC students the benefit of interacting with future company commanders and staff officers. (This exercise provides an additional instructional opportunity for this interaction.)

Familiarization with Battlefield Simulations -

SJ.61004 - Battlefield Simulation:
Students will review and discuss Battlefield Simulations. Discussion will focus on how to use simulations to identify training weaknesses and correct them. Students will receive an orientation/familiarization of SIMNET and an overview of the JANUS and ARTBASS systems. (This exercise provides a concrete example of use of simulation for training.)

In the unit training context, the appropriate training task for this exercise can be found in the Battalion AMTP as shown below.

Battalion Task Force (ARTEP 71-2-MTP)

TASK: Command and Control the battalion task force.

Subtask: TF accomplishes reconnaissance and other actions to gather needed
             information.

Standard: Commander/subordinate leaders and staff conduct a personal
             reconnaissance when possible.

Operational Concept for Training Delivery. This exercise is intended to be used in conjunction with the Battle Staff Planning Exercise. It allows the Battalion Commander the opportunity to conduct a more in-depth leader's reconnaissance than is possible with the map reconnaissance built into the planning exercise.

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After the tentative plan is derived in the planning exercise, the Battalion Commander would leave the TOC and go to the STEALTH. He may bring his battalion staff with him to observe his reconnaissance. First, he would be provided with familiarization training on the operation of the STEALTH and how to communicate with the Semi-Automated Forces (SAFOR) Operator who will actually accomplish the movement of the STEALTH vehicle in accordance with the Battalion Commander's guidance. Then, with the terrain database initialized to the appropriate terrain and his vehicle placed at the nominal physical location of the TOC, the Battalion Commander would be given an opportunity to conduct a leader's reconnaissance. He would accomplish the reconnaissance by directing the SAFOR operator to move to specified locations or in a specified direction. While the approach and procedures used to conduct the reconnaissance would be left up to the Battalion Commander, he would be reminded that the objectives of the leaders reconnaissance are to confirm the tentative plan and to examine the METT-T factors which might influence the plan (Mission, Enemy Troops, Friendly Troops, Time, Terrain).

After completion of the reconnaissance, the Battalion Commander and his staff would return to the TOC to complete the planning exercise. His immediate task would be to make inputs for updating the tentative plan based on the information he acquired during his reconnaissance.

Operational Concept for Training Feedback. After completion of his reconnaissance, the Battalion Commander would go to the Plan View Display (PVD) to review and replay his reconnaissance. The other members of his battle staff participating in the planning exercise may also be invited to participate as observers in this activity.) At key points, the intervisibility function will be invoked to examine the visibility of the commander's vehicle to the enemy.

Using a similar format as in the Planning Exercise, a message center for feedback would also be displayed on the PVD screen. This message center would allow for the display of explanatory text windows conveying major teaching principles on leader reconnaissance. These points would focus on the role of the leader reconnaissance in confirming a tentative plan and examining potential influences of METT-T factors. Particular attention would be paid to identification of avenues of approach, obstacles, enemy locations and positions, selection of the reconnaissance route and key observation points.

Required Hardware/Software Configuration. This training exercise would require:

- one STEALTH operating as a ground vehicle;

- one SAFOR station;

- terrain database initialized based on scenario used for planning exercise;

- one Plan View Display (PVD);

- one Data Logger.

Recommendations for Initial Implementation and Tryout of Exercise. Our recommendations are to use the same mission as the Planning Exercise, Defense in Sector, for initial implementation and tryout of this exercise. The primary duty position would be the Battalion Commander, although other members of the battle staff (e.g., XO, S2, S3) may participate in the debriefing session if desired.

We expect that approximately two hours would be required for STEALTH familiarization and completion of the reconnaissance exercise.

Training Materials Development Required. The following materials would need to be adapted from existing materials (1) or developed (2) to implement this exercise:

- (1) Initialized terrain database with enemy and friendly vehicle placement as indicated by mission scenario;

- (2) Introductory materials to introduce trainees to purpose of exercise, training objectives, expectations for their behavior, and administrative/logistical issues;

- (2) Training materials and exercises to be used for familiarization training with the STEALTH and procedures for communicating with the SAFOR operator;

- (2) Specification of rules for invoking intervisibility function on PVD and associated teaching principles/rationale;

- (2) Storyboards for message center feedback system to include text windows conveying teaching principles, explanatory rationales.

Software Modifications Required. The software as currently implemented in the DIS environment allows delivery of the training exercise as described. The only restriction is that the STEALTH must be tethered to a SAFOR vehicle during the reconnaissance so that the reconnaissance may be displayed and replayed later on the PVD. The STEALTH operating untethered does not currently send data packets over the network thus requiring this restriction.

However, software modifications would be required to implement the training feedback portion of this exercise. More specifically, these software modifications center on implementing routines for providing feedback to trainees on-line at the PVD in a timely manner. Two types of feedback are anticipated. This first capitalizes on the intervisibility analysis capability of the PVD. The student will be provided cues at predetermined points to invoke the intervisibility function and make a self-assessment based on this information.

The second type of feedback is expected to include textual descriptions listing major teaching points associated with leader reconnaissance. A two-level system is envisioned with a first level overview of key teaching points and a capability to click on any point which then brings up a second explanatory screen with more detailed information.

In summary, the Leaders Reconnaissance Exercise is intended to use the STEALTH capabilities within the DIS environment to train reconnaissance skills of leaders in confirming their tentative plan and assessing the potential impact of METT-T factors. It is intended to be used in conjunction with the Battle Staff Planning Exercise described earlier.

A Mission Rehearsal Exercise (Electronic Sandtable)

This exercise capitalizes on the capabilities of the DIS environment to train unit leaders in the conduct of an effective rehearsal. Mission rehearsals are typically conducted as backbriefs or verbal "talk throughs" using a map or a sand table with movable objects to represent units, vehicles, obstacles, key features of the terrain and control measures. The DIS environment offers the additional capability to conduct more realistic rehearsals using vehicle simulators placed on a digital battlefield. This "electronic sandtable" is more realistic than a conventional sandtable but more cost effective and feasible than a field rehearsal (which is often difficult to conduct due to available time and/or tactical and logistical considerations). Rehearsals in a DIS environment may

be conducted as full force or reduced force rehearsals and may be used in conjunction with other forms of rehearsal such as backbriefs.

Training Audience. The ability to conduct effective mission rehearsals is an important skill at all echelon levels. Recent lessons learned from the Combat Training Centers (CTCs) and Operation JUST CAUSE in Panama (CALL, 1991) suggest that, not only must leaders practice with their own units, but that multiechelon rehearsals are required to yield the synchronization necessary for an effective mission. Thus, the recommended training audience for this exercise includes leaders and key staff at battalion (the Battalion Commander, the Executive Officer [XO], the Operations Officer [S3], the Intelligence Officer [S2], and the Fire Support Officer [FSO] at a minimum along with respective vehicle crews or TOC assistants), at company (company commanders, XOs and their respective crews), and at platoon (platoon leaders, platoon sergeants, wingmen and their respective crews). In some cases, it may be appropriate to use the semi-automated forces (SAFOR) capability within the DIS environment to represent selected BLUEFOR units to reduce personnel requirements for the exercise.

The Mission Rehearsal Exercise could be treated as a follow-on to the Battle Staff Planning Exercise described earlier by maintaining members of the Battalion Command and Staff group from that exercise and augmenting them with additional personnel at battalion, company and platoon. This approach would have the advantage of providing an opportunity for battalion leaders to rehearse the mission which they have just planned. Alternatively, this exercise may be treated as a standalone exercise focused on rehearsal skills with a given set of operations orders as a starting point.

Training Context. The training audience may appropriately be drawn from either an institutional training context or a unit training context assuming access to a DIS environment. These contexts are described below along with the training tasks addressed by this exercise as stated in current POIs for institutional training and in Army Mission Training Plans (AMTPs) for unit training.

For example, in the Armor institutional training context, the Armor Pre-Command Course (PCC) would be appropriate for drawing prospective Battalion Commanders and the Armor Officer Advanced Course (AOAC) would be appropriate for drawing members of the Battalion Command Group (such as the XO), primary battalion staff members (such as the S2, S3 and the FSO), Company Commanders and their XOs. In the institutional training context, it would probably be appropriate to represent platoons using the SAFOR capability since the Armor Officer Basic (AOB) Course for platoon leaders has a broad and diverse POI with only minimal tactical training. Additional crew members for vehicles and assistants for the TOC could be filled on a rotating round-out basis with PCC and AOAC students since rotation through other positions has cross-training value as well as provides students the opportunity to acquire alternative perspectives on the battlefield.

In the Armor PCC, there are three training tasks which relate to this exercise as outlined below.

SJ.25004 - Synchronization Rehearsals
Students will review synchronization of the Battlefield Operating Systems, the importance of rehearsals to synchronization, and how to conduct rehearsals.

SJ.61002 - SGI Interactions
Students will observe/participate in AOAC small group instruction. The emphasis is on familiarizing students with the current AOAC environment and instruction, and on giving the PCC students the benefit of interacting with future company commanders and staff officers.

SJ.61004 - Battlefield Simulation
Students will review and discuss Battlefield Simulations. Discussion will focus on how to use simulations to identify training weaknesses and correct them.

In the AOAC POI, this exercise is relevant to Annex C which is taught by the Command and Staff Department. The specific point in the POI would depends on the specific mission selected for rehearsal as shown below:

- Bn Deliberate attack (prior to Test Point II)

- Bn Movement to Contact (Prior to Test Point III)

- Bn Defense [Sector or Battle Position] (Prior to Test Point IV)

It is noteworthy that the current POI focuses on planning of the above types of missions and their execution using Command Post Exercises (CPXs) based on a computer-assisted simulated wargame. This mission rehearsal exercise fills a critical gap between the planning and execution training objectives shown below for the three types of missions.

Battalion Deliberate Attack [Planning] -

HC.44008 - Battalion Deliberate Attack (OPORD):
Students will develop and discuss a Task Force Operations Order (TF OPORD).

HC.45208 - Battalion/Task Force Deliberate Attack:
Students will plan, perform, prepare, present and discuss directing a deliberate attack and issuing a hasty attack FRAGO.

Battalion Movement to Contact [Planning] -

HC.58004 - Battalion/Task Force Movement to Contact OPORD:
Students will finalize, present and discuss their OPORDs.

Offensive Operations [Execution] -

HC.65208 - Offense CPX:
Students will apply the principles of offensive operation in a computer-assisted wargame.

Battalion Defense [Planning] -

HC.73008 - Defensive OPORD:
Students will prepare and brief their Defensive OPORD [Defense in Sector].

HC.74008 - Battalion/Task Force Battle Position Planning:
Students will discuss and apply key considerations when planning a Battalion/Task Force Battle Position, preparing mission analysis, and a tentative plan and brief them to the team leader.

Defensive Operations [Execution] -

HC. 76216 - Defense CPX:
Students will participate in a computerized role-playing game where a Defense in Sector at Bn/TF level is planned and executed against an OPFOR.

In the unit training context, participants in this exercise may be drawn from battalion, company and platoon levels as appropriate and available. If necessary, the SAFOR capability within the DIS environment may be used to represent some units within the battalion to reduce the number of personnel required for the exercise. Training tasks at each echelon drawn from the appropriate AMTP are outlined below.

Battalion Task Force (ARTEP 71-2-MTP) -

TASK: Occupy assembly area

Subtask: Task Force conducts assembly area operations and prepares for combat operations.

Standard: Use of time is made to prepare for the next operation to include:
- Preparation and dissemination of company- and platoon-level OPORDs, conduct of briefbacks and rehearsals, and leader reconnaissance.

Company/Team (ARTEP 71-1-MTP) -

TASK: Prepare for Combat

Subtask: The company team prepares for the mission.

Standard: Key company team actions are rehearsed as the situation permits. Company team leaders supervise, inspect, rehearse, and finalize coordination.

Platoon (ARTEP 17-237-10-MTP) -

TASK: Conduct rehearsals for a mission

Subtask: Platoon Leader conducts the rehearsal.

Standard: Repeats the rehearsals until all TCs are capable of leading the mission.

Operational Concept for Training Delivery. The Mission Rehearsal Exercise is structured into two main phases. The first is intended as a leader rehearsal and includes the Battalion Command and Staff (the Commander, XO, S3, S2, and FSO at a minimum, although other staff officers may be included as desired), Company Commanders and their XOs, and Platoon Leaders and their Sergeants (unless platoons are planned to be represented by SAFOR to reduce personnel requirements). In this phase, backbriefs and an electronic map rehearsal are the primary rehearsal techniques. The second is the "electronic sandtable" portion of the rehearsal which is conducted using the simulated TOC and the simulators in the DIS facility and may be conducted with a full or reduced force depending on training objectives and personnel availability.

The first phase of the exercise would begin in the simulated TOC with the Battalion Commander delivering his Battalion Operations Order (OPORD) to his XO, Battalion Staff, Company Commanders and their XOs. If trainees were participants in the Battle Staff Planning Exercise, the OPORD derived from this exercise may be used. If not, the OPORD for the mission would be provided to the Battalion Commander beforehand for review and study. After the OPORD has been briefed, the Battalion Commander would conduct a backbrief and ask each individual to state their understanding of the mission, the commander's intent, the concept, and

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their role and timing in the mission. A Training Coordinator would be available to monitor the briefing and backbriefing process and to make observations on performance.

After the backbrief, Company Commanders would have an opportunity to go to their simulators to conduct their own mission planning, to brief their platoon leaders (if they are participating in the exercise), and to rehearse among themselves. (Platoon leaders would be provided a similar opportunity if they are exercise participants.)

At this point, company commanders and their XOs would return to the TOC for a second backbrief and an electronic map rehearsal. In the backbrief, company commanders would tell the battalion commander how they are going to accomplish the mission. After the backbriefs, the Battalion Commander would direct a map rehearsal using a workstation located in the TOC. The workstation would display the terrain for the mission with an overlay of mission graphics and control measures. (This display could be projected onto a large screen display if desired.) Using the electronic map, the battalion and company leaders would verbalize their elements' actions interactively as the concept of operation of the mission is walked through. The goal here is to synchronize the discussion to correspond to planned actions, not a "one at a time" discussion of each element's role.

At this point, the second phase, the "electronic sandbox", would begin. This phase would be conducted in the simulators with battalion staff (most likely the XO, Assistant S3, S2, and FSO) in the TOC and the Battalion Commander, the S3, companies and platoons in the simulators. This phase may be conducted as a full force or reduced force rehearsal depending on training objectives, personnel availability and simulation availability. In the reduced force mode, all tank commanders would require a crew which could be reduced below a four man crew depending on training objectives. However, some units within the battalion may be represented by SAFOR. In the full force mode, all vehicles within the battalion would be manned with a four man crew.

The Battalion Commander would direct the "electronic sandtable" rehearsal from his simulator using radio communications. After a ready signal, all elements of the battalion would initiate actions in accordance with their respective plans and timelines. The exercise would be monitored by a Training Coordinator who would monitor the radio nets, observe and flag key events using the Plan View Display, and formulate his own observations of the exercise.

At the end of the mission rehearsal, an After Action Review (AAR) would be held to assess performance. If a requirement for adjusting mission planning is uncovered in the rehearsal or if performance does not meet established standards, the mission may be rehearsed again by "resetting" the "electronic sandtable" to the starting terrain for the mission and repeating the rehearsal. This iterative rehearsal capability is a major strength of the "electronic sandtable".

Operational Concept for Training Feedback. The primary vehicle for training feedback would be the After Action Review (AAR) process. AARs would be conducted by the Training Coordinator after each phase of the training exercise.

The first AAR would be for all leaders participating in the initial briefing and backbrief during the first phase. This AAR would be fairly informal and directed at eliciting from the training audience the strengths and weaknesses of the backbrief process as an effective rehearsal technique. The key elements of an effective backbrief and its distinguishing features from coordination would be stressed.

The second AAR would be conducted for the full or reduced force participating in the "electronic sandtable" phase of the training exercise. Here the training coordinator would lead the discussion to allow the battalion to assess the quality of their rehearsal. Inputs into this assessment would include replays of critical events occurring during the rehearsal identified by the Training

Coordinator, clips of communications tapes as relevant, observations made by the Training Coordinator and quantitative measures drawn from the DIS automated data stream. In the latter case, these measures would be specified beforehand based on the training audience, mission objectives and the commander's intent. Since rehearsal is intended to mirror execution, many of these measures would likely be drawn from measures derived for the Mission Execution Exercise which examine the correspondence between unit actions and control measures.

The AAR discussion would focus on the correspondence between actions taken in the rehearsal and those called for in the planning process and whether any weaknesses in the plan were uncovered. In the former case, the training unit would have the opportunity to conduct another rehearsal to improve their performance if deemed desirable. In the latter, the S3 would be given an opportunity to update the Decision Support Template and the exercise could be rerun as a rehearsal for the adjusted mission.

<u>Required Hardware/Software Configuration</u>. This training exercise would require:

- networked SPARCS workstations with TOC software for all TOC participants (most likely, the XO, Assistant S3, S2 and FSO) and a terrain database housed in a simulated TOC;

- a large screen display for projecting the electronic map for use in map reconnaissance and initial AAR;

- simulators for each tank crew participating in the "Electronic Sandtable" phase of the exercise (number will vary depending on use of SAFOR to represent units within the battalion);

- at least one (and possibly two) SAFOR stations for monitoring and controlling units within the battalion represented by SAFOR;

- networked radios in simulators, TOC and exercise control room;

- a Plan View Display (PVD) housed in the exercise control room;

- MCC and SCC systems in the exercise control room for simulator setup, monitoring and control; and

- a Data Logger to capture automated data packets and a Data Probe/RS/1 Workstation for data reduction and analysis.

<u>Recommendations for Initial Implementation and Tryout</u>. It is recommended that this exercise be developed using a Battalion Deliberate Attack mission. This strategy would yield two possible missions for use in the exercise. If used in conjunction with an earlier exercise, the Defense mission developed in conjunction with the Battle Staff Planning Exercise could be used. Alternatively, developing an offensive mission in addition would provide the opportunity for tactical movement as part of the rehearsal process and would yield a mission which would complement the defense mission derived in the Battle Staff Planning Exercise.

To keep personnel requirements manageable, we recommend a reduced force "electronic sandtable" exercise with selected units within the battalion represented by SAFOR. More specifically, in the first phase of the exercise, we suggest inclusion of six members of the battalion command and staff group (the Battalion Commander, the XO, the S3, the Assistant S3, the S2 and the FSO) along with three Company Commanders and their XOs. The fourth company in the battalion would be represented using the SAFOR. We also recommend using the SAFOR to

represent the platoons within each of the four companies. These individuals would participate in the second phase of the exercise as well. All tank commanders (Battalion Commander, S3, Company Commanders and XOs) would also require crews for the "electronic sandtable".

We expect that prerequisite training on the TOC workstation and simulators and completion of the rehearsal exercise would take approximately two days. Multiple iterations of the "electronic sandtable" which are highly desirable from a training perspectively would probably extend this period to three or four days.

Training Materials Development Required. The following materials would need to be adapted from existing materials (1) or developed (2):

- (1) Mission scenario including Battalion OPORD and accompanying graphics;

- (1) Specifications for terrain database corresponding to scenario;

- (1) Modifications to existing Battalion TOC SOP to include a Rehearsal Annex ;

- (2) Introductory materials to introduce trainees to purpose of exercise, training I objectives, expectations for their behavior, and administrative/logistical issues;

- (1) Familiarization training on simulators and workstations;

- (2) Exercise guidelines for Training Coordinator and SAFOR operator(s);

- (2) Specifications for automated measures to be derived from Data Logger;

- (2) Observational formats for Training Coordinator;

- (2) Guidelines for AARs.

Software Modifications Required. The software as it currently stands is able to support the delivery of the Mission Rehearsal Exercise. However, there are two modifications that are required to enhance the delivery of training feedback.

The first modification involves speeding up the turnaround on the capture of data packets from Data Logger so that the data can be quickly entered into an analysis program such as Data Probe/RS/1 for summary. In order to incorporate automated data into the AAR discussion, data summaries must be available no longer than 30 minutes after the end of the exercise. Perhaps adjustments could be made to speed the Data Logger system or another system such as the Unit Performance Assessment System (UPAS) currently under development by ARI could be incorporated.

The second modification concerns the capability to quickly access and clip segments of communication tapes for replay in the AAR. In order for such segments to serve as inputs to the AAR, a process must be in place which would allow flagging of segments, preferably by time, and access of designated segments within a 30 minute period.

In summary, the Mission Rehearsal Exercise provides an opportunity for leaders to rehearse on a realistic "electronic sandtable". Mission rehearsal skills can be honed by iterative rehearsals to ensure that units are performing to standard and to finetune plans as shortfalls are uncovered in the rehearsal process.

A Mission Execution Exercise (Electronic Sandbox)

As the Army reconsiders its training strategy in light of reduced budgets, the use of simulation to train units in mission execution has been a focal point of attention. While networked simulators such as the Close Combat Tactical Trainer (CCTT) are not expected to completely replace expensive field training exercises, they are expected to provide prerequisite training in command and control, synchronization and tactical execution of combat missions. This simulation training will allow leaders and units to hone their skills so that their field exercises can be used for maximum training advantage. This mission execution exercise or "electronic sandbox" is one example of how the DIS environment can be used to provide a well structured exercise for leaders and units with systematic feedback on their performance. It may be used in conjunction with the Mission Rehearsal Exercise or may serve as a standalone exercise.

Training Audience. The flexible networking structure within the DIS environment allows networks to be configured which are appropriate for training at platoon, company and battalion level. The Mission Execution Exercise described here focuses on the battalion level. We have selected battalion since it represents a more complex example than company or platoon and training developers could use the battalion example to derive lower echelon exercises if desired. Maintaining focus at the battalion level also provides an example of how the Mission Execution Exercise can be used in conjunction with the Mission Rehearsal Exercise.

The recommended training audience for this exercise includes leaders and key staff at battalion (the Battalion Commander, the Executive Officer [XO], the Operations Officer [S3], the Intelligence Officer [S2], and the Fire Support Officer [FSO] at a minimum along with respective vehicle crews or TOC assistants), at company (company commanders, XOs and their respective crews), and at platoon (platoon leaders, platoon sergeants, wingmen and their respective crews). In some cases, it may be appropriate to use the semi-automated forces (SAFOR) capability within the DIS environment to represent selected BLUEFOR units to reduce personnel requirements for the exercise.

As noted earlier, the Mission Execution Exercise could be treated as a follow-on to the Mission Rehearsal Exercise. This approach has the advantage of providing an opportunity for units to actually execute the mission which they have rehearsed. Furthermore, if the Mission Rehearsal Exercise is used in conjunction with the Battle Staff Planning Exercise, battalion leaders have the opportunity to perform all phases of a mission from planning to rehearsal to execution. However, as an alternative, the exercise may be treated as a standalone focused on mission execution with a given set of operations orders as a starting point.

Training Context. As with the rehearsal exercise, the training audience may appropriately be drawn from either an institutional training context or a unit training context assuming access to a DIS environment. These contexts are described below along with the training tasks addressed by this exercise as stated in current POIs for institutional training and in Army Mission Training Plans (AMTPs) for unit training.

For example, in the Armor institutional training context, the Armor Pre-Command Course (PCC) would be appropriate for drawing prospective Battalion Commanders and the Armor Officer Advanced Course (AOAC) would be appropriate for drawing members of the Battalion Command Group (such as the XO), primary battalion staff members (such as the S2, S3 and the FSO), Company Commanders and their XOs. In the institutional training context, it would probably be appropriate to represent platoons using the SAFOR capability since the Armor Officer Basic (AOB) Course for platoon leaders has a broad and diverse POI with only minimal tactical training. (Further, the tactical training provided in AOB focuses largely on platoon tactics. Thus, if a DIS-based exercise were to be incorporated into AOB, it would more appropriately be a platoon exercise rather than incorporating platoons within the context of a battalion exercise as described

her.) Additional crew members for vehicles and assistants for the TOC could be filled on a rotating round-out basis with PCC and AOAC students since rotation through other positions has cross-training value as well as provides students the opportunity to acquire alternative perspectives on the battlefield.

In the Armor PCC, training objectives do not currently focus on mission execution due to time constraints. However, training tasks currently focus on offensive and defensive planning, as well as interactions with AOAC students and familiarization with simulations. This Mission Execution exercise, focused on the execution of an offense or a defense, would augment the tasks outlined below.

SJ.24004 - Offensive Planning
Students will review and discuss troop-leading procedures from receipt of mission to issuance of the OPORD. The students will be taught the IPB process and the commander's guidance required to execute an offense mission. The commander's role in the orders process will be emphasized.

SJ.73004 - Defensive Planning
Students will discuss the command estimate process, IPB and commander's guidance required to conduct defensive operations. Development of a battalion engagement area, disengagement criteria and integration of the seven battlefield operating systems during operations will also be discussed. Lessons learned during defensive operations conclude the discussion.

SJ.61002 - SGI Interactions
Students will observe/participate in AOAC small group instruction. The emphasis is on familiarizing students with the current AOAC environment and instruction, and on giving the PCC students the benefit of interacting with future company commanders and staff officers.

SJ.61004 - Battlefield Simulation
Students will review and discuss Battlefield Simulations. Discussion will focus on how to use simulations to identify training weaknesses and correct them.

In the AOAC POI, this exercise is relevant to Annex C which is taught by the Command and Staff Department. The specific point in the POI would depends on whether an offensive or defensive is selected for execution.

It is noteworthy that the current POI focuses on mission planning and their execution using Command Post Exercises (CPXs) based on a computer-assisted simulated wargame. This mission execution exercise would provide a more realistic environment for providing training on the mission execution training objectives listed below.

Offensive Operations [Execution] -

HC.65208 - Offense CPX:
Students will apply the principles of offensive operation in a computer-assisted wargame.

Defensive Operations [Execution] -

HC. 76216 - Defense CPX:
Students will participate in a computerized role-playing game where a Defense in Sector at Bn/TF level is planned and executed against an OPFOR.

In the unit training context, participants in this exercise may be drawn from battalion, company and platoon levels as appropriate and available. If necessary, the SAFOR capability

within the DIS environment may be used to represent some units within the battalion to reduce the number of personnel required for the exercise.

Since the Army Mission Training Plans (AMTPs) which drive unit training are organized by training tasks rather than missions, a number of maneuver tasks can be incorporated into the scenario for execution of an offensive or defensive mission. These maneuver training tasks which serve as candidate training objectives at each echelon (drawn from the appropriate AMTP) are outlined below. (Subtasks and standards are not listed here for brevity but can be found in the referenced AMTPs.)

Battalion Task Force (ARTEP 71-2-MTP) -

Occupy Assembly Area
Perform Tactical Road March
Perform Passage of Lines
Move Tactically
Fight a Meeting Engagement
Assault
Attack/Counterattack by Fire
Defend
Cover Passage of Lines
Withdraw Not Under Enemy Pressure
Withdraw Under Enemy Fire
Reorganize
Consolidate

Company/Team (ARTEP 71-1-MTP) -

Occupy Assembly Area
Perform Tactical Movement
Perform Tactical Road March
Perform Passage of Lines
Assist Passage of Lines
Perform Actions on Contact
Support by Fire
Occupy Objective Rally Point
Assault on Enemy Position (Mounted)
Perform an Attack by Fire
Defend
Work Up
Withdraw Not Under Enemy Pressure
Withdraw Under Enemy Pressure

Platoon (ARTEP 17-237-10-MTP) -

Execute a Coil Formation
Execute a Herringbone Formation
Execute a Column Formation
Execute a Staggered Column
Execute a Wedge Formation
Execute a Vee Formation
Execute a Line Formation
Execute an Echelon Formation
Execute Traveling

Execute a Traveling Overwatch
Execute Bounding Overwatch
Conduct a Tactical Road March
Assist a Passage of Lines
Perform a Passage of Lines
Perform Platoon Fire and Movement
Perform an Attack by Fire
Assault an Enemy Position
Execute Actions on Contact
Execute a Platoon Defensive Mission

Operational Concept for Training Delivery. The concept for delivery of the Mission Execution Exercise varies somewhat depending if the exercise is a follow-on to the Mission Rehearsal Exercise (and the Battle Staff Planning Exercise) or whether it is a standalone exercise. Two main differences are anticipated based on which of these situations is operable. They concern the amount of equipment training required and the amount of time required for planning prior to the initiation of the exercise.

In the former case, only refresher training on the TOC workstations and the simulators would be needed since the unit would have recently participated in the Mission Rehearsal Exercise. After this refresher training, the exercise would begin in the simulated TOC with the Battalion Commander delivering his Battalion Operations Order (OPORD) to his XO, Battalion Staff, Company Commanders and their XOs. Since the Battalion staff would have participated in the preparation of the OPORD in the Battalion Staff Planning Exercise and the unit would have participated in a rehearsal of the mission in the Mission Rehearsal Exercise, it can be assumed that the leaders and unit members are familiar with the mission and the OPORD. Thus, after the issuance of the order, the unit would disperse to the TOC or their vehicle simulators.

In the latter case where the exercise is a standalone one, time would need to be built in for both familiarization training on the TOC workstations and the simulators and for further study of the OPORD, planning and preparation. In either case, the Training Coordinator would be available to direct the equipment training process and to monitor the briefing and to make observations on performance.

After the briefing of the OPORD, Company Commanders would have an opportunity to go to their simulators, to go over their own mission planning (or to conduct the planning if it is a standalone exercise), and to brief their platoon leaders (if they are participating in the exercise). (Platoon leaders would be provided a similar opportunity if they are exercise participants.)

At this point, the "electronic sandbox", would begin. Battalion staff (most likely the XO, Assistant S3, S2, and FSO) would be located in the TOC and the Battalion Commander, the S3, companies and platoons would be located in the simulators. The exercise may be conducted with a full force or reduced force depending on training objectives and availability of personnel and simulators. In the reduced force mode, some units within the battalion may be represented by SAFOR. In the full force mode, all vehicles within the battalion would be manned with a four man crew if sufficient networked simulators are available.

The mission would begin after a ready signal from the Battalion Commander. The Battalion Commander would command and control the execution of the mission from his simulator using radio communications. All elements of the battalion would initiate actions in accordance with their respective plans and timelines. The exercise would be monitored by a Training Coordinator and an assistant who would monitor the radio nets, observe and flag key events using the Plan View Display, and formulate their own observations of the exercise.

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At the end of the mission, an After Action Review (AAR) would be held to assess performance. This AAR would be led by the Training Coordinator and structured to encourage the unit to assess their strengths and weaknesses in executing the mission and to identify needs for improvement.

Operational Concept for Training Feedback. The primary vehicle for training feedback would be the After Action Review (AAR) process. AARs would be conducted by the Training Coordinator at the end of the training exercise.

The AAR would be conducted by the training coordinator who would lead the discussion to allow the battalion to assess the quality of their mission execution. Inputs into this assessment would include replays of critical events occurring during the exercise identified by the Training Coordinator, clips of communications tapes as relevant, observations made by the Training Coordinator and quantitative measures drawn from the DIS automated data stream.

In the latter case, these measures would be specified beforehand based on the training audience, mission objectives and the commander's intent. It is expected that many of these measures would be drawn from the Control Measure Performance Measurement System described below examines the correspondence between unit actions and control measures.

The AAR discussion would focus on the correspondence between actions taken in the execution of the mission and those called for by the mission plan. The unit would be encouraged to identify the strengths and weaknesses of their execution and how they would improve upon their performance if they were to execute the mission again.

Specifications for a Control Measure Performance Measurement System. Overlays are regularly used to distribute Operations Plans, Fire Support Plans, Intelligence Data, Administrative and Logistics Information and other information as needed to elements subordinate to the issuing headquarters. The main features of the Operations Plans consist of two major components: the scheme of maneuver (and fire support planning to support it); and the control measures designated to assist in command and control of the unit. Control measures have been standardized for use in the US Army and have also been standardized for use in NATO.

An automated data collection system is required which will record the relationship between the maneuver of blue force units and the location of control measures which have been designated by the battalion headquarters. The control measures of concern are shown in Table 9 below.

Lines	
Boundaries	Line of Departure
Routes	Phase Lines
Restrictive Fire Line	Limit of Advance
Forward Line of Own Troops (FLOT)	Forward Edge of the Battle Area (FEBA)
Fire Support Coordination Line (FSCL)	Front Lines
Points	
Coordinating Point	Contact Point
Strat Point	Release Point
Strongpoint	Checkpoint
Linkup Point	Passage Point
Point of Departure	Rally Point
Traffic Control Point	

Table 9. Control Measures

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For each of the control measures shown in Table 9 certain specific information is desired. The data desired to be recorded is shown for each of the measures following:

a. Boundaries. Violation of assigned boundaries by any element of a unit will be recorded. Specific information required is:

    (1)   Unit or element(s) violating boundaries.
    (2)   Time the violation occurred.
    (3)   Location at which violation occurred.

b. Line of Departure. Record crossing of the Line of departure by a subordinate element.

    (1)   Time the Line of Departure was crossed.
    (2)   The location where the Line of departure was crossed.
    (3)   The unit which has crossed the line of departure.

c. Routes. Recording of deviations from a specific route designated to be followed by subordinate unit.

    (1)   Time the deviation from the route began.
    (2)   Time the deviation from the route ended.
    (3)   Unit deviating from its assigned unit.
    (4)   Distance of deviation from the route (center of mass of the deviating unit).

d. Phase Lines. Record the reaching/crossing of phase lines by subordinate units.

    (1)   Identification of the unit and the phase line.
    (2)   Location at which the phase line was reached.
    (3)   Time at which the lead element reached the phase line.
    (4)   If unit halted, time unit resumed movement after crossing the phase line.

e. Restrictive Fire Line. Record any fires crossing a restrictive fire line.

    (1)   Time at which either direct or indirect fires were delivered across a restrictive fire line.
    (2)   Location at which fires crossed a restrictive fire line.
    (3)   Unit delivering the fires across a restrictive fire line.
    (4)   Number of rounds delivered across the restrictive fire line.
    (5)   Identification of any targets struck by the fires.

f. Limit of Advance. Record arrival of units at a limit of advance line and any violation thereof.

    (1)   Time of arrival of the unit at the Limit of Advance Line.
    (2)   Identification of the Unit in (1) above.
    (3)   Time unit crosses the Limit of Advance Line.
    (4)   Identification of the element crossing the Limit of Advance Line.
    (5)   Distance by which the unit crossed the Limit of Advance Line.

g. Forward Line of Own Troops (FLOT). Record arrival at and crossing of the FLOT by Blue Force troops.

   (1) Time of arrival of the unit at the FLOT.
   (2) Identification of the Unit in (1) above.
   (3) Time of crossing of the FLOT by blue force units.
   (4) Identification of the element first crossing the FLOT.

h. Forward Edge of the Battle Area (FEBA). Record arrival at and crossing of the FEBA.

   (1) Time of arrival of the unit at the FEBA.
   (2) Identification of the Unit in (1) above.
   (3) Time of crossing of the FEBA by blue force units.
   (4) Identification of the element first crossing the FEBA.

i. Fire Support Coordination Line (FSCL). Record direct and indirect fires delivered by Blue Forces across an FSCL.

   (1) Time at which direct and indirect fires are delivered across an FSCL.
   (2) Type of fires in (1) above.
   (3) Unit delivering the fires in (1) above.
   (4) Number of rounds delivered in (1) above.
   (5) Identification of targets struck by fires in (1) above.

j. Front Lines. Record units which move forward of the front line trace of the blue force units.

   (1) Time at which Blue Force Unit moved forward of the front line trace of BLUFOR forces.
   (2) Identification of BLUFOR unit moving forward of the BLUFOR front line trace.

k. Coordinating Point. Record arrival and departure of a BLUFOR element at a Coordinating Point.

   (1) Time at which a BLUFOR element arrived at a coordinating point.
   (2) Location of the coordinating point.
   (3) Identification of the BLUFOR element at the coordination point.
   (4) Time at which the BLUFOR element departed the coordination point.

l. Contact Point. Record arrival and departure of a BLUFOR element at a Contact Point.

   (1) Time at which a BLUFOR element arrived at a contact point.
   (2) Location of the contact point.
   (3) Identification of the BLUFOR element at the contact point.
   (4) Time at which the BLUFOR element departed the contact point.

m. Start Point. Record arrival and departure of a BLUFOR unit at a Start Point.

   (1) Time at which a BLUFOR element arrived at a start point.
   (2) Location of the start point.

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        (3)   Identification of the BLUFOR element at the start point.
        (4)   Time at which the BLUFOR element departed the start point.

n.   Release Point. Record arrival and departure of a BLUFOR element at a Release Point.

        (1)   Time at which a BLUFOR element arrived at a release point.
        (2)   Location of the release point.
        (3)   Identification of the BLUFOR element at the release point.
        (4)   Time at which the BLUFOR element departed the release point.

o.   Strongpoint. Record arrival and departure of a BLUFOR element at a strongpoint.

        (1)   Time at which a BLUFOR element arrived at a strongpoint.
        (2)   Location of the strongpoint.
        (3)   Identification of the BLUFOR element at the strongpoint.
        (4)   Time at which the BLUFOR element departed the strongpoint.

p.   Checkpoint. Record arrival and departure of a BLUFOR element at a checkpoint.

        (1)   Time at which a BLUFOR element arrived at a checkpoint.
        (2)   Location of the checkpoint.
        (3)   Identification of the BLUFOR element at the checkpoint.
        (4)   Time at which the BLUFOR element departed the checkpoint.

q.   Linkup Point. Record arrival and departure of a BLUFOR element at a Linkup Point.

        (1)   Time at which a BLUFOR element arrived at a linkup point.
        (2)   Location of the linkup point.
        (3)   Identification of the BLUFOR element at the linkup point.
        (4)   Time at which the BLUFOR element departed the linkup point.

r.   Passage Point. Record arrival and departure of a BLUFOR element at a Passage Point.

        (1)   Time at which a BLUFOR element arrived at a passage point.
        (2)   Location of the passage point.
        (3)   Identification of the BLUFOR element at the passage point.
        (4)   Time at which the BLUFOR element departed the passage point.

s.   Point of Departure. Record arrival and departure of a BLUFOR element at a Point of Departure.

        (1)   Time at which a BLUFOR element arrived at a point of departure.
        (2)   Location of the point of departure.
        (3)   Identification of the BLUFOR element at the point of departure.
        (4)   Time at which the BLUFOR element departed the point of departure.

t.   Rally Point. Record arrival and departure of BLUFOR elements at a Rally Point.

        (1)   Time at which each BLUFOR element arrived at a rally point.
        (2)   Location of the rally point.
        (3)   Identification of each BLUFOR element upon arrival at the rally point.

u. Traffic Control Point. Record arrival and departure of a BLUFOR element at a Traffic Control Point.

    (1)   Time at which a BLUFOR element arrived at a traffic control point.
    (2)   Location of the traffic control point.
    (3)   Identification of the BLUFOR element at the traffic control point.
    (4)   Time at which the BLUFOR element departed the traffic control point.

Note: In each case, arrival within 200 meters of a linear control measure and 100 meters of a point control measure is considered as an accurate arrival.

There are several areas which it will be useful to record BLUFOR unit movements to and from. These are shown in Table 10 below.

No-fire Areas	Objective Areas
Assembly Areas	Restrictive Fire Areas
Free Fire Areas	
Battle Positions	

Table 10. Area Locations for Control Measures

For each of the control measures shown in Table 10 certain specific information is desired. The data desired to be recorded is shown for each of the measures following:

a. No-fire Areas (NFA). Record the volume, location and type of fires delivered into a NFA and the unit delivering such fires.

    (1)   Time at which direct and indirect fires are delivered into a NFA.
    (2)   Type of fires delivered into the NFA.
    (3)   Unit delivering the fires into the NFA.
    (4)   Number of rounds delivered into the NFA.
    (5)   Identification of targets struck by fires in the NFA.

b. Objective Areas. Record the arrival of BLUFOR units on assigned objectives.
    (1)   Time at which the BLUFOR unit arrives on an assigned objective area.
    (2)   Location of the objective area.

c. Assembly Areas. Record the arrival and departure of BLUFOR units into and out of an assembly area.
    (1)   Time at which the BLUFOR unit arrives at an assembly area.
    (2)   Location of the assembly area.
    (3)   Time the BLUFOR unit lead element departs the assembly area.

d. Restrictive Fire Areas (RFA).
    (1)   Time at which direct and indirect fires are delivered into an RFA.
    (2)   Type of fires into the RFA.
    (3)   Unit delivering the fires into the RFA.
    (4)   Number of rounds delivered into the RFA.
    (5)   Identification of targets struck by fires in the RFA.

e. Free Fire Areas (FFA).
    (1) Time at which direct and indirect fires are delivered into a FFA.
    (2) Type of fires into the FFA.
    (3) Unit delivering the fires into the FFA.
    (4) Number of rounds delivered into the FFA.
    (5) Identification of targets struck by fires in (1) above.

f. Battle Positions. Record the time and location when BLUFOR units arrive and/or depart battle positions.
    (1) Time a BLUFOR unit arrive in a battle position.
    (2) Identification of the unit in the battle position.
    (3) Location of the battle position.
    (4) Time a BLUFOR unit departs from a battle position.

The specifications described here for a control measure performance measurement system would provide automated data on the quality of mission execution. These measures would provide important input into AAR discussions on the correspondence between mission plans and execution.

Required Hardware/Software Configuration. This training exercise would require:

- networked SPARCS workstations with TOC software for all TOC participants (most likely, the XO, Assistant S3, S2 and FSO) and a terrain database housed in a simulated TOC;

- a large screen display for use in the AAR;

- simulators for each tank crew participating in the "Electronic Sandbox" phase of the exercise (number will vary depending on use of SAFOR to represent units within the battalion);

- at least two (and possibly three) SAFOR stations for monitoring and controlling units within the battalion represented by SAFOR and controlling the Opposing Force (OPFOR);

- networked radios in simulators, TOC and exercise control room;

- a Plan View Display (PVD) housed in the exercise control room;

- MCC and SCC systems in the exercise control room for simulator setup, monitoring and control; and

- a Data Logger to capture automated data packets and a Data Probe/RS/1 Workstation for data reduction and analysis.

Recommendations for Initial Implementation and Tryout. It is recommended that this exercise be developed using either the Battalion Defense or the Battalion Deliberate Attack mission developed for earlier exercises.

To keep personnel requirements manageable, we recommend a reduced force "electronic sandbox" exercise with selected units within the battalion represented by SAFOR. More specifically, we suggest inclusion of six members of the battalion command and staff group (the Battalion Commander, the XO, the S3, the Assistant S3, the S2 and the FSO) along with three Company Commanders and their XOs. The fourth company in the battalion would be represented

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using the SAFOR. We also recommend using the SAFOR to represent the platoons within each of the four companies. All tank commanders (Battalion Commander, S3, Company Commanders and XOs) would also require crews for the "electronic sandbox".

We expect that prerequisite training on the TOC workstation and simulators and completion of the Mission Execution Exercise would take approximately three to four days depending on whether the exercise is a follow-on to the Mission Rehearsal Exercise or a standalone.

Training Materials Development Required. The following materials would need to be adapted from existing materials (1) or developed (2):

- (1) Mission scenario including Battalion OPORD and accompanying graphics;

- (1) Specifications for terrain database corresponding to scenario;

- (2) Introductory materials to introduce trainees to purpose of exercise, training objectives, expectations for their behavior, and administrative/logistical issues;

- (1) Familiarization training on simulators and workstations;

- (2) Exercise guidelines for Training Coordinator and SAFOR operator(s);

- (2) Specifications for automated measures to be derived from Data Logger;

- (2) Observational formats for Training Coordinator;

- (2) Guidelines for AARs.

Software Modifications Required. The software as it currently stands is able to support the delivery of the Mission Execution Exercise. However, there are two modifications that are required to enhance the delivery of training feedback.

The first modification involves speeding up the turnaround on the capture of data packets from Data Logger so that the data can be quickly entered into an analysis program such as Data Probe/RS/1 for summary. In order to incorporate automated data into the AAR discussion, data summaries must be available no longer than 30 minutes after the end of the exercise. Perhaps adjustments could be made to speed the Data Logger system or another system such as the Unit Performance Assessment System (UPAS) currently under development by ARI could be incorporated.

The second modification concerns the capability to quickly access and clip segments of communication tapes for replay in the AAR. In order for such segments to serve as inputs to the AAR, a process must be in place which would allow flagging of segments, preferably by time, and access of designated segments within a 30 minute period.

In summary, the Mission Execution Exercise offers an opportunity for leaders and units to train on the execution of specific missions in a simulation environment prior to the expenditure of resources for field training exercises. This strategy offers the advantages of providing an opportunity for units and leaders in institutional training settings to hone their skills before going to the field and to train in a setting that can provide objective and quantitative feedback on their performance.

Implementation Decision

The preceding five training concepts are intended to illustrate how the DIS environment can be used to support new approaches to leader and unit training. They are intended to offer training developers and trainers ideas as they consider the role of simulation in training. To further explore such innovative training concepts, ARI elected to implement and try out one of these approaches, the Information Management Exercise (IMEX). The remaining two sections of this Research Product describes the implementation of the IMEX and the results of the tryout.

Implementation of the IMEX

The Information Management Exercises were designed to implement training techniques centered on simulation-based, networked technologies. The platform for this training program was a network of four double-screened workstations, providing individual training to soldiers on the receipt, processing, and dissemination of information using automated digital communications. These four workstations were configured to communicate with a Coordinator's workstation, but not with each other. A printer provided output of training feedback to each participant at the prompt of a signal from each of the four workstations or the Coordinator's workstation. The Situation Display (Sit Display) was used during training and After Action Reviews (AARs). Figure 12 shows the IMEX hardware configuration.

The left monitor of the four double-screened workstations was configured as a Command and Control Display (CCD) while the right monitor was used to display IMEX feedback information. More discussion of the CCD and IMEX-specific software will be presented in a following section; however, an initial description of the CCD is included here to facilitate understanding of the IMEX implementation. Figure 13 shows a schematic drawing of the CCD display.

The CCD is a component designed to automate command, control, and communication functions. It has a computerized tactical map which can be tailored by the user to display terrain on different scales and with selected terrain features. The map can also be scrolled to show particular sections of terrain. Standardized digital mission overlays created by supporting Battalion Tactical Operations Center (Bn TOC) workstations can be transmitted to units with CCDs. These overlays can be shown on the map display and multiple overlays stored for future reference. The map display is integrated with a component known as Position Navigation (POSNAV) which provides digital location and heading information, graphic routes on digital maps, an automated steer-to-device for drivers, display of own friendly vehicle locations (known as mutual POSNAV), and a tactical map on the battlefield in X-Y grid coordinates.

The CCD was used to present the "message handling" component of IMEX. This consisted of one practice and three training vignettes which progressed in difficulty. Within each vignette, students familiarized themselves with the training objectives, initial instruction materials, and an Operations Order (OPORD) extract. After this familiarization phase, students began the information management phase of the vignette and managed their respective message traffic using the CCD. Messages included SPOT, CONTACT, and INTEL reports. Students were directed to handle their message traffic appropriately, given the tactical situation and guided by the initial instruction. Appropriate actions included receiving messages, processing information contained in the messages, and taking appropriate action including posting information to the map display, deleting messages, relaying messages to higher or lower, and taking no action.

At the end of the vignette, each student prepared a situation report (SITREP) identifying current location, degree and type of enemy activity, critical shortages, and a decision to attack, defend, or delay. Students then completed and scored a situational awareness questionnaire developed specifically for each vignette. Next, students directed their attention to a second monitor which presented the feedback component of the exercise. Finally, an AAR was conducted by an SME who reviewed the training objectives, tactical situation, and appropriate actions for particular reports. The platform conducting the AARs was the Situation Display shadowing that vignette's CCD with message icons posted. The AARs were conducted in a group format with each student having his workstation available for review of feedback materials. Students were given ample opportunity to ask questions about the suggested actions and provide input to future development of the exercises. Figure 14 shows the training schedule for participants.

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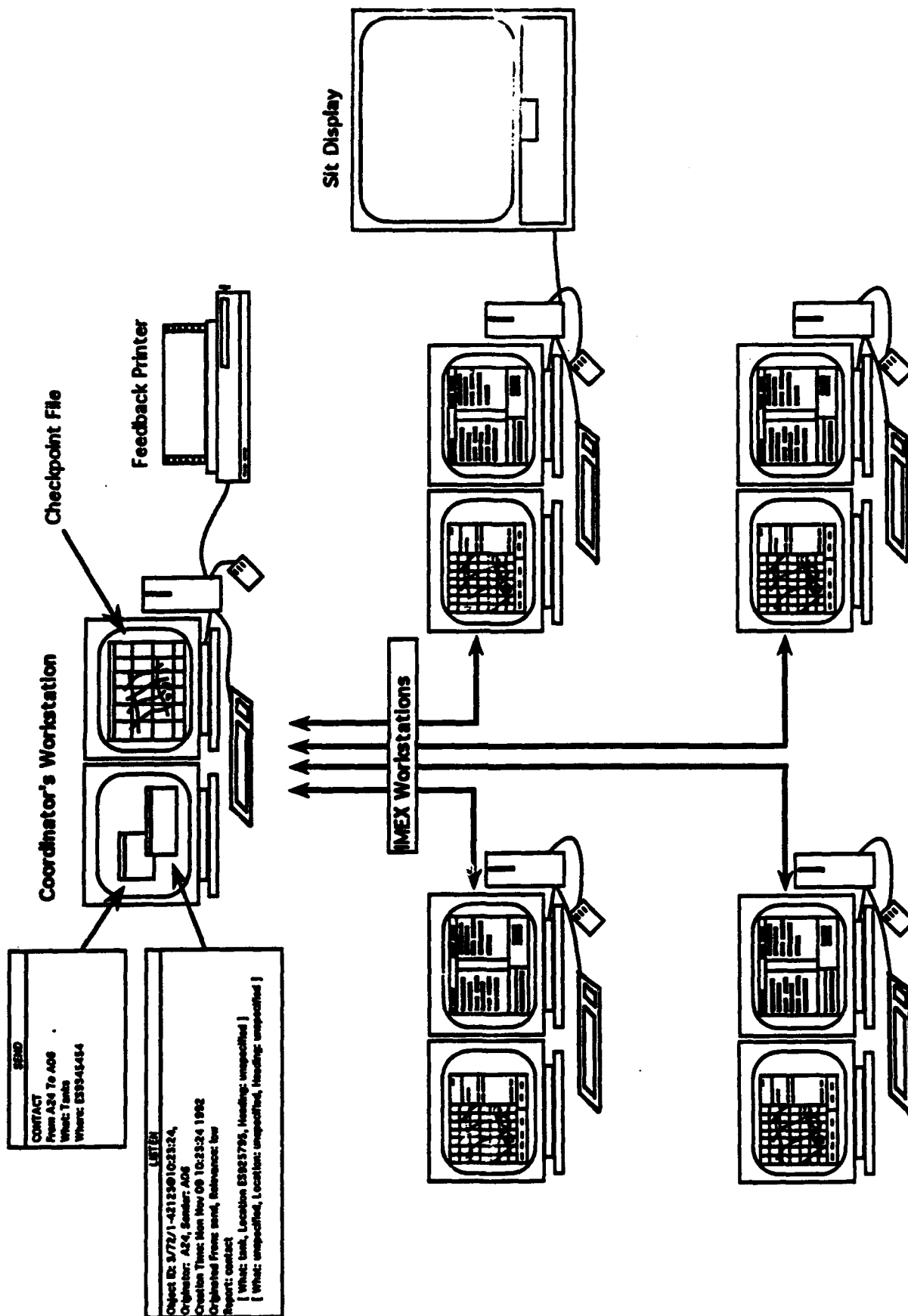
Figure 12. The IMEX Hardware Configuration
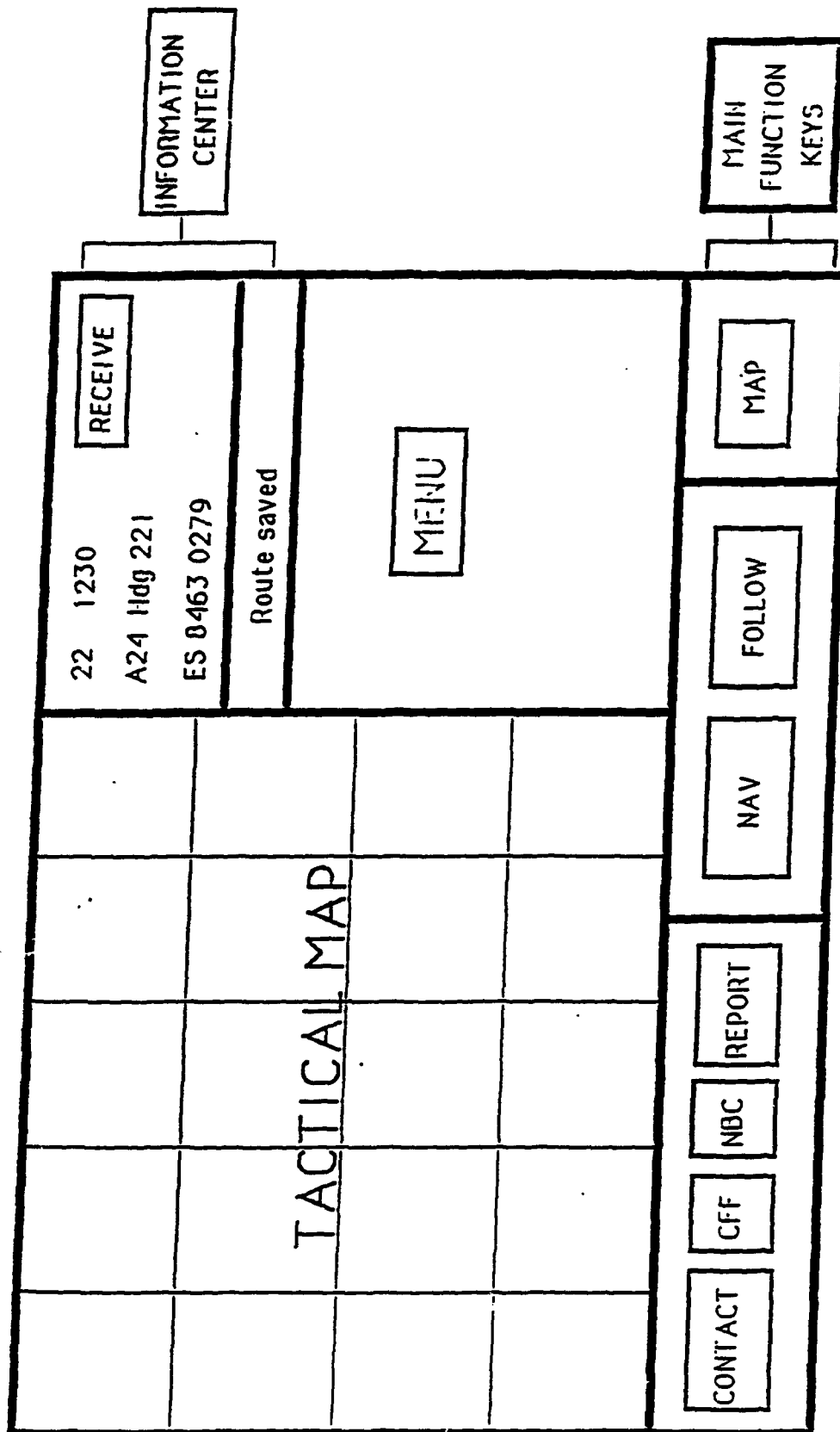
Figure 13. CCD Display

EXERCISE SCHEDULE
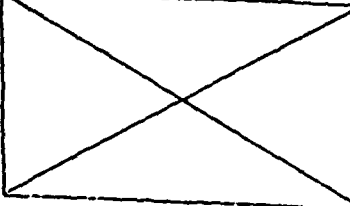
DAY 1		DAY 2	
0800		0800	Practice Training Vignette
1300	Introduction and Demonstration	0900	Break
		1000	Training Vignette 1
	Break		Break
1400	CCD Training Module	1100	Training Vignette 2
	Self Paced Training Materials	1200	Lunch
1500	Job Aid	1300	Training Vignette 3
	Practice Exercises	1400	Break
1600	Q&A With Training Coordinator	1500	Debriefing
	Skills Test	1600	
1700		1700	

Figure 14. Training Schedule for Participants

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IMEX Training Objectives

The IMEX training objectives resulted from an analysis of information management skills necessary for a company commander tasked with executing a planned defensive mission using automated message traffic from higher, lower, and adjacent units. Tasks were clustered within training objectives to ensure mastery of the CCD, efficient information management strategies, and an increased ability to assess the battlefield situation. The training objectives served as the basis for the development of each vignette's tactical scenario and message sets. The overall training objective was presented to the students as follows:

> Acting as a company commander, given a CCD and a paper map with and an operations order extract, process information to support execution of the planned defensive mission.

The training objective for the practice vignette focused on CCD operation while giving each participant the opportunity to use the CCD in an IMEX-like session. Tasks aimed at map adjustment, viewing "old" messages, manipulating overlays, and accessing newly received messages comprised the practice vignette and are shown in Table 11. The training objective for vignette 1 (Table 12) focused on correctly directing message traffic by determining the relevance of each report to any potential recipients (higher, lower, or adjacent units). Tasks aimed at maintaining communications, determining a report's relevance, and correctly relaying reports are shown in Table 12. The training objective for vignette 2 focused on analyzing the content of messages in terms of urgency, redundancy, and accuracy. Tasks aimed at determining message priority, redundancy, and conflicting information are shown in Table 13. The training objective for vignette 3 focused on situational awareness. Tasks aimed at tactical map management, message filtering, and determining the enemy's scheme of maneuver are shown in Table 14.

VIGNETTE	OBJECTIVE
Practice	Manage the CCD to facilitate your ability to process information
	TASKS
	Adjust CCD map to suit situation and preferences
	Access previously received messages relevant to area of interest by examining the locations and types of message icons displayed
	Open and post a CCD overlay to your map
	Open and read newly received messages and take appropriate actions

Table 11. IMEX Training Objectives Linked to Tasks for Practice Vignette

VIGNETTE	OBJECTIVE
1	Keep higher, subordinates, and adjacent units informed of changes to the tactical situation.

TASKS

Maintain communications with higher headquarters, subordinates, and adjacent units

Determine relevance of reported information to higher headquarters, subordinates, and adjacent units

Relay messages to higher headquarters, subordinates and adjacent units based on your evaluation

Table 12. IMEX Training Objectives Linked to Tasks for Vignette 1

VIGNETTE	OBJECTIVE
2	Recognize and correctly process high priority messages, messages with redundant information, and messages with conflicting information.

TASKS

When multiple messages are received, open and process high priority messages first

Recognize multiple sightings of the same element and relay one representative report of a sighting as appropriate, ignoring reports with redundant information

Recognize conflicting reports of sightings and relay most timely message as appropriate

Table 13. IMEX Training Objectives Linked to Tasks for Vignette 2

VIGNETTE	OBJECTIVE
3	Maintain current status of enemy and friendly dispositions and determine enemy's order of battle.

TASKS

Keep your tactical map current by posting new enemy sightings and friendly locations which are in or could soon be within your unit's area of interest

Delete message icons from your tactical map based on outdated information

Ignore messages not likely to influence your unit's area of interest

Determine the enemy's scheme of maneuver based on enemy sightings from higher headquarters, subordinates, and adjacent units

Table 14. IMEX Training Objectives Linked to Tasks for Vignette 3

Training Approach for Prerequisite Skills

The primary prerequisite skill for participation in IMEX was CCD proficiency. Since the CCD is the prototype of an automated command and control device not currently fielded, it was necessary for students to complete a training program centered on CCD operation before the information management component of the exercises was begun. Two approaches to CCD training were implemented. First, students were given an overview of the CCD during an Introductory Briefing, followed by a CCD Demonstration (Demo) that highlighted specific CCD functions to be used during the exercises (refer to Appendix A for the Introductory Briefing and CCD Demo). Both the CCD overview and Demo relied heavily on visual presentation of the system. For instance, the CCD Demo was conducted via the Sit Display (see Figure 12) which shadowed a CCD workstation, changing states as the result of various functions controlled by an operator as the Coordinator presented the Demo. Based on the "A picture is worth 1000 words" principle, the features of the CCD relevant to IMEX, especially those considered by trainers most difficult to conceptualize were featured in the IMEX Demo. These features were explained and examples were presented on the following topics: map manipulation and scrolling; CCD icon identification and use; accessing reports, posting and unposting overlays; and SITREP creation. The CCD Demo ended with the operator sending messages across the network and the Coordinator providing suggested strategies on managing the incoming message traffic.

The second approach to CCD training permitted hands-on experience. Students were presented with a set of self-paced training materials and a CCD Job Aid to be used as a training supplement and reference once the self-paced training was completed (see Appendix A for IMEX Self-Paced Training materials and CCD Job Aid). The self-paced training materials consisted of three units, each with its own set of objectives and exercises. These training objectives are shown in Table 15.

<u>Unit 1: Command & Control Display Introduction</u>

Objectives:

- Demonstrate familiarity with requirements for the CCD
- Display knowledge of the capabilities of the CCD
- Use the mouse to manipulate the cursor
- Identify the locations of CCD functions
- Use the Information Center as a resource for information on the state of your vehicle and the current operations being performed by your CCD
- Use basic CCD command options
- Practice policing screen to keep CCD operating at maximum efficiency

<u>Unit 2: Map-Related Functions</u>

Objectives:

- Identify the characteristics of your own vehicle icon
- Demonstrate familiarity with the significance of friendly overlay icons
- Practice scaling and scrolling the CCD tactical map to see the terrain you want at the scale you want
- Customize your terrain features with the MAP Features function

<u>Unit 3: Report Functions</u>

Objectives:

- Identify CCD message icons using an icon reference sheet and know how to use their locations and types for help in report retrieval and report processing
- Process newly received CCD-type messages and those found in the OLD files
- Post and unpost CCD overlays to and from your map to allow you a current, standardized picture of the operation
- Post message icons to your map and delete them from your map to keep your battlefield picture current
- Use CCD hot icons to retrieve reports from the RECEIVE queue and the OLD files
- Create a SITREP based on battlefield information

Table 15. IMEX CCD Self-paced Training Materials Training Objectives

     The self-paced training and CCD Job Aid familiarization took approximately 2.5 hours. Following the CCD training, students completed a CCD Skills Test (see Appendix A for CCD Skills Test) and were given the opportunity to ask CCD-related questions and review functions. As a final rehearsal, a practice vignette provided a training objective centered on CCD skills. Students were closely observed by the Coordinator during this time who provided any necessary remedial help.

IMEX Training Delivery Software

Coordinator's workstation. The Coordinator's workstation (depicted in Figure 15) was a specially configured Bn TOC workstation which allowed the Coordinator to use the left monitor for SEND and LISTEN activities while the right monitor was used to restart checkpoint files on each IMEX workstation. A printer was attached to the Coordinator's workstation which generated personalized hardcopies of the digital feedback information received by each student. See Atwood and Winsch (1993, in preparation) for a full description of training applications associated with the SEND, LISTEN, and Checkpointing Utilities available within the CCTB. See BBN Report # 7631 for a functional description. Since these utilities are fully described in other documents, their description here will be limited to their role in IMEX.

The SEND utility is a software tool for creating and sending digital messages to vehicle simulators and the Bn Tactical Operations Center (Bn TOC) workstations within the DIS environment. SEND was used to create and transmit files to the four workstations containing training materials, exercise control features, and digital reports. SEND was modified for IMEX to allow for report types unique to IMEX such as SME Rationales, OPORD extracts, training objectives, coordinator alerts, and coordinator messages. Each of these items, except coordinator alerts, were constructed prior to the exercises and loaded into the workstations using the Checkpoint utility discussed later. Coordinator alerts were not used during IMEX but are intended to allow the Coordinator to transmit a message online to a single student.

SEND was also utilized in IMEX to create and transmit digital sets of CONTACT, CFF, and INTEL reports to each student. Students received and processed two sets of SEND messages for each vignette. The first set of SEND messages was known to students as the "old files." The Coordinator's workstation was used to transmit these messages so that they were available to students at the beginning of each exercise. The old files were cast as being the last messages received by the previous A Co Cdr whom each student was replacing. Along with the OPORD extract, these messages helped to set the context for the present battlefield situation.

The second set of messages was sent to each student once he had reviewed the training objectives and OPORD extract for a particular vignette. To achieve a real-time effect, messages were set up in files for each vignette with 30 second intervals between each report, so that the Coordinator could send all messages in a single transmission without the messages arriving at the student's CCD simultaneously. Vignettes 1 - 3 contained 9, 15, and 21 reports, respectively. The practice vignette contained 15 reports. Reports for each vignette are shown in Appendices B - E.

LISTEN, a companion utility to SEND, was used by the Coordinator to monitor the transmission of reports by SEND, including student "Ready" signals and SITREPS. LISTEN was particularly useful for letting the Coordinator know when the last message of a vignette had been transmitted.

The Checkpointing utility was used to save the IMEX workstation's starting states for each vignette. This was accomplished by setting the workstations up in their initial states and taking an "electronic snapshot." Checkpointing was used to save files with the appropriate tactical map and own vehicle location for the CCD, as well as the OPORD extract and teaching objectives for Monitor 2. Once a Checkpointing file for each vignette was constructed, the Coordinator simply had to activate that file using the Restart function of the coordinator's Bn TOC workstation prior to the start of each exercise.
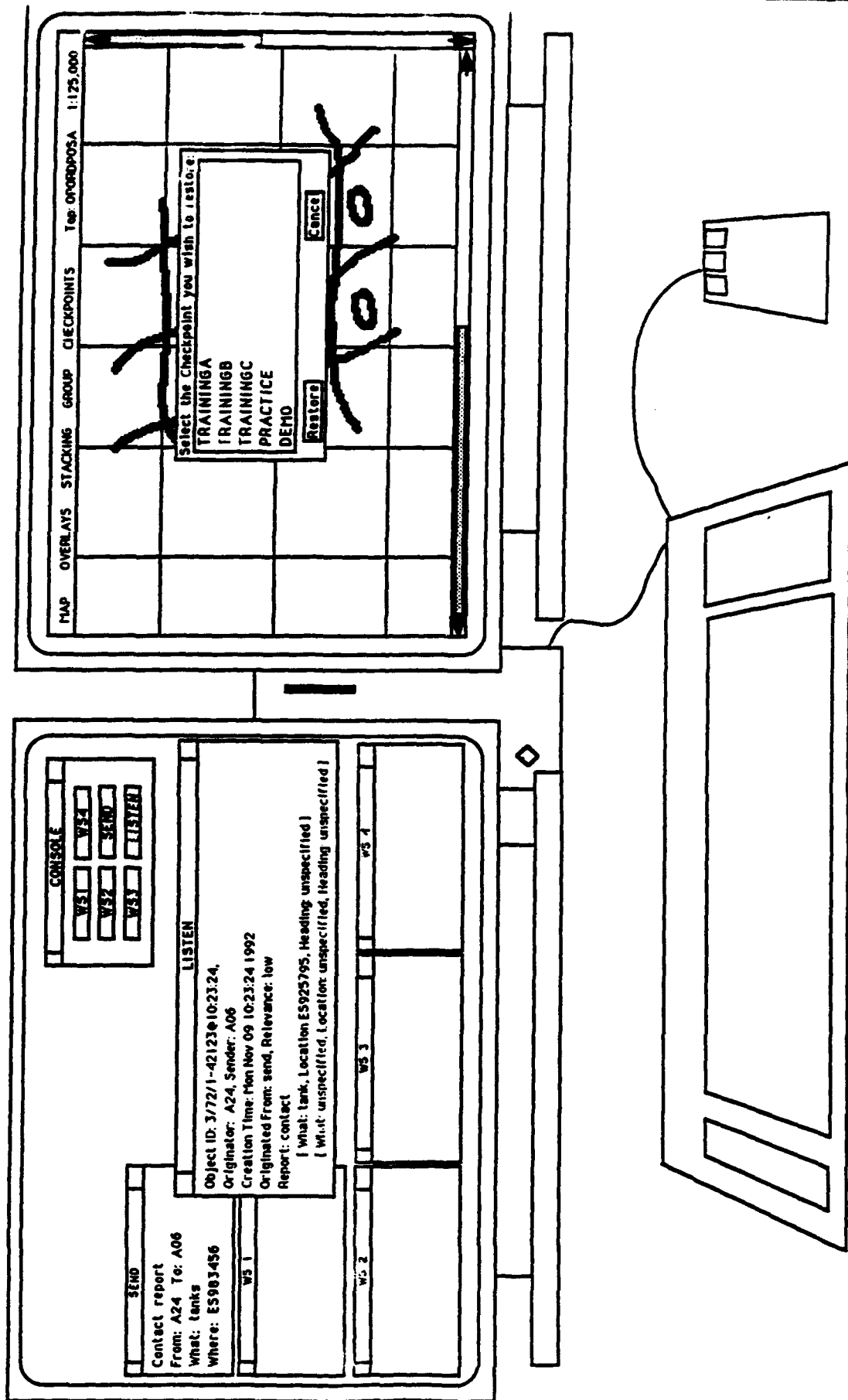
Figure 15. Coordinator's Workstation

Dual Screen Student Workstation. Two monitors were used to execute IMEX. The left monitor housed a CCD while the right monitor was used to present the training materials. Figure 16 shows the two monitors used for the exercises (Figure 16 is also contained in Appendix A).

The left monitor at each workstation displayed an automated Command and Control Display (CCD) used by the student to manage tactical information.

The CCD offers many functions that can be of significant assistance in planning, preparing, and executing missions. Table 16 shows a complete listing of the CCD functions used for current CVCC evaluations. See O'Brien et al. (in preparation) for a description of the CCD used to support a recent CVCC Battalion TOC evaluation. Because IMEX was configured for an institutional training setting and the primary objective was to train information management skills, only a subset of CCD features was selected for IMEX. The CCD's features selected for inclusion with IMEX were as follows: the CCD's digital message capabilities which allow the user to prepare, transmit, and receive digital reports; the CCD's computer-based tactical map of the battlefield, designed to suit individual user's needs through scaling and scrolling and choice of terrain features displayed; and the CCD's standardized digital mission overlays function which allows for receipt of overlays from other units and multiple overlays to be displayed at one time on the map display.

Navigation

       Grid map
       Terrain map
       Graphic overlays
       Own-vehicle icon (directional)
       Friendly vehicle locations
       Report-based icons
       Route waypoints
       Driver's steer-to display
       Waypoint Autoadvance
       Transmission of routes

Communications

       Create/send/receive/relay reports (text)
       Receive/relay graphics
       LRF input to reports
       Report-based icons

General characteristics

       Thumb control
       Touchscreen control
       Color display

Table 16. C3 Capabilities of the CVCC CCD Configuration
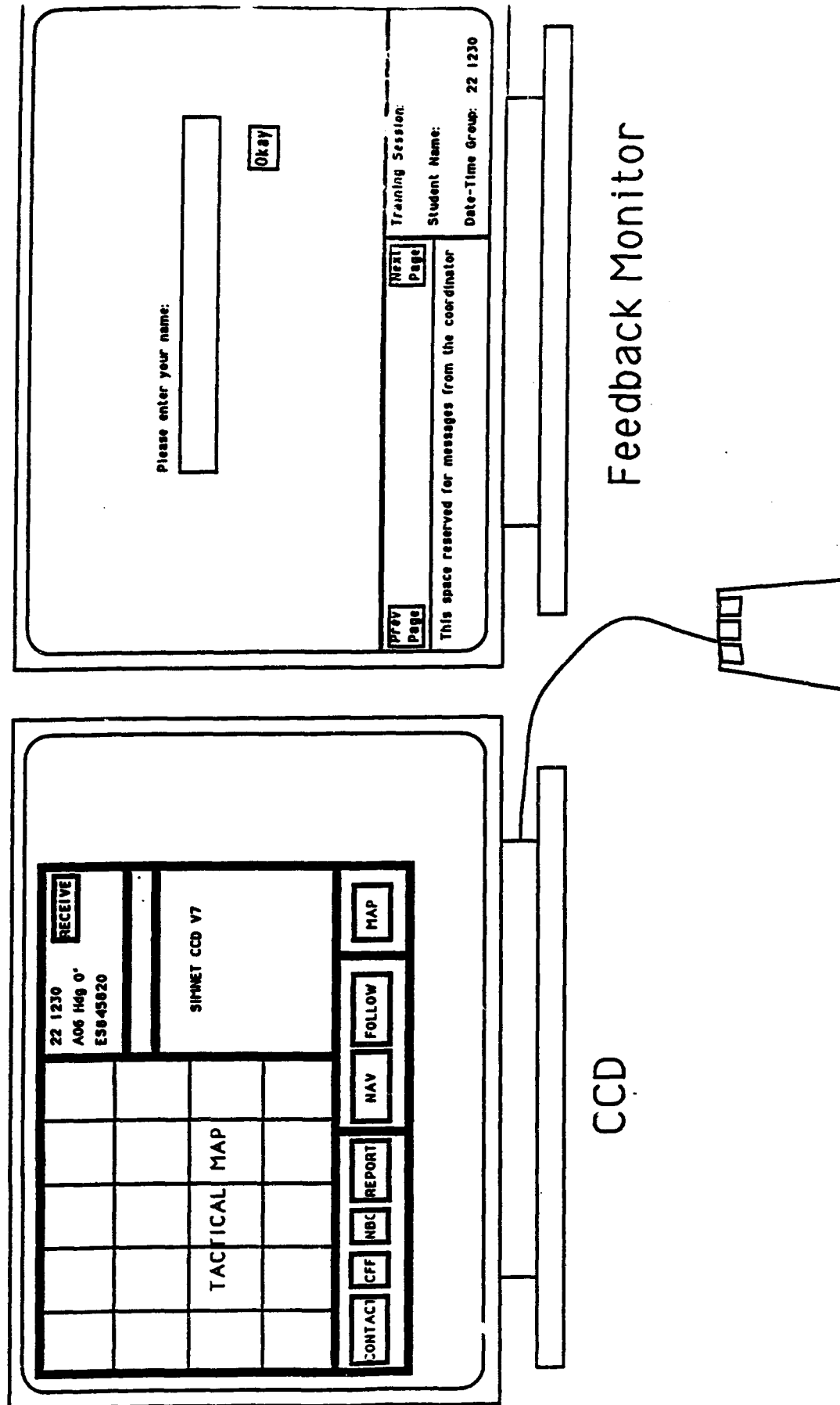
Figure 16. The Two Monitors Used for IMEX Exercise

The right monitor was used for presenting instructional materials to students including training objectives, tactical information such as OPORD extracts, control messages, and feedback on performance. Students were given a set of guidelines on procedures to follow in dividing their attention between the two monitors, and these are shown in Table 17. Figure 17 shows the sign-in screen for Monitor 2. This was the first screen each student saw on Monitor 2. When the student entered his name andclicked on the "Okay" button, a new screen appeared displaying the OPORD extract and training objectives for the appropriate vignette (see Figure 18). Once the students had thoroughly reviewed the OPORD extract and training objectives, they clicked on the "Ready" button at the top of this screen. This caused Monitor 2 to go to a "shell" screen which served as an additional prompt to students to turn their attention to the CCD. Once students finished using the CCD to process all of their messages, they created and sent a SITREP to Battalion. This activated a new screen on Monitor 2. This screen, shown in Figure 19, remained active until the situational awareness questionnaire was completed and scored. At this point, the students were instructed to ENDEX, and the feedback component of the exercise was begun.

---

1. LOGIN:

    °Look at the right monitor
    °Click on the name box
    °Type in your last name
    °Click on "Okay" when done

2. REVIEW OPORD AND TRAINING OBJECTIVE:

    °Read right screen

3. POST OVERLAY:

    °Post overlay to CCD (left screen).

4. REVIEW OLD MESSAGES:

    °Do not relay this information

5. READY TO BEGIN EXERCISE:

    °Look at right screen
    °Click on "Ready"

6.   RECEIVE MESSAGES:

    °Look at the CCD.
    °You will begin receiving messages shortly.

7.   MESSAGE COMPLETION:

    °Once all messages have been processed, complete and send a SITREP to Battalion

---

Table 17. IMEX Operating Guidelines

Monitor 2

Please enter your name:

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┌─────────────────────────────────────────────┐
│                                               │
└─────────────────────────────────────────────┘
```

```
┌──────────────────┐
│       Okay       │
└──────────────────┘
```

Prev Page	Next Page	
This spot reserved for messages from coordinator.		Training Session: checkpoint file name
		Student Name:
		Date-Time Group:

Figure 17. Sign-In Screen

Monitor 2

Training Objectives	Ready	OPORD Extract

Prev Page	Next Page

The purpose of this exercise...

Prev Page	Next Page

These are operation orders...

Prev Page		Next Page

This spot reserved
for messages from
coordinator.

Training Session: checkpoint file name

Student Name:

Date-Time Group:

Figure 18. OPORD/Training Objectives Screen

Monitor 2

Endex

Okay

Prev Page		Next Page	Training Session: checkpoint file name
This spot reserved for messages from coordinator.			Student Name:
			Date-Time Group:

Figure 19. ENDEX Screen

IMEX Training Feedback Software

The feedback component of the exercise is housed on Monitor 2 and begins with the Main Menu screen shown in Figure 20. This menu allows the student to click on "Show" to review the OPORD Extract/Training Objectives, or choose one of three options to view the comparison of his performance to the SME preferred actions and rationales.

The first feedback option presented on the Main Menu is the Message Summary Option. The Message Summary Option screen is shown in Figure 21. Here, agreement between student message routing and SME recommendations for each report is characterized by a "GO" or "NO GO" in the status field. Complete agreement between student and SMEs was the requisite for "GO". Students were encouraged to review all reports for each feedback mechanism; however, students tended to focus more on "NO GOs" than "GOs". In the example shown in Figure 21, the student has selected a CFF report from A21 to review. That report is shown in the next section of the display. Adjacent is a listing of the actual student actions performed on that report, followed by the SME preferred actions and rationale. Note that the first and last cells of the Message Summary display have pagination features allowing for multiple pages of information. When a report is selected on the Message Summary display, the CCD also shows the same report and highlights the report icon on the tactical map. Once all of the reports have been reviewed, the student selects "Exit" and returns to the Main Menu.

The second feedback option was an Exercise Summary. This listing records the number of times the student and SME performed an action for a particular report type, along with the number of discrepancies between the student and SME. Figure 22 shows an Exercise Summary where there were a total of two discrepancies on CONTACT reports. These discrepancies occurred because the student posted two reports counter to the SMEs recommendation. Once all reports had been reviewed, the students selected "Exit" to return to the Main Menu.

The third feedback option presented the student SITREP along with the SME SITREP and rationale for that vignette. Figure 23 shows the feedback screen for this option. In this example, the SITREP would have been presented on the Message Summary Screen as a "NO GO" since there are discrepancies between the student and SMEs on the FLOT, Enemy, and Critical Shortage fields. When the student exited from this option, he returned to the Main Menu and was able to revisit any of the options listed on the menu.

As a supplement to the feedback provided via Monitor 2, a printout was provided to each student listing a tally of all reports and discrepancies, the Exercise Summary, and the SITREP comparison for each vignette. It was intended that these printouts would serve as the primary reference during the AARs; however, students preferred to rely on the information provided by Monitor 2 during the AARs and kept the printouts as take-home materials.

Developmental Phases and Iterative Improvements

The development of IMEX was a multi-stage, collaborative effort drawing from a number of resources in the Armor, Training, Research and Development, and Simulation communities. Table 18 shows the major milestones associated with designing the IMEX training program. Note that to facilitate their description, milestones are described in a linear fashion; however, it should not be assumed that all milestones were crossed sequentially.

Monitor 2

Main Menu

◇ OPORD Extract/Training Obj

◆ Message Summary

◇ Exercise Summary

◇ Sitrep Feedback

Show

Prev Page		Next Page
	This spot reserved for messages from coordinator.	

Training Session: checkpoint file name

Student Name:

Date-Time Group:

Figure 20. Main Menu Screen

Monitor 2

Message Summary

Prev Page	3-10/21	Next Page

GO	A06	SPOT	2312
NOGO	B06	CONTACT	2312
GO	Y33	SHELL	2313
▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓			
NOGO	A21	ADJUST	2314
NOGO	Y06	INTEL	2316
NOGO	Y02	INTEL	2317
NOGO	Y02	INTEL	2317

CFF Report

From: A21/A21 At 2314

What   [Tank]

Where   [ES855955]

OTL   [43]

Exit

Prev Page	Next Page

Student Actions:
    Inspect, Relay Up

SME Actions:
    Inspect, Relay Up

SME Rationale:
    Because of the close proximity of the enemy, the SME chose to inspect this report and relay it to the intelligence officer....

Prev Page		Next Page

This spot reserved
for messages from
coordinator.

Training Session: checkpoint file name

Student Name:

Date-Time Group:

Figure 21. Message Summary Feedback Screen

Monitor 2

Exercise summary

| Prev Page | | Next Page |

```
Contact Reports (7 total)

          Student          SME        Discrepancy
Reading      6              6              0
Posting      4              3              2
                                   B06   Contact   2312
                                   Y33   Contact   2322

etc.
```

Exit

| Prev Page | | Next Page |

This spot reserved
for messages from
coordinator.

Training Session: checkpoint file name

Student Name:

Date-Time Group:

Figure 22. Exercise Summary Feedback Screen

Monitor 2

Situation ReportFeedback

Student's Report: **SME's Report:**   **SME Rationale:**

Situation Report

From A06/A06 at 2330:02

As of:	11 2330:15
Flot:	ES845945
	ES832945
Enemy:	Light
	Gnd Atk
Crit Short:	A
Cdr Intent:	Defend

Situation Report

SME's example

As of:	11 2328:05
Flot:	ES843946
	ES831945
Enemy:	Med
	Gnd Atk
Crit Short:	FA
Cdr Intent:	Defend

Prev Page	Next Page

In this scenario, it was important to note...

Exit

Prev Page		Next Page

This spot reserved
for messages from
coordinator.

Training Session: checkpoint file name

Student Name:

Date-Time Group:

Figure 23. Situation Report Feedback Screen

°Conduct FEA

°Select training method aimed at FEA results

°Software development specification

°Material development

°Conduct pilot

°Conduct tryout

°Produce report

Table 18. IMEX Milestones

Front End Analysis (FEA). As part of a FEA, structured interviews were conducted with SMES in Armor Training at Fort Knox, Ky. and Ft. Leavenworth, Ks. The increased information load associated with automated C3 equipment was consistently identified as creating a future training requirement for information management skills.

The FEA provided the foundation for focusing our training efforts on information management skills. Further impetus was provided by the fact that C3 is a focal interest of the ARI-Knox FBC team. Finally, it was desirable to focus on a future training requirement which would capitalize on the DIS capabilities of the CCTB. Thus, it was decided that a training program aimed at honing information management skills would be developed. Once a concept paper directed at information management skills was written and approved, the next step was to begin coordination with software developers to ensure that the required software was available within a desirable timeframe.

Software Development. New software was required to support the following desired IMEX capabilities: to allow the CCD to operate in a standalone capacity, to present the feedback component of IMEX, and to tailor SEND's messaging capabilities to support messages unique to IMEX (e.g., coordinator messages). Specifically, development and/or modifications were identified to support a configuration of four networked standalone CCDs, one networked coordinating display for instructor use, one large-screen display for demonstrations, and one printer to provide paper copies of feedback information. Several working conversations with software developers occurred regarding the feasibility of specific software changes before a written functional specifications document was produced. This prevented staff from wasting time describing software modifications that were not feasible given the available resources. Once the practical limitations were understood, a functional specification document using text descriptions and storyboards was written detailing required software modifications. This document described all anticipated software development and modifications and was presented to the software developers to use as their primary reference.

Functional testing of the IMEX software was conducted in a cyclical fashion. Once a new version of the IMEX software was installed on the network, a cycle of functional testing began. Initial testing was conducted in phases which grew as software development progressed (e.g., CCD software only, CCD and feedback screen parameters only, etc.) culminating in a "full-up" test of the software's final version. Software Functional Testing forms were developed to assist

the final software check of each workstation and were organized by functionalities for the Coordinator's workstation, the CCD and Feedback monitors (each menu level), and printer (Table 19 shows one form).

With the completion of each software check, developers were presented with a "software problems" list used to document existing problems. Most software problems were assigned a priority to be used by developers in expending programming resources. Since programming time and financial resources were of concern, problems with manageable workarounds were assigned the lowest priority. Problems that were considered to be "show-stoppers" were given a high priority as well as problems requiring minimal effort to fix. Table 20 shows an example of a suitable format for describing software problems.

Material Development. Many of the materials required an iterative development process and were not considered final until feedback from the pilot test was received. For example, since there were no standing operating procedures (SOPs) for information management available for the Armor environment, the SME doctrinal solutions were developed in multiple stages. First the SMEs were given the message sets for each vignette and asked to independently produce a solution for each message. Second, the solutions were tallied and discrepancies in recommendations were recorded. Third, a SME Roundtable was held to resolve all discrepancies. This allowed each differing SME to presented an argument supporting his rationale, followed by group discussion until all SMEs agreed on a rationale. Finally, a few rationales were amended due to comments from pilot subjects where appropriate.

Table 21 shows a listing of all of the materials developed to support IMEX. Each of these items may be found in the appendices.

Pilot. A pilot test was scheduled to permit ample time for any necessary software or material revisions. Every attempt was made to duplicate the procedures planned for the actual IMEX tryout. However, due to scheduling constraints, some changes were necessary. For instance, an abbreviated Introductory Briefing was given, and participants were detained following the debrief to solicit discussion on any items of concern. Four pilot subjects with extensive Armor experience but no CCD training were chosen to participate. Results of the pilot indicated minimal need for material or software revisions. Most discussion focused on questions involving SME recommendations. Each question regarding the SME recommendations was discussed with the entire group of participants and an SME. If the majority of participants disagreed with the recommendation, it was generally agreed that the recommendation would be amended. However, in most cases, doubt in a specific recommendation was usually resolved through group discussion of the rationale. All changes were completed prior to the Tryout, with the exception of a requested software change to the "GO"/"NOGO" characterization of student performance. Unfortunately, programming resources did not permit such a change to the software. As a temporary alternative, this issue was thoroughly addressed during the Introductory Briefing for the Tryout and it was acknowledged that future implementations should adopt less sensitive performance labels. Participants' progress and positive reaction to the training materials were quire encouraging given that this was the first time that such an approach for the CCD had been attempted.

INNOVATIVE TRAINING REPORT/MESSAGE FORMAT CHECKLIST
MONITOR 1 & MONITOR 2

Research Asst: _____   Workstation: _____   Date: _____

# STATUS Yes/No	ITEM	REMARKS
1. _____	Verify User name screen appears.	_____
2. _____	Verify students are able to enter name.	_____
3. _____	Verify OPORD extract on Monitor 2 after student enters name.	_____
4. _____	Verify Teaching Objectivesappear on Monitor 2.	_____
5. _____	Verify "ready" button is present on Monitor 2.	_____
6. _____	Verify area for coordinator messages is present on Monitor 2.	_____
7. _____	Clicking on "ready" button sends signal to coordinator's workstation via LISTEN.	_____
8. _____	Verify Monitor 2 display closes down once "ready" is activated.	_____
9. _____	Verify messages sent by CVCC-Send are received on Monitor 1.	_____
10. _____	Verify message relays are seen by coordinator only	_____
10a. _____	Relays to Bn	_____
10b. _____	Relays to Co	_____
11. _____	Verify correct relay default is shown on CCD for each message	_____

After Vignette is completed:

12. _____	Verify "Endex" report box screen appears on Monitor 2 after student has sent SITREP.	_____

Remarks. Use the space below to note additional problems encountered after initial checkout, or if additional space is needed.

Table 19. Software Functional Testing Form

Problem # 1	DESCRIPTION
	Reliable communication between a Bn TOC workstation configured as a coordinator and 4 StandAlone CCDs configured as A06 does not occur although, the software did appear to be stable on a 2 workstation setup. HIGH PRIORITY.
	STATUS
	Reported 4 Sept. 4 workstations tested 11 Sept. Software appeared stable.
Problem # 2	DESCRIPTION
	LISTEN does not pick up "ready" signal. LOW PRIORITY.
	STATUS
	Reported 12 Aug. Demonstrated to work 20 Aug.
Problem # 4	DESCRIPTION
	Nets can not be specified within SEND vignettes. This frequently results in inappropriate net defaults on the CCD. LOW PRIORITY, given workaround exists.
	STATUS
	BDM has developed a workaround.
Problem # 5	DESCRIPTION
	SEND does not tolerate "unseen" spaces following key words. LOW priority, given a workaround exists.
	STATUS
	BBN has offered a workaround.

Table 20. Software Problem List

IMEX Introductory Briefing
CCD Demo
CCD Self-Paced Training Program
CCD Job Aid
Tactical scenario materials
Initial instruction files
Teaching objective files
IMEX scenario message sets
SME doctrinal solutions and rationales
Situational Assessment Questionnaires
Training Evaluation Questionnaire
AAR guidelines

Table 21. IMEX Materials

Tryout. An IMEX tryout with three recent AOAC graduates was conducted over a two-day period (see Figure 14 for the schedule). The schedule was adhered to closely and permitted ample time to cover each event. Again, reaction to the self-paced training approach for the CCD was unanimously positive. Specific findings and recommendations are discussed below.

IMEX Program

Prerequisite Training. Since soldiers currently receive the majority of their CCD training via a demo and student/instructor lessons, one of the most notable aspects of the IMEX prerequisite training was the inclusion of self-paced training materials for the CCD. The reaction to this training approach was overwhelmingly positive. Students appreciated the opportunity to work directly with the equipment almost immediately. Another advantage noted by the students was that the self-paced approach allowed quicker learners to continue their progress while students needing help had the attention of the Coordinator. Several students commented that a smaller student/instructor ratio would be unnecessary, given the adequacy of the training materials.

A useful source of information for student assessment of IMEX is the Training Evaluation Questionnaire (contained in Appendix A). Students used this questionnaire to rate components of CCD training and the effectiveness of IMEX in training information management skills, and to provide comments on a range of related topics. Ratings and comments related to CCD training are presented in Tables 22 and 23. It is important to note that any data presented will reflect the opinions of only 3 students. More data collection is needed before any definitive conclusions regarding IMEX can be offered; however, these data do seem to indicate that IMEX has laid a firm foundation for teaching information management skills in an automated C3 environment.

For instance, Table 22 shows that students rated the CCD training component of IMEX very favorably, in fact 100% of the students rated the self-paced materials as excellent and 100% of the students believed the training program sufficiently taught the necessary prerequisite skills for successful use of the CCD.

Table 23 presents student comments regarding the CCD training. The comments provided by students were overwhelming positive regarding the self-paced approach to CCD training and reinforce the high ratings presented in Table 22.

How adequate were the components of CCD training in preparing you to operate the CCD?[1]		
	Mean	Std. Dev.
CCD Demo	4.67	.58
Self-paced CCD Training Materials	5	0
CCD Job Aid	4.33	.58
CCD Skills Test	4.67	.58
Overall Approach to Self-paced Training	5	0
Did the CCD training materials lack any components necessary to operate the CCD? No 100%		

[1]Rating scale ranged from 1 (Poor) to 5 (Excellent).

Table 22. Student Ratings of IMEX CCD Training

. Training materials were adequate for teaching CCD skills
. Self-paced materials are clear and convenient
. CCD was easy to operate
. Answers to CCD questions were easily found in the training materials
. 3:1 student/instructor ratio was effective

Table 23. Student Comments Regarding CCD Training

Exercise Materials. The exercise materials consisted primarily of each vignette's initial instructions and training objectives, message set, SME recommendations, situational assessment questionnaire and AAR. Students rated each of these items (except the situational assessment questionnaire discussed below) on the Training Evaluation Questionnaire. The ratings are shown in Table 24 and indicate that the exercise materials were rated very highly, with 100% of the students rating the initial instructions and training objectives, AARS, and IMEX overall as excellent. The lowest rating was given to the SME SITREP preferred solutions. Students commented that they needed more instruction on determining the enemy's level of activity (low, medium, or high) for the SITREP. This was the most likely source of student/SME disagreement on the SITREPs and any future IMEX implementation should include a set of criteria for each student to use in making this determination. Student comments regarding the exercise materials are shown in Table 25 and again echo their ratings of the exercises. Students agreed unanimously that they would have liked more exercises to complete which continued to increase in difficulty and led to interaction with other students.

How adequate were the following components of the training programming in helping you to improve your information management skills?[1]		
	Mean	Std. Dev.
Initial Instructions Linked to Training Objectives	5	0
IMEX Scenario Message Sets	4.67	.58
IMEX SME Preferred Message Solutions	4.44	.51
IMEX Message Summaries	4.67	.58
IMEX Exercise Summaries	4.67	.58
IMEX SME SITREP Preferred Solution	4.33	.58
AARs	5	0
Overall rating of IMEX	5	0
Did the training meet the objectives? Yes 100%		

[1]Rating scale ranged from 1 (Poor) to 5 (Excellent).

Table 24. Student Ratings of Exercise Materials

.	Exercises should be repeated with a larger test bed of students
.	Scenario materials and exercises were superior
.	Increase the difficulty and number of exercises, building on what already exists
.	Add an additional exercise on basic movement (offensive or withdrawal)
.	Include Logistics reports
.	Good match between training objectives and exercises
.	Ability to develop picture of the battlefield provided by system is a must for current and future battlefield.

Table 25. Student Comments Regarding Exercise Materials

The situational assessment questionnaires are also a useful source of information in evaluating the success of IMEX (the questionnaires are located in Appendices B - E). Since it was desirable to develop separate questionnaires for each vignette, comparisons between vignettes are difficult. However, students did improve across vignettes, both in confidence and response accuracy as shown in Table 26. Students showed a 27% increase in confidence and a 21% increase in situational assessment accuracy. This may indicate a favorable training effect of IMEX for situational assessment; however, the small number of students (n = 3) and the fact that there were some common questions across vignettes, prevent any definitive conclusions at this point.

	Vignette			
	Practice	1	2	3
Confidence Ratings1	3.34 (.67)	4.23 (.5)	4.14 (.9)	4.24 (.45)
% Correct	67 (33.4)	75 (38.3)	76 (25.23)	81 (26.25)

1Confidence ratings ranged from 1 (Not at all Confident) to 5 (Completely Confident).

Table 26. Situational Assessment Questionnaire Performance:
Means and Standard Deviations (in parentheses)

A more objective source of data for evaluating the effectiveness of IMEX is provided by the student/SME agreement rate across vignettes. This information was obtained by retaining a copy of each student's feedback printout. Table 27 shows that student/SME agreement increased overall from the Practice Vignette to Vignette 3. The most striking change is the 22% increase in student/SME agreement regarding deletion of messages. Given that a cogent concern for automated command and control devices deals with the potential for information overload, the finding that IMEX may be able to teach soldiers how to effectively filter unneeded information is noteworthy. The fact that students showed a small negative trend in SME agreement for relaying reports down may be due to students becoming overly conservative in their report filtering. However, this is a small trend and more data is needed for an acceptable explanation. No change was noted for SME/student agreement on report reading. It is recommended that report reading be dropped as a behavioral category since past research (see Lickteig, 1997) has shown that there is a

strong tendency of soldiers to open all reports received and this was the recommendation of the SMEs for each IMEX report.

Practice

	Reading	Posting	Relay Up	Relay Down	Delete
OK1	100%	77.78%	95.56%	82.22%	71.11%
IA2		11.11%		15.56%	4.45%
MA3		11.11%	4.44%	2.22%	24.44%

Training 1

	Reading	Posting	Relay Up	Relay Down	Delete
OK	100%	a85.19%	100%	77.78%	85.19%
IA		11.11%			3.70%
MA		3.70%		22.22%	11.11%

Training 2

	Reading	Posting	Relay Up	Relay Down	Delete
OK	100%	82.22%	95.56%	84.44%	77.78%
IA		13.34%	15.56%		6.55%
MA		4.44%	4.44%		15.56%

Training 3[4]

	Reading	Posting	Relay Up	Relay Down	Delete
OK	100%	85.71%	92.86%	90.48%	92.86%
IA		4.76%		4.76%	
MA		9.53%	7.14%	4.76%	7.14%

% Change from Practice to Training 3

	Reading	Posting	Relay Up	Relay Down	Delete
	0.00%	+7.93%	-2.70%	+8.26%	+21.75%

[1]OK = Student and SME are in agreement

[2]IA = Student took an Inappropriate Action

[3]MA = Student Missed an Action

[4]N=2, due to printer malfunction

Table 27. Student/SME Suggested Action Agreement Rate

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IMEX Software

The software development for IMEX was a multi-stage, collaborative effort described in the previous chapter. The software adequately supported the objective of IMEX, training information management skills. However, there is much room for software modification mostly in terms of refining parameters associated with the feedback materials and developing a more sophisticated Coordinator's workstation for training session execution. Modifications to SEND would also facilitate any future development of new and more complex IMEX vignettes. Comments from students are shown in Table 28. Comments not derived from student input are reflect the observations and recommendations of the Coordinator.

. Add an additional numerical identifier to track enemy icons
. Change software to support interactive training between students from different companies
. Develop mechanism to ensure critical information is not deleted
. Develop mechanism to filter redundant reports
. Change "Go/No Go" labeling on feedback screens

Table 28. Student Comments Regarding Software

The comment regarding enemy icons stems from the belief of students that the current way the CCD displays enemy icons is not optimal. When there is more than one type of enemy specified in a report, the CCD displays an icon for the first vehicle specified in the report. For instance, if a report specifies 1 tank and 20 PCs, the CCD will display a tank icon with a 1 drawn beneath it. Students requested that both pieces of numerical information be listed with the icon.

The second comment deals with further IMEX development. Students wanted to progress from initial vignettes to exercises which allowed them to interactively manage traffic across different companies. The software currently does not support the capability to send messages from the Coordinator's workstation to different companies simultaneously. In addition, further developmental work would be needed to provide feedback to students on reports generated online. The first step to this would be the development of information management SOPs which could be entered into a data base used to evaluate online behavior. This will be discussed further in a following section.

The third comment addresses the problem that one student experienced when he accidentally deleted an overlay from his overlay file. All of the students agreed that there should be a category of items which when selected for deletion, results in the user being issued a prompt asking for verification of his selection.

The fourth comment refers to the students' recommendation that a filtering mechanism be instrumented for duplicate reports. A filtering mechanism does exist which screens duplicate reports from the same originator; however, students desired a more sophisticated mechanism which could screen duplicate reports from different originators or reports which varied in only small degrees such as a slight difference in grid location.

The final comment reflects the students' sensitivity to the use of "Go/NoGo" performance characterizations. These labels were unacceptable, especially since no information management SOPs currently exist to support such an "all or nothing" scoring strategy. It is recommended the software be modified to present student/SME agreement in terms of less sensitive labels such as

"Agree/Disagree" rather than "Go/No Go". Additional changes to feedback parameters are discussed below.

Feedback Software. The feedback software was organized in terms of student/SME agreement on: individual messages, overall exercises, and SITREPs. Additional software was written to provide students with a printout of their performance to use as a reference during AARs. Observations of the students as they completed the feedback component of each vignette yielded some recommendations for software modifications. Two general user interface suggestions are offered: (1) drop the pagination button and build in a scrolling feature for each screen and (2) highlight the bottom line of text to signal the user when there is additional information on a following page. Additional software modifications are suggested below.

(1)   Message summary option: Students spent the greatest amount of time reviewing their performance using this option. Students took advantage of the handshaking ability of this option which activates a report's icon on the CCD's tactical map when that report was selected on the feedback screen. As mentioned above, an easy and important software change to implement is changing the "Go/NoGo" student performance labels to something less sensitive such as "Agree/Disagree". Another recommendation is to incorporate the SITREP feedback into this option. As it stands, the SITREP feedback does not require a separate option and lends itself well to this format.

(2)   Exercise summary option: Students did not use this feedback option, probably because the message summary option provided sufficient feedback. This option could be eliminated or modified to match the format of data presented in Table 17.

(3)   SME SITREP feedback option: Since the SITREP is a report type, this option could be incorporated into the message summary feedback option. Also, the student scoring software should be modified to accept a range of values for the specified FLOTs. Currently, any deviation from the SME FLOTS results in a "NoGo" for students. This was dealt with by including a textual explanation in the SME feedback explaining that values close to the SME FLOTS were considered "Gos". However, the optimal solution is a software modification to avoid unnecessary negative feedback.

(4)   Feedback printouts: The printouts presented to each student prior to the commencement of a vignette's AAR were largely ignored. Students preferred to refer to their feedback screens for an accounting of their performance. In cases where the monitors would be available, this would be the preferred mode for all performance feedback. Further, "buffer jams" occurred when multiple students activated the printer at very close intervals. Given that the printouts were largely unused, it is recommended that they be presented in a take home package when a printer is available. Otherwise, the printouts could be eliminated with no negative training effect. Recommendations are offered below for the developer who wishes to continue using printouts as a source of feedback.

The first part of this feedback presents reports in terms of inappropriate actions (IA), missed actions (MA), and oks (OK) (see Table 22). For instance, a student receives an IA if they posted a report counter to the SME's recommendation. However, if they failed to post a report that the SME recommended to post, they received an MA. This labeling scheme becomes cumbersome to interpret. An alternative way to present the data would be to replace IA and MA with easier to interpret symbols such as "+" and "-". A student would receive "+" if they committed an action not recommended by the SMEs and " - " if they omitted an SME recommended action.

A second recommendation is to eliminate the "Read" column of the feedback. As mentioned earlier, soldiers have a heavy predisposition toward opening all received reports. This matched

100% with SME behavior; therefore, it appears that this category offers little potential for shaping information management strategies.

The second part of the feedback matches the format of the exercise summary option. Breaking the feedback down by report type is of little interest unless training objectives are directed at report type. This feedback could be eliminated without negative training effects.

The printouts were useful to the Coordinator in that they provided a permanent record of training performance for each student. Related, at a minimum software should be written so that the information from the printouts is written to a disk. The preferred format for the data would allow for easy importing to data analysis software.

Coordinator's Workstation. Software for the Coordinator's workstation should be developed to provide the option of menu driven control of the exercises. Currently all exercise control is accomplished through manual input of sometimes extremely lengthy command lines for each workstation. Different commands require access to different directories, requiring some understanding of the UNIX system. While the Coordinator would still require the ability to interact with each workstation individually, the workstation should have as a feature one window which controls all workstations and includes a menu with exercise control feature selections such as "Bring up IMEX student workstations", "Bring up IMEX Coordinator's Workstation", "Print innovate file", etc. The feature selection button for the startup of the student workstations should also activate the appropriate checkpoint file and place each student's own vehicle icon in the correct location on the CCD's tactical map. Besides decreasing the probability of input errors, these modifications would make the workstation much easier for novice and short-term users.

SEND. SEND should be modified to allow bundling of messages from different echelons into one vignette file containing a radio net field for each report. Otherwise, the correct CCD default route will not be presented to the user when he chooses to relay a report. This is a problem when a developer wants to place reports from different echelons into one vignette file and the interval of reports is a variable as well as the order in which the reports are transmitted. The workaround for this problem should not be considered a long-term option as it is time consuming and it would seem that the software fix would be straightforward given that radio nets can be specified within session files. The workaround entails splitting the vignette file into separate files, one for each radio net (Company and Bn). Then, reports within each file are given intervals based on the order in which they should be transmitted (occasional timing problems still occur). These files are then bundled into one session file.

Another suggested modification of SEND deals with the creation of text files. Training objectives, direct instructions, OPORDs, and SME rationales were built using SEND. While it was desirable to keep text files brief, SEND has a limit of 1024 characters for a single text file which greatly constrained the presentation of some training materials. This modification was beyond the scope of the current program's resources, but is recommended as a high priority change for future training development efforts.

Information Management SOPs

This tryout of IMEX has provided support for the SME recommendations offered to students. However, information management SOPs must be developed and validated before the IMEX program can be considered complete. As a start, it is recommended that additional tryouts be conducted to validate the SME recommendations and begin the development of information management SOPs. One approach to the development of SOPs would be to develop a data base of student performance, working toward a comprehensive source of information which could be used for the development of an expert system.

Innovative Training

The IMEX training program provides a sound basis for refining training technologies for the CVCC systems aimed at information management skills; however, several modifications to the program could enhance future training. First, future extensions of IMEX might require the capability for workstations to role-play company commanders of several companies, interacting with each other on a Battalion net and with subordinates on a Comany net. Providing feedback aimed at reports generated online would require the development of an expert system based upon a valid set of information management SOPs. The development of scenarios and software supporting online student to student interaction would add increased complexity and realism to the exercises. This was a consistent recommendation offered by the students.

Second, since all of the IMEX vignettes were defensive, additional scenarios could be developed based on offensive operations or more specialized situations such as a counterattack, attack, or delay missions. Related, the IMEX software currently does not allow for POSNAV or mutual POSNAV input to a student workstation. This would be a desirable change if students interacted with each other and/or scenarios requiring vehicle movement were developed.

Third, multiple levels of SME feedback could be made available to the user. For instance, "key terms" in a SME rationale could be presented in boldface. Students could have the capability to select any key term associated with a rationale. This selection would activate a second level of detail linking the key term to the SME rationale.

This implementation of IMEX has demonstrated the value of the DIS environment for innovative training uses and paved the way for future development that should be further pursued by the training and development community. While IMEX is focused on the CCD component of the CVCC system, other test and evaluation or training facilities concerned with training information management skills may tailor this approach to suit their needs.

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