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Prototype Methods for Training and Assessing Future Tactical Command and Control Skills

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Fort Knox Field Unit
Training Research Laboratory

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This report presents prototype methods for training and assessing selected command and control (C^2) skills for future tactical commanders. The methods are designed to support training requirements for vehicle-based automated C^2 systems and to overcome some of the current limitations in the training and assessment of tactical C^2 skills. The C^2 vignette method is designed to rapidly generate standardized, operationally based, C^2 training and assessment exercises with a minimum of personnel resources. The situational awareness (SA) measures are designed for objective assessment of a tactical commander's ability to "see the battlefield" and to support quantifying objectives for SA training programs. These prototype methods are provided as tools that can be adapted by training developers and analysts of future C^2 systems at simulation-based training and assessment facilities.

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Prototype Methods for Training and Assessing Future Tactical Command and Control Skills

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Training Simulation

FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) conducts basic and applied research that focuses on meeting soldier performance needs that face the Army of today and tomorrow. As part of ARI's program to train the force, the objective of the Future Battlefield Conditions team at Fort Knox, Kentucky, is to enhance soldier preparedness through identification of future battlefield conditions and development of training methods that take those conditions into account.

As the Army moves toward fielding vehicle-based automated command and control (C^2) systems, new methods are needed to train and assess the C^2 capabilities of small-unit commanders using these systems. This product provides two prototype methods developed by ARI for training and assessing selected skills of tactical commanders using C^2 systems. These prototype methods are provided as tools that can be adapted by training developers and analysts for future C^2 systems.

ARI's research on training requirements and methods for future automated C^2 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 entitled Research in Future Battlefield Conditions, 12 April 1989.

Results of this effort were briefed to the Chief of the Command, Control, Communication, and Computer (C^4) branch of the Armor School's Directorate of Combat Developments and provided to the Chief of the Close Combat Test Bed (CTTB) and the Chief of the Combined Arms Tactical Training Center (CATTC) at Fort Knox.

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Introduction

As the Army moves toward fielding vehicle-based automated command and control (C^2) systems, new methods are needed to train and assess the C^2 capabilities of small unit commanders using these systems. Future C^2 systems create new training requirements and also provide a computer-based medium for developing new methods for training and assessing C^2 performance.

In support of the Army's requirement for future C^2 systems, the Army Research Institute's (ARI) Future Battlefield Conditions (FBC) team at Fort Knox is currently involved in a Research and Development (R&D) program on future Combat Vehicle Command and Control (CVCC) systems. As part of the CVCC program, ARI conducts simulation-based research on future C^2 system configurations and the training requirements associated with these systems by using the Armor Center's Close Combat Test Bed (CCTB) at Fort Knox, formerly SIMulation NETworking Developmental (SIMNET-D).

ARI's FBC team has recently conducted a series of simulation-based, soldier-in-the-loop evaluations on future tank systems using the CCTB. Component systems evaluated in crew and platoon assessments include the position navigation (POSNAV) system (Du Bois and Smith, 1989) and the tactical commander's Command and Control Display (CCD) (Du Bois and Smith, 1991). The research program's bottom-up approach proceeded with the integration of the CCD and POSNAV with the Commander's Independent Thermal Viewer (CITV) (Quinkert, 1990) in a company level evaluation (Leibrecht et al., in preparation). Current and future FBC team efforts include extension of these future C^2 capabilities to a battalion Tactical Operations Center (TOC) and a battalion level evaluation.

In contrast to this escalating series of relatively large force-on-force assessments, the research problem addressed in this effort was to develop more efficient and robust methods for training and assessing the C^2 skills of future tactical commanders. The prototype methods presented in this report are designed to both support training requirements for future C^2 systems and to overcome some of the current limitations in the training and assessment of C^2 skills.

Arguably, the greatest difficulty with respect to C^2 training and assessment is the inability to control the multitude of extraneous variables associated with field-based exercises (Baker, Cook, Warnick, and Robinson, 1964; Barron et al., 1976). To ensure standardized battlefield situations for C^2 training and assessment, a set of tactical-level C^2 vignettes or "snapshots" from an operational scenario was developed as part of the current

effort. The vignette method is designed to rapidly generate standardized, operationally-based, C^2 training and assessment exercises.

While command and control consists of the procedures and techniques used to make and execute battlefield decisions, "...the commander must make his decisions based upon his ability to see the battlefield" (Department of Army, 1985, p. 1-2). However, observations at the National Training Center (NTC) indicate that one of the greatest deficiencies at the small unit level is the inability of the platoon leader to assess the battlefield situation (Word, 1987). To better train and assess tactical commanders in situation assessment, a prototype method for objectively measuring the commander's situational awareness (SA) was developed under the current effort.

The methods developed--C^2 vignettes and SA measures--are prototypes. Armor branch Subject Matter Experts (SMEs) contributed significantly in their design and development. Active duty platoon and company commanders, serving as pilot participants, provided valuable recommendations for method refinement which are integrated in the methods provided. The steps required for development and adaptation of these methods are described and documented. While these methods may be used independently, this report provides a detailed implementation example in which the two methods are closely combined.

This implementation example is provided to illustrate and facilitate method utilization. This example includes a set of tactical C^2 vignettes and related situational awareness measures for training and assessing the future tactical commander's ability to: acquire and communicate information and maintain status; and, assess the situation. Respectively, these are the first two functions specified under tactical command and control in the Blueprint of the Battlefield (Department of the Army, 1989).

These prototype methods are provided as "tools" that can be adapted by training developers and analysts for future C^2 systems. The simulation-based nature of these methods supports both their current utilization in the CCTB for research on future C^2 systems, and their future utilization in simulation-based Army training facilities such as the Combined Arms Tactical Training Center (CATTC) and the proposed Close Combat Tactical Trainer (CCTT).

Background

Military Requirement

Automated C^2 systems should provide full or partial solutions to several of the deficiencies repeatedly cited in the Level II Close Combat (Heavy) Mission Area Analyses, regularly published by the Armor Center, and the TRADOC Battlefield Development

Plans. Identified areas of concern to be addressed by automated C^2 systems include: command and control, tactical communication, target localization, and target handoff.

In support of these requirements, the Directorate of Combat Developments (DCD) at Fort Knox published the starter-set requirements for a system called the Intervehicular Information System (IVIS)(U.S. Army Armor School, 1988). IVIS is a near-term automated C^2 system currently being tested on the M1A2, the block-two upgrade to the Army's main battle tank, the M1 Abrams.

CVCC, in comparison, is a far-term R&D program to define user specifications for vehicle-based automated C^2 systems beyond the M1A2. CVCC is an integrated complex of battlefield information acquisition, processing, and distribution technologies proposed for the battalion-down maneuver force. Future C^2 systems will provide ground vehicle commanders, in addition to voice radio, the capability for digital-burst communication of text and graphic battlefield information.

The military requirement for lower echelon automated C^2 systems resulted in an Organization and Operation (O&O) Plan. To ensure system compatibility among the family of Army Tactical Command and Control Systems (ATTCS), the O&O Plans for all Army automated C^2 systems were rolled into the draft umbrella O&O for ATCCS issued 22 Sept 1988. The O&O for IVIS is included as Appendix 3 to the O&O for the Maneuver Control System which is included as Annex D to the ATTCS O&O.

User requirements summarized in the IVIS O&O specify that significant improvement in C^2 capabilities must be achieved by the provision of automated and digital information processing systems. This O&O proposes that to speed the decision-loop for battlefield operations, automated C^2 systems must minimize the time-consuming manual preparation by tactical commanders of reports, orders, and operational overlays. This plan also requires that these systems must be tailored to meet the unique requirements of each echelon to ensure soldier-friendly interfaces.

While the criticality of command and control is traditionally noted in the annals of military warfare, the pace and complexity of the future battlefield will require more exacting C^2 capabilities. Automated C^2 systems that provide commanders the freedom to operate and lead from any point on the battlefield are needed to meet the basic tenets of the Air Land Battle doctrine: initiative, agility, depth and synchronization (Army Science Board, 1986). Both the IVIS and CVCC systems represent the Army's long term commitment to link the upper and lower echelons in a unified C^2 network and provide small unit commanders more automated C^2 capabilities for forcefully executing the Air Land Battle mission.

Conventional C^2 Procedures. Conventional C^2 procedures are frequently dictated by the limitations of the Army's voice-based radio system. Voice radios force users to become overly involved in communication processes. For example, data from NTC company level missions demonstrate that small unit commanders wait 28 seconds, on the average, simply to gain net access to begin a transmission (Phelps and Kupets, 1984). Completion of a message usually entails several transmissions. As a result, users are frequently kept on "hold" awaiting a clear net.

Once the combat net frequency is accessed, call signs and authentication procedures are required for ensuring communicator identities. The NTC data discloses these requirements can account for over one-half of the "information" transmitted (Phelps and Kupets, 1984). In addition, nearly one-third of all messages are lost due to interference. Since no FM record exists, the user must repeat these message-related procedures to obtain good "copy" of lost messages. To relay any message received, all procedures must be repeated. The problems are compounded during the most intense phases of combat when more messages are attempted and a smaller percentage completed: ". . . the harder they tried, the less successful they were" (Coleman, Stewart and Wooten, 1986).

Most military communications, and particularly C^2 tactical communications, must convey spatial-geographic data about the geometry of the battlefield. Unfortunately, voice-based systems force soldiers to repeatedly encode this spatial-geographic data into alphanumeric formats or "grids" at the sender's station, and then decode the same elements back to spatial-geographic formats at the receiver's station. An extremely simple and critical battlefield communication such as the Contact report on an enemy unit, for example, might be: "T-72 tank at grid Echo Sierra four, six, eight, two, five, zero; BMP at grid Echo Sierra four, eight, eight, two, seven, five."

More complex communications of battlefield data such as operational overlays, the blueprints of the mission, are constructed with grease pencils and acetate sheets. An operational overlay is literally a product created and used atop a geographic map. Its graphic format is identical in form to the spatial-geographic nature of the battlefield. Voice-based communication of this essentially spatial information is extremely difficult and inefficient. With conventional C^2 procedures, therefore, the "transmission" of overlays is almost always accomplished by manual copying in a face-to-face, dismounted setting (Lickteig, 1987).

Automated C^2 Procedures. In contrast to conventional C^2 procedures, automated C^2 systems automatically generate many required C^2 inputs such as call signs and authentication procedures, and increase the speed and accuracy of inputting others such as enemy location by laser designation. Since message preparation is distinct from transmission with automated

systems, they eliminate the user's wait for net access and automatically retransmit when required.

Digital-burst transmissions by automated C^2 systems occur in milliseconds, reducing the risk to information security. Conventional system requirements for encryption, "breaks" in transmission, and multiple transmissions to complete an extended voice message are eliminated. Reception of clean copy is monitored and ensured with automated systems. And given digital copy, message relay requirements can be reduced to a one-button selection.

Most importantly, the spatial and graphic nature of C^2 information is retained by the graphic data formats of future C^2 systems which include a map display of the battlefield. Military symbols for units and control measures are automatically depicted at the correct locations on a tactical map of the area. The ability of automated C^2 systems to provide a digital map, friendly vehicle icons, report-based enemy icons, and operational overlays is expected to provide an unprecedented capability for vehicle commanders to "see the battlefield."

In summary, the purpose of a command and control system is to provide commanders accurate and timely information for developing feasible courses of action and making logical decisions (Department of Army, 1985). The military requirement for more automated C^2 systems does not change that purpose, but reflects the increasing need for more timely and accurate battlefield information.

The above comparison of conventional versus automated procedures suggests that while future C^2 systems may greatly enhance tactical C^2 performance, these new systems will also revolutionize the manner in which C^2 functions and tasks are performed. The following description of the user interface anticipated for future C^2 systems will more clearly indicate the types of tasks that must be trained and mastered. The methods developed under this effort were designed to train and assess many of the skills underlying these tasks.

Research Requirement

Future C^2 System Development. To provide a medium for the investigation of future C^2 training and assessment, ARI's FBC team initiated the development of a future C^2 system compatible with the simulation-based CCTB. ARI's development of a future C^2 system included the integrated simulation of three component systems. The Command and Control Display (CCD) will be described below and is the primary component of interest for this effort. With component integration, the POSNAV system provides the commander continuous CCD updates on own and friendly vehicle locations. The CITV provides an independent thermal capability to search, identify, and handoff targets to the gunner. The

current configuration of the CVCC-equipped commander's weapon station is depicted in Figure 1.

To initiate development of this future C^2 system, ARI prepared a set of design guidelines and functional specifications for a vehicle-based automated C^2 system (Lickteig, 1988) to guide the efforts of simulation hardware and software engineers. The guidelines attempted to ensure the development of a simulation-based C^2 system responsive to basic research and development issues. Two primary characteristics of the CCD design, therefore, were user tailorability during an operational exercise and rapid system reconfigurability between operational exercises and evaluative efforts.

A brief description of the CCD interface is provided to indicate the general training and performance requirements associated with future tactical C^2 systems. This description will focus on the functions and tasks required to acquire and communicate tactical information, and the system's potential for enhancing the commander's awareness of his battlefield situation. For a more complete description of the CCD, see Smith (in preparation).

The CCD is expected to provide the user access to the automated C^2 functions available in future tank systems including integrated functions available in the POSNAV and CITV components. The majority of the CCD's display surface, as indicated in Figure 2, is dedicated to providing the commander a tactical map of the area of operations. This map, generated by an on-board digital terrain data base, depicts a bird's-eye view of the battlefield at multiple map-scale levels.

The tactical map displays an icon of the commander's vehicle depicting current location and heading as determined by the POSNAV system. In addition, POSNAV information exchanged with similarly equipped combat systems results in the tactical map's depiction of other friendly vehicles or units.

Graphic C^2 information is automatically displayed on the tactical map as reports and overlays are received or prepared. For example, an Intelligence report might contain friendly, enemy, and obstacle information. Upon reception of an Intelligence report, each of these informational elements is immediately displayed at its precise location on the tactical display in color-coded, standard military symbols. Atop the digital map, the system also displays the operational overlays used to communicate the mission and command and control the force.

At the bottom of the CCD, a row of dedicated soft switches identify and access the primary functions provided by the CCD. These functions include report preparation and retrieval capabilities, navigation and route designation menus, and map "tools" such as scale and scroll functions.

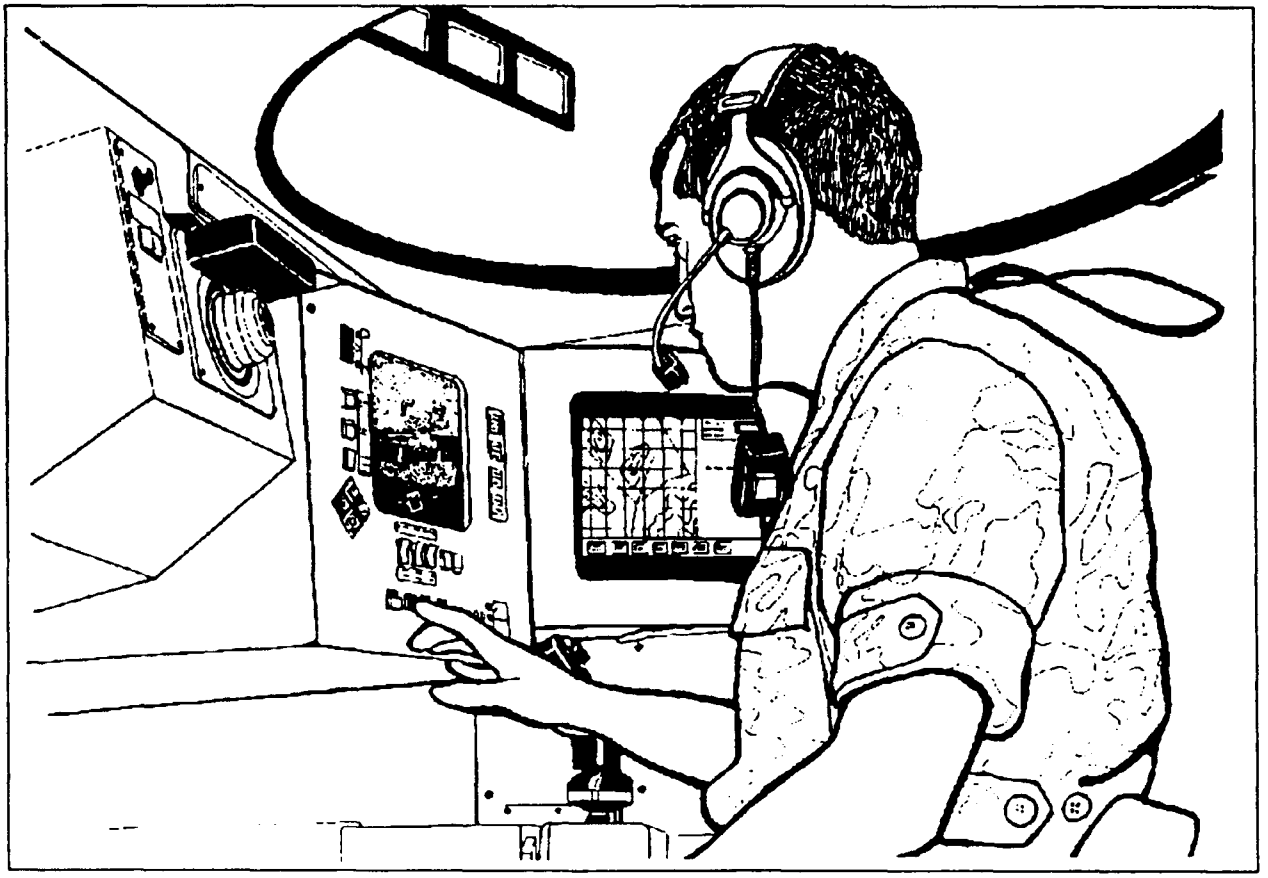

Figure 1. Vehicle commander touching Commander's Independent Thermal Viewer left of the Command and Control Display.

The dedicated menu area on the right side of the CCD provides access to a variety of functions for processing battlefield information and manipulating the map. Reports can be generated in this area by activation of designated selections at the bottom of the CCD. Incoming reports are accessed by activation of the RECEIVE key at the top of the display.

Activation of the RECEIVE key, by touch or thumb cursor selection, opens the Receive Queue, which displays a list of the messages received. This list is composed of message "headers" that identify the time the message was received, the source of the message by call sign (e.g., A06, Y06), and the type of message or report received (e.g., Spot, Contact or Intelligence). Selection of a message header highlights its corresponding message icon displayed on the tactical map at the time of reception.

If multiple messages have been received, the commander's review of the header contents, along with icon type and proximity, provides a basis for deciding which messages should be processed first. After selection of a message header, the commander can elect to read the message contents by selecting a multifunction key labelled SHOW that corresponds to the SEND key in Figure 2.

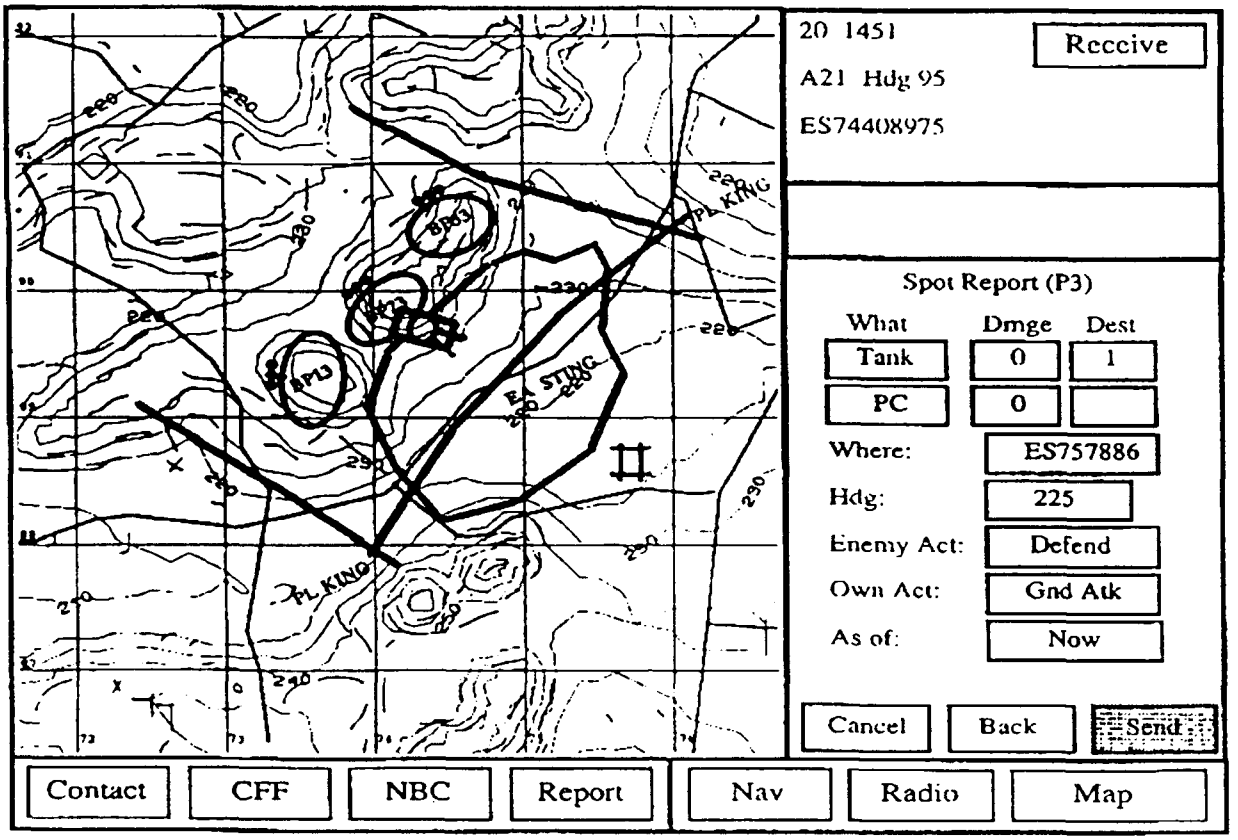

Figure 2. Command and Control Display with digital terrain, overlay, Spot report and SEND function selected.

After reading a message, the user can post the message icon to his tactical map, relay the message on the combat radio nets allotted to his respective duty position, or delete it. Relays on the company net, for example, link a platoon leader to the company commander and the company's other two platoon leaders. Similarly, relays on the platoon net link a platoon leader to the three tank commanders in his platoon.

CCD training requirements for information acquisition and communication include knowledge of the procedures to receive, transmit, store, and display CCD-based information. Proper management of the CCD's information processing capabilities, provides the commander a unique capability to see the battlefield situation. Training requirements for assessing this situation include the ability to fuse and evaluate this CCD-based depiction of the current situation and to project future situation requirements.

Simulation-Based C^2 Training and Assessment. The problems associated with the development of standardized training and tests for evaluating even small unit tactical performance are well documented (Barron et al., 1976; Drucker and Morrison, 1987; Schwartz and Floyd, 1963). These efforts to develop field tests of tactical proficiency for tank commanders, tank crews, and

platoons have stressed the difficulties associated with identifying acceptable task standards, developing equivalent tests forms, and providing evaluators an adequate position (e.g., the tank bustle) to objectively monitor and record performance measures.

Additional field training and evaluation issues underlying the need for simulation-based training and assessment include: the absence of realistic combat conditions; limitations in suitable training sites for generalization of results to other settings; insufficient area for maneuver operations; inefficiency with respect to training time, personnel requirements, and cost required for multi-vehicle combat exercises; and, the inability to standardize the many variables associated with field-based training and evaluation exercises (Baker, Cook, Warnick and Robinson, 1964; Barron et al., 1976; Crumley, 1988; Olmstead, Baranick, and Elder, 1978).

To address these training and evaluation issues, the ARI Field Unit at Fort Knox utilizes simulation-based technologies as a medium for training and assessing key elements of battalion-and-below C^2 performance with particular emphasis on the platoon leader and company commander.

The utilization of computer-driven simulation is a fairly recent approach to the tactical training and assessment of small units (Bessemer and Lampton, 1985). An initial ARI program of research utilized the Simulation and Combined Arms Training (SIMCAT) system. SIMCAT was a low fidelity simulator for platoon level exercises, particularly C^2 tasks. Despite fidelity limitations, SIMCAT training helped to fill the gaps between institutional and field training (Drucker and Morrison, 1987), and resulted in significant improvements in accuracy and timeliness of tank commander C^2 task requirements (Graham, 1987).

The FBC team initiated its current C^2 research program in support of CVCC using a more advanced computer-based simulation technology called SIMulation NETworking (SIMNET) which was implemented at Fort Knox in May, 1986 (Alluisi, 1991). SIMNET is a technological innovation sponsored by the Defense Advanced Research Projects Agency. This technology provides distributed, multiplayer, real-time combat gaming (Chung, Dickens, O'Toole and Chiang 1987; Miller and Chung, 1987; U.S. Army Armor School, 1987b). The system provides ground and air, soldier-in-the-loop, combined arms weapon system modules including the M1 tank. The simulation network links and updates all simulator appearances, activities, and weapon system effects via an Ethernet (Pope, 1987).

Standard SIMNET combined arms simulators are routinely used for tactical training, particularly command and control, at the Fort Knox CATTC (Bessemer, 1991). In support of combat development issues, developmental SIMNET simulators are available in the CCTB. The developmental simulators are 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. M1 tank simulators in the CCTB were configured with SIMNET-compatible CVCC systems to support ARI's CVCC program.

As noted in the Introduction, ARI's research program in support of CVCC includes an escalating--crew to battalion--series of soldier-in-the-loop operational assessments. These efforts have raised the need for complementary methods to assess selected C^2 research training and assessment issues in a more limited but systematic manner.

Despite the relatively well structured nature of the scenarios utilized in the CVCC company evaluation, for instance, the results were still subject to the free-play indeterminacy typical of combat operations. A commander's information acquisition and communication performance during force-on-force operations, for example, is dependent upon many factors including the direction, speed and formation of the opposing units.

Larger scale operational assessments, even when simulation-based, require intensive equipment, personnel and fiscal resources as well as extended evaluation schedules (e.g., 3-6 months). Such assessments are subject to a wide range of extraneous variables including training inadequacies and equipment malfunctions. Extended assessments "freeze" the current component configuration until the evaluation is completed, and reduce the number of variables or alternate configurations that might be investigated. In addition, large scale assessments severely restrict the size of the samples obtained and the opportunities for repeated observations and measures.

Prototype Methods for C^2 Training and Assessment. To provide new methods that might overcome some of the limitations noted with C^2 training and assessment, a set of prototype C^2 vignettes and situational awareness measures was developed. Prior to a detailed description of the steps required for method development and utilization, this section provides a general description of the methods and their rationale.

A vignette is a brief segment of an operational scenario which provides a snapshot or capsule segment from that scenario. The segment length is explicitly defined with discrete start and stop points, and the operational conditions or situational determinants are standardized. Operational realism is stressed in generating battlefield conditions both preceding and during the vignette. The rationale for development of the C^2 vignettes is standardization of both independent and extraneous variables affecting C^2 performance, and rapid generation of operationally-based C^2 training and assessment exercises.

The vignette's limited structure is in marked contrast to situational training exercises (STXs) frequently used to train and assess C^2 skills and tactical decision making. The Army Training and Evaluation Program Mission Training Plan (ARTEP, MTP), for example, details the platoon leader tasks and subtasks underlying basic armor missions such as movement to contact or hasty defense (Department of Army, 1988a). Each STX may include 20-30 tasks, and each task, 3-20 subtasks. ARI's SIMCAT research developed a series of such exercises for computer-based training and assessment (Lampton and Koger, 1987; O'Brien, 1986). The goal of the present effort, however, was to develop a method for more thoroughly training and assessing a limited set of C^2 tasks.

Tank combat tables for gunnery and tactical training (Department of Army, 1988b) provide a structure more analogous to a vignette. Gunnery tables, for example, precisely specify the target types and ranges as well as vehicle movement and time parameters. They also specify the evaluation procedures and standards associated with each task including detailed point calculation sheets. Tank tactical tables specify the conditions and tasks required for individuals and units to respond effectively to opposing force activity. To standardize conditions, the tactical tables require rigid control over the activities of the opposing force.

Similarly, the vignette method provides a robust medium for stabilizing the extraneous variables impacting system and user performance and systematically varying selected variables under investigation. The Ballistic Research Lab (Chamberlain, 1990), for example, selected tactical inputs from a master events list to generate a series of vignettes that provided a particular perception of the battle for designated friendly units at selected points in time. By creating multiple vignettes which varied unit and time parameters, more stringent and generalizable tests of their Information Distribution System were possible.

The commander's ability to "see the battlefield" is regarded as one the most fundamental skills underlying his planning, preparation and execution of the battle. The training and assessment of situational awareness (SA), however, has received relatively little attention in the military literature. Recent efforts (Endsley, 1988; Fracker, 1988) have focused on the development of objective measures of SA for fighter pilots. This work is grounded on a model of information processing that is beginning to identify and assess the skills and component mental processes underlying the global construct of situational awareness.

A combatant's SA represents his knowledge of the world and his role in that world. SA includes both lower and higher order mental processes ranging from the simple perception of individual elements of the situation to an assessment of their meaning and impact on immediate and overall mission objectives. Endsley's model of SA details three distinct levels--perception,

comprehension, and projection--included in the following definition of SA: "...the perception of the elements in the environment within a volume of space and time, the comprehension of their meaning, and the projection of their status in the near future" (Endsley, 1988, p. 97).

Based on the SA models and methods recently developed for air combatants (Endsley, 1988; Fracker, 1988; Sarter and Woods, 1991), the current effort attempted to extend this work to the assessment of SA for ground vehicle commanders. For ground forces, SA is more commonly described as the commander's ability to "see the battlefield" in relation to his mission and the overall mission. Combined arms combat, particularly for ground systems, entails coordination and support of multiple units. Situational awareness for combined arms commanders must include, perhaps more so than for combat pilots, the context of the combined mission (Lickteig, 1990).

Typically, a commander's awareness of a combat situation begins with the assignment of his unit's mission embedded in the concept or schema of the overall mission that his unit is supporting. The mission specifies the area of operations on the battlefield including the locations and routes assigned to the commander and the objectives and schedule driving mission pace. The mission brief and order of operations describe the known and suspected enemy forces and activities in that area, key terrain features and locations related to mission accomplishment, and friendly combat, support, and service support units responsible for mission execution.

For the delay-in-sector mission, for example, the commander's perception (Endsley's SA Level 1) of the situation is critically enhanced by the direct or reported detection of enemy units. When initial Contact and Spot reports are received by the commander, his perception of the situation must be quickly updated. As a commander, he must also attempt to comprehend (SA Level 2) this information, particularly, its significance to his unit and mission. Given the reported type and number of enemy units detected, he may begin to estimate the size and type of the overall force committed, their weapon systems and range, their organization and support.

As his understanding of the situation develops, the commander begins to project (SA Level 3) or reassess probable enemy and friendly courses of action. Given the location and heading of units reported and his estimate of force structure, he may begin to calculate when, or if, the main enemy unit will reach his location, at what point he may need to displace his unit from their current location, and what impact the current situation will have on the future situation such as his unit's next proposed location.

The potentially intrusive nature of assessing a combatant's awareness of the battlefield situation during the course of

operations is a primary concern in the development of SA measures. Sarter and Woods (1991) suggest several methodological approaches for minimizing intrusion. A primary concern raised by Sarter and Woods is to avoid disruption of the situation by "freezing" the operational setting to collect SA data. On the other hand, they warn that after-the-fact data collection may reduce contextual information that might trigger unconscious aspects of awareness. And they caution that post hoc assessments may actually distort the commander's awareness, particularly, in the case of extended operations.

To avoid intrusion, the SA measures developed for prototype implementation for this effort are after-the-fact assessments. To reduce distortion in assessment, the vignette approach provided capsule operational exercises or situations rather than extended operations, and SA questionnaires were administered immediately after vignette completion.

Objective

The objective of the present effort was to develop prototype methods for training and assessing selected C^2 skills of future tactical commanders. In addition, the objective was to develop methods that would overcome several of the limitations commonly associated with C^2 training and assessment. The limitations addressed include a lack of standardized battlefield conditions, an inability to rapidly generate these conditions, the high level of resources required for conducting C^2 exercises, and the absence of an objective measure of the commander's awareness of the battlefield situation.

The prototype C^2 vignettes provide a method for standardizing simulated battlefield conditions and rapidly generating exercises for training and assessing selected C^2 skills. In addition, the utilization of simulation-based exercises with surrogate transmitters and receivers substantially reduces the resources required for training and assessment. To illustrate method utilization, a more immediate objective was to tailor the C^2 vignette method for training and assessment exercises directed at future tactical commander's information acquisition and communication skills.

The objective in developing a quantifiable measure of a tactical commander's situational awareness was to provide a prototype method for assessing this important C^2 skill. Training programs for SA require quantifiable training and performance objectives. The primary goal of this effort, therefore, was to develop a prototype measure which could be adapted for subsequent training and assessment efforts directed at SA and its underlying components: perception, comprehension and projection.

The methods' focus on future C^2 skills is targeted at future C^2 systems such as the CCD, and simulation-based training and assessment facilities such as CATTC, CCTT, and CCTB. The

methods, therefore, capitalize on the utilities currently available in the CCTB and transferrable to similar simulation-based training settings. These CCTB utilities include a SEND utility for transmitting battlefield communications to participant commanders using the CCD, the Plan View Display (PVD) for creating digital overlays and controlling vignette administration, and instrumented measures on utilization of the CCD for processing C^2 information.

To facilitate utilization of these prototype methods, the steps in method development are documented, and illustrated with a detailed example of method implementation. The SEND-based message sets and file structures developed for prototype implementation and the controller input requirements for transmitting these message sets are described and provided. A description of the general procedures recommended for participants and researchers in the setup and administration of the C^2 vignettes and SA measures is also provided.

Method Development and Utilization

Tactical Command and Control Vignettes

The six steps used in development of the C^2 vignettes include: define training and performance objectives; define the operational situation; develop supporting materials and measures; develop message sets; develop simulation-based message files; and, develop training and assessment procedures. The first five steps are described in this section. The last step describing the development of the training and assessment procedures is included in the Procedure section.

Define training and performance objectives. The initial step in development of the C^2 vignettes is to determine the training and performance objectives to be addressed. To define the training and performance objectives for C^2 exercises, a review of the C^2 Battlefield Operating Systems (BOS) as documented in the Blueprint of the Battlefield (Department of the Army, 1989) is recommended. The tactical C^2 BOS specifies four tactical C^2 functions: acquire and communicate information and maintain status; assess the situation; determine actions; and, direct and lead subordinate forces.

For prototype implementation, a set of C^2 vignettes were developed to train and assess the ability of future tank commanders to acquire and communicate information when equipped with an automated C^2 system. The functions and tasks underlying the acquisition and communication of tactical information are also specified in the tactical C^2 BOS and summarized in Table 1.

The CCD developed under the CVCC program was designed to ensure user requirements are met in the development of future vehicle-based automated C^2 systems. While identification of the functional specifications for future C^2 systems is an iterative

Table 1

Comparison of Tactical C^2 Functions, C^2 Display (CCD) Functions, and Methods for Training and Assessing C^2 Skills

Acquire/communicate information/maintain status	CCD Function	Vignette Method
Communicate information	+	+
Receive/transmit mission	+	+
Receive/transmit enemy information	+	+
Receive/transmit terrain/weather information	+	+
Receive/transmit friendly troop information	+	+
Manage means of communicating information	+	+
Maintain information and force status	+	+
Store information	+	+
Display information	+	+
Publish and reproduce information	+	+
Manage information distribution	+	+

Assess Situation	CCD Function	SA Method
Review current situation	-	+
Analyze mission	-	+
Fuse information	+	+
Evaluate incoming information	-	+
Project future requirements	-	+
Decide on need for action or change	-	-

Note. Comparison based on two of the four tactical C^2 functions specified in Blueprint of the Battlefield (Department of the Army, 1989); does not include Determine Actions or Direct and Lead Subordinate Forces. SA = Situational Awareness; + indicates function is addressed; - indicates not addressed.

process, the CCD interface and functions previously described (and Smith, in preparation) represent a current best estimate of a future C^2 system interface. As indicated in Table 1, the information acquisition and communication functions available on the CCD parallel those specified under the tactical C^2 BOS.

To further define the training and performance objectives, the platoon leader duty position was selected for initial C^2 vignette development. The information acquisition and communication tasks for platoon leaders are specified in the Army Training and Evaluation Program Mission Training Plan (Department of Army, 1988a). A mission-based analyses of armor training

requirements by Drucker and O'Brien (1982) provides a useful synopsis of the platoon leader's operational tasks including the types of information to be acquired and communicated.

For prototype implementation of the C^2 vignettes, the platoon leader information acquisition and communication requirements were reduced to three of the report types currently available on the CCD: Contact, Spot, and Intelligence reports. While additional report types could be readily included in the vignette structure, the set selected includes information being received from lower, higher and adjacent units. This information is important both to the platoon leader's duty position as well as the subordinates and superiors in his chain of command. As indicated in Table 1, C^2 vignettes incorporating this set of reports should address, at least partially, each of the C^2 BOS functions under acquire and communicate information and maintain status.

Define the operational situation. The next step in the development of the C^2 vignettes was to define an operational situation appropriate for the training and performance objectives identified. The operational situation dictates the conditions and tasks to be performed. The vignette's limited duration and standardized conditions require that the operational situation be reduced to the discrete start and stop points required for task execution and the situational determinants be completely specified. At the same time, the vignette structure places a heavy emphasis on establishing realistic task conditions.

A review of armor scenarios with armor Subject Matter Experts (SMEs), indicated the delay in sector mission would provide an adequate operational situation for the platoon leader training and performance objectives previously defined. The next step in defining the operational setting was to extract a scenario "snapshot" from this mission that would include the conditions and tasks required. The start point of the vignettes was defined as immediately after the postulated completion of a successful delay by the commander's unit. The end point of the vignettes was defined as immediately prior to the platoon leader's order to displace to a subsequent battle position (BP). The duration of the vignette was set at 10 minutes.

The start and stop boundaries selected for the vignette define a slice of time from an operational situation in which a commander normally receives a flurry of communications from lower, higher and adjacent units. The situation selected places the commander at a critical phase in the mission and highlights his responsibilities as a vital link in the information acquisition and communication chain, and a troop commander who must continuously assess the impact of this incoming information on his imminent order to displace.

To ensure realistic task conditions, the vignettes developed were adapted from a company-level evaluation of the

CVCC recently conducted by ARI (Leibrecht et al., in preparation). The basic operational situation and supporting overlays for the company evaluation were developed by armor SMEs and doctrinally approved by Fort Knox's Command and Staff Directorate. Participants in the company evaluation executed force-on-force offensive and defensive scenarios. The three delay-in-sector segments of the company defensive scenario were selected as the operational situation for development of the C^2 vignettes.

The primary scenario adaptations required for vignette construction were the development by armor SMEs of differing enemy force structures and courses of action. To provide a more representative sample of task conditions for generalized training and assessment, a set of operational situations was developed that varied the amount and relevance of the information received by the platoon leader during each vignette. The overall size and type of attacking force for each vignette was either a motorized rifle or tank regiment in a deliberate attack mission. For differing levels of information amount and relevance, the enemy subunits directly approaching the participant commander's BP varied in size and course of action.

Develop supporting materials and measures. A critical element in the commander's execution of his mission and the performance of his C^2 responsibilities is a clear understanding of the concept of the operations. The vignette structure, however, was developed to provide relatively rapid and repeated assessments of C^2 performance across different battlefield locations and situations. An important step, therefore, in the development of a training or assessment program employing vignettes is the development of the supporting materials required to quickly transition commanders to operational situations with differing task conditions.

To ensure commanders had a clear understanding of their mission and current situation as they transitioned from one vignette to the next, armor SMEs developed a brief extract of an operations order (OPORD) for each battlefield situation. Each extract, see Table 2 for a sample, provided a starting synopsis of the preceding battlefield activities and noted the commander's immediate responsibility to receive and forward incoming battlefield reports. In addition, the extract provided summaries of current enemy and friendly status and the commander's mission The appropriate extract should be provided to the commander at the start of each exercise.

In addition to the extracts, acetate operational overlays were developed for each of the three battlefield situations selected. These overlays included a detailed set of control measures to provide the commander a solid understanding of his mission as well as that of the overall task force. Control measures for these overlays included: Alpha company's current and subsequent BPs, BPs of the adjacent companies, phase lines,

Table 2

Sample Extract of C^2 Vignette Operations Order

STARTING SITUATION - VIGNETTE 1

Extracts from the OPORD you received last night follow this synopsis of the starting situation.

STARTING SYNOPSIS: Your unit has been in contact with the enemy for several days. Reconnaissance units probed your position extensively during the previous evening. The battalion just engaged and defeated an attacking force of unknown size and composition and are trying to discover the current situation. You (for some unknown reason) were unable to directly observe or hear any of this engagement.

You and your tank are now fully functional and are trying to gather information on the engagement to pass to your commander. You have requested your subordinate elements provide you information on the engagement. The only means of communication with your higher or lower elements is through your Command and Control Display (CCD). You may also be getting information from your higher headquarters and possibly from your adjacent units that may be of interest to your subordinate elements.

EXTRACTS FROM LAST NIGHT'S OPORD

ENEMY SITUATION: The enemy appears to be preparing to attack in sector. Intelligence has been unable to determine the size or composition of the force that may attack in sector.

FRIENDLY SITUATION:

B Company (LEFT FLANK): Defend Battle Position (BP) 22. On order, defend BP 23. (See overlay)
D Company (RIGHT FLANK): Defend BP 42. On order, defend BP 43. (See overlay)

MISSION: A Company defend BP 12. On order, defend from BP 13.

CONCEPT OF OPERATION:

1st PLT: Defend BP 113. On order, defend from BP 114.

2nd PLT: Defend BP 123. On order, defend from BP 124.

3rd PLT: Defend BP 133. On order, defend from BP 134.

SERVICE SUPPORT & COMMAND AND SIGNAL: NOT INCLUDED

engagement areas, and target reference points. To support the training and assessment of up to four platoon leaders simultaneously, multiple acetate copies of each overlay were prepared as well as map boards.

Digital copies of each overlay, identical to the acetate versions, were developed on the CCTB's Plan View Display (PVD) to enable digital transmission of the overlays to the commander's CCD at the start of each vignette. File copies of these overlays are available under the SEND utility in the CCTB. The names of these files and the controller commands required to initiate transmission to four commanders simultaneously across four selected vignettes is provided in Appendix A.

The CCD design includes an instrumentation package that automatically records the time and type of operator inputs for many of the CCD functions. The CCTB's Data Collection and Analysis (DCA) System records, maintains, and analyzes the data packets related to simulator dynamics and CCD utilization. For prototype implementation, additional measures that more precisely defined the platoon leader's information acquisition and communication performance were developed and integrated into standard DCA output files. The key information acquisition and communication measures available with the DCA now include: message content; message source; time message received; time message opened; message action (e.g., relay, delete, post message icon to tactical map); time message action taken; direction (net) message relayed.

In addition, a controller's log was developed for recording the time the exercise controller initiates and terminates the transmission of the simulated messages for each vignette. A sample controller's log is provided in Appendix A. The final measure developed for prototype implementation was the situational measures completed at the end of each vignette. These measures are described in a following section, Situational Awareness Measures, and provided in Appendix E.

Develop message sets. The most important step in the development of the C^2 vignettes for prototype implementation was the development of simulation-based message sets. The message sets comprised the primary information to be acquired and communicated by the platoon leader during each vignette. In addition to the supporting overlays and OPORD extracts, the message set defined the situational determinants of the vignette.

The messages sets for prototype implementation were developed by armor SMEs and designed to provide a realistic set of communications appropriate for a platoon leader at the previously defined phase of the delay-in-sector mission. The sets were designed to provide a representative mix of enemy, friendly, and control measure battlefield information, and exercise the commander's responsibility for communicating this information to others in his chain of command via message relays.

As noted, the message sets for each vignette contained three types of reports: Contact, Spot and Intelligence. These reports were selected because they were available on the CCD, appropriate to the current phase of operations, and ensured both higher and lower unit relay requirements. Overall, the message sets were designed to describe the successful delay of the attacking force by the entire task force and provide additional information pertinent to the platoon leader's upcoming displacement to a subsequent BP.

The preformatted CCD message elements available for each of the three types of messages used in the vignettes are depicted in Table 3. A review of the informational elements available with these reports will indicate that a wide range of battlefield information could be communicated during each vignette. As previously indicated in Table 1, this range of information includes the four types of battlefield information to be received and transmitted as specified by the tactical C^2 BOS.

The CCD message elements include size, type, location, heading and activity items for both friendly and enemy ground and air units. In addition, the Intelligence report includes items for designating one of four different types of battlefield obstacles and its location. Spot and Intelligence reports also include an "AS OF" field for postdating a reported event that the sender may have observed at an earlier time. Multiple "what" formats are available for each report to allow the sender to report on more than unit or obstacle per report. For prototype implementation, each message was limited to one type of "what" information.

To train and assess the platoon leader's skills in acquiring and communicating information over differing situations and conditions, the prototype vignettes were designed to vary the number and relevance of the messages received by a commander during the course of each vignette. For low relevance vignettes, the majority of the reported enemy activity occurred outside the commander's assigned sector. For high relevance vignettes, all enemy units and battlefield events to be reported were currently in the commander's assigned sector with the brunt of the overall attacking force moving toward 'is current BP.

A set of guidelines were formulated to assist armor SMEs in development of the actual message sets required for each vignette. These guidelines (see Appendix B) ensured that SMEs generated messages compatible with the CCD message formats and response options for message construction. In addition, the guidelines provided operational definitions for varying message amount and relevance.

A sample message set is depicted in Figure 3, and the detailed contents of this message set are provided in Table 4. For comparison, the reader can replot the grid locations in

Table 3

CCD Message Elements Used in Vignette Development

Type	From	What	Number/Status			Where	Activity			As Of
			Obs	Dam	Des		Dir	En	Fr	
Contact	x	x	x			x				
Spot	x	x		x	x	x	x	x	x	x
Intel	x	x	x			x	x	x	x	x

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes postdated.

Table 4 to the grid matrix in Figure 3. The figure illustrates the relative location of this reported information with respect to the commander's situation. The commander's current and subsequent BPs are indicated as well as the sector boundaries for Alpha company. In addition, the figure provides selected informational elements from the reports for this message set.

In contrast to the predominantly text-based format provided in Figure 3 and generated by the DCA system, the commander's CCD graphically depicts unit alignment and type in military symbology at the correct locations on his tactical map. Additional textual information on the CCD such as unit type, number, and heading information are displayed in the adjacent report menu. However, the CCD's spatial location of the reported information with respect to the commander's BP and sector is quite similar to Figure 3.

For prototype implementation, 24 different C^2 vignette message sets were developed for training and assessing future platoon leader information and acquisition skills. As discussed in the Procedure section below, it is recommended that six of these platoon leader vignettes might be used for training. These training and practice vignettes differ by combining the two threat types with each of three levels of information amount.

The remaining 18 platoon leader C^2 vignettes might be used for assessment. For each of the two threat types, nine different vignettes combining the three levels of information amount with the three levels of information relevance are provided. Message contents for the 18 platoon leader test vignettes are presented in Appendix C. For comparability, vignettes differing in amount were developed by eliminating messages from the high amount vignettes as indicated in Appendix C.

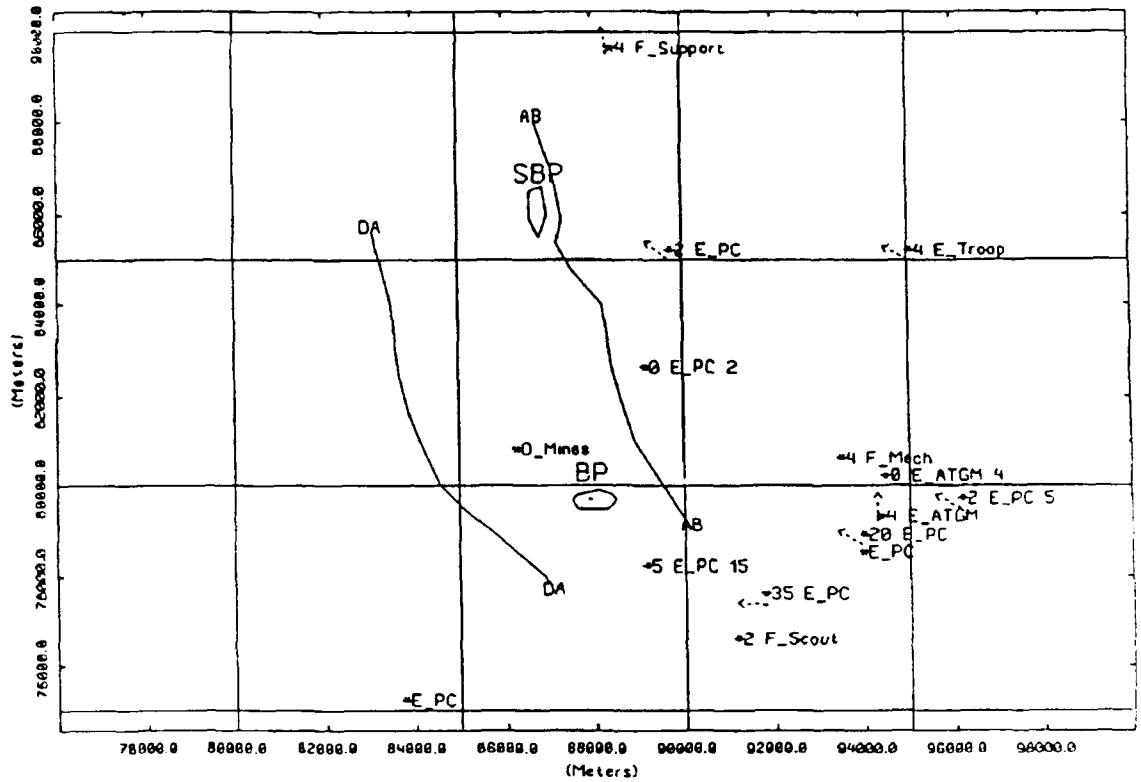

Figure 3. Sample message set depicting motorized rifle battalion attacking with main effort in adjacent company sector.

Develop simulation-based message files. The next step in development of the C^2 vignettes for prototype implementation was to develop simulation-based message files for the message sets previously developed. By simulating message transmissions from units above, below and adjacent to the platoon leader, the C^2 vignette ensures standardized information acquisition and communication exercises in a software format that supports rapid and repeated exercise setup.

In addition, by simulating message transmission from other units and commanders, the personnel and time resources normally required for conducting C^2 exercises of this type are reduced substantially. To ensure messages relayed by participants are not received by others involved in simultaneous training and assessment exercises, the simulators can be configured in an "isolate" mode described in the following Procedure section.

The SEND utility is a software program specifically designed to support the transmission of digital message information via Ethernet to digitally-based C^2 systems such as the CCD. SEND is currently available in the CCTB and hosted on MASSCOMP 5600 computers. The utility includes various routines for adjusting transmission variables such as message contents, message source, message destination, and the timing of message transmissions.

Table 4

Sample Message Set for Motorized Rifle Battalion Attacking with Main Effort in Adjacent Company Sector.

Type	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Intel	YO2	En PC	35			918775	275			-15
Cont	CO6	En PC	nr			940788				Now
Spot	CO6	En PC		2	5	962798	300	Atk	Def	Now
Intel	YO2	Fr Sct	2			912765			Rec	-15
Intel	CO6	En Trp	4			951850			Rec	-15
Spot	A33	En PC		5	15	892781			Atk	Def
Intel	YO2	Fr Mech	4			935805			Def	Now
Intel	YO2	En PC	2			898850	310			-15
Spot	A34	En PC		0	2	892825		Rec	Def	
Cont	DO6	En PC	nr			838749				
Intel	YO3	Mine				867806[b]				-15
Intel	YO2	En PC	20			940788	300	Atk		Now
Intel	YO2	En ATGM	4			944792	001			Now
Intel	YO2	Fr Supt	4			885895	350		Def	-15
Spot	YO2	En ATGM		0	4	945800		Atk	Def	

Note. As Of = minutes message postdated; ATGM = anti-tank guided missile; Atk = attack; C^2 = command and control; Dam = damaged; Def = defend; Des = destroyed; Dir = direction; En = enemy; FW = fixed wing air; Fr = friendly; Helo = helicopter; Mech = mechanized infantry; Mort = mortar; nr = not reported; Obs = observed; PC = personnel carrier; Rec = reconnaissance; Sct = scout; Supt = support; Trp = troops.

[a]Own location = ES879797. All other locations have ES prefix.

[b]Minefield location equals center of mass, but report provides coordinates for each endpoint of minefield.

Documentation on SEND including instructions for utilization is available in the CCTB facility.

For the current effort, the message sets previously developed were implemented into the SEND utility. The messages were entered into a common pool or directory and each message was tagged with a series of identifiers for collating messages into

the required message sets for each vignette. This pool structure supports easy modification of the sets. For example, additional vignettes can be generated by reordering or recollating the messages currently available into new files.

The SEND utility was adapted to train multiple commanders simultaneously and control the order of training and assessment exercises. To facilitate administration, the message sets were combined into a series of executable files that interleaved message transmissions across multiple message sets. Within each message set, unique radio net or frequency allocations for each commander's simulator ensured reception of only the designated set.

Finally, a "sleeper" routine was implemented that generated required pauses between separate message transmissions. For the 10-minute transmission duration selected for prototype vignette implementation, pause intervals were created that provided a fixed interval between messages. Intervals of 26-, 45-, and 54-seconds respectively were used for differing message set amounts to ensure reception of all message transmissions within the first nine minutes of the vignette. Both fixed and variable interval schedules for message transmission can be developed with SEND.

The SEND file names for each of the 24 platoon leader C^2 vignettes developed for prototype implementation are provided in Appendix D. These files are stored on the SEND utility in the CCTB and on backup floppy disks. The controller procedures for transmitting these message sets are provided in the following Procedure section. While the SEND utility has since been revised, program updates have maintained compatibility with the file structures developed.

Generalization. The implementation example illustrates the application of the vignette method to a limited set of C^2 skills and operational conditions for the platoon leader duty position. Utilization of the C^2 vignette method will depend upon the training and assessment objectives to be addressed, and access to the type of simulation-based facilities and utilities employed.

The vignette method can be generalized to other duty positions, C^2 skills, and operational situations. Appropriate message sets, for example, can be readily developed for other tactical commanders such as company and battalion commanders. The message sets can include other report types available on future C^2 systems including the operational overlays required for mission execution or a change in mission.

Similarly, other operational segments or vignettes can be developed for differing C^2 training and assessment objectives. The delay-in-sector mission was selected for prototype implementation because it included the functions and tasks required for acquiring and communicating information, and allowed for limiting the variables impacting C^2 performance. In the

development of other C^2 vignettes, developers should limit the variables included in generating task conditions in order to standardize the performance requirements under investigation.

Situational Awareness Measures

The six steps used in development of the prototype Situational Awareness (SA) measures include: define training and performance objectives; develop plotting items for perception; develop "seeing" items for comprehension and projection; develop scoring guidelines; and, develop training and assessment procedures. The first five steps are described in this section. The last step describing the development of training and assessment procedures is included in the Procedure section. The SA measures developed for prototype implementation are provided in Appendix E.

Define training and performance objectives. The noted lack of a measure for objectively assessing a tactical commander's situational awareness reflects the absence of definitive training and performance objectives for this important C^2 skill. The development of an acceptable training program for enhancing SA requires a training effectiveness measure. Therefore, the primary objective was to develop a quantifiable measure of SA for subsequent training and assessment efforts.

While situational awareness is a difficult skill to define (Sarter and Woods, 1991), parallels with the tactical C^2 BOS function, assess the situation, are apparent. As indicated in Table 1, functions underlying assess the situation include review of the current situation. This review requires the commander to analyze the mission and fuse and evaluate incoming information related to his current situation. In addition, this assessment must project beyond the current situation in anticipation of future situation requirements. An SA measure, therefore, should address both current and future situation requirements.

The current effort's emphasis on the development of prototype training and assessment methods for future C^2 skills directed the objectives address commanders' SA skills in the context of future C^2 systems. As previously described, the CCD developed under the CVCC program was designed to provide a real-time tactical display of the battlefield situation. This tactical display includes a digital map of the area, tactical overlays, icon-based locations of own and friendly units, and icon-based reported enemy locations.

Based on the tactical display's ability to continuously depict and update the situation, the fuse information function, Table 1, is indicated as addressed by the CCD. The lack of artificial intelligence (AI) software routines in the current CCD is the primary reason the other functions under assess the situation are indicated as not addressed by the CCD, Table 1. While the tactical map's depiction of the current battlefield

situation may assist the commander in performing these assess the situation functions, the absence of an AI capability results in the commander ultimately executing these functions.

To further define the component skills underlying SA, a review of models and methods developed for assessing air combatant's SA was conducted (Endsley, 1988; Fracker, 1988; Sarter and Woods, 1991). Based on the model proposed by Endsley (1988), the SA components of perception, comprehension, and projection of the battlefield situation were included in the prototype SA measures developed. As indicated in Table 1, SA measures including each of these components should address, at least partially, all but one of the C^2 BOS functions under assess the situation. The noted exception, decide on need for action or change, was not included in the SA measures developed for prototype implementation.

To further define the training and performance objectives for SA assessment, the platoon leader duty position was selected for initial development of the SA measures. The goal of an objective measure of SA requires the commander's awareness of the situation be compared with an absolute knowledge of the situation. The C^2 vignettes previously developed for platoon leaders provide a firm basis for knowledge of the situation and SA scoring.

Develop plotting items for perception. The simulation-based vignettes defining the operational situation were designed by armor SMEs to provide a wide range of battlefield reports of differing relevance to the commander's mission. A key concern, therefore, in the construction of the SA items was to develop a set of questions that clearly specified the situational information requested. Careful attention was given to item wording. Questions consistently emphasized, for example, distinctions between enemy units engaged versus not engaged, locations in the unit's sector versus adjacent sectors, and elements to the front versus the rear of the unit's BP location.

To capture the commander's perception of the battlefield situation, a situational awareness form was developed that required commanders to plot on a military map the locations of reported enemy units, friendly units, and key control measures. The locations selected for these items were based on armor SMEs' estimates of the more important location information provided during the C^2 vignettes. A five-item set of plotting questions was developed for both the commander's current situation and future situation as indicated in Table 5.

The current situation was defined by informational elements of more immediate concern to the commander, including enemy elements currently being engaged by his unit. The future situation was defined by less immediate information such as enemy units in the area but beyond current range, or information related to the commander's next location, the subsequent BP.

Table 5

Situational Awareness Items: Plotting

Current Situation	Future Situation
Largest unit engaged	Support unit to rear
Largest unit approaching	Company's subsequent BP
Friendly scout unit	Obstacle(s) to rear
Target reference points	Enemy scouts to rear
Largest unit outside sector	Mortar unit to rear

Note. BP = battle position.

Develop "seeing" items for comprehension and projection. To assess the commander's comprehension and projection of the battlefield situation, a second SA form was developed. Items on this form required commanders to compile isolated report information into aggregate reports, to estimate the size of designated enemy units including main and attacking units, and to project the impact of the information received during the vignette on his unit's current and future situations. A five item set was developed for both the current and the future situation, Table 6.

For the current situation, the items addressed the commander's ability to comprehend the more immediate battlefield situation to the front of his current BP. The first two items required him to compile information received during the vignette into summary responses identifying the number and type of enemy units destroyed and damaged by his company, and the number and type of enemy units still approaching his current BP. The remaining items addressed the commander's ability to go beyond the data actually reported to understand the nature of the threat facing both his unit and the overall task force. These items asked the commander to estimate the size and type of the enemy unit actually engaged, the unit approaching his company, and the total unit committed against the overall task force.

For the future situation, the items addressed the commander's ability to project beyond his immediate situation and use the information provided during the vignette to anticipate upcoming events. The initial items focused on the commander's awareness of the main enemy unit approaching his company sector. Reports received during the vignette had provided information about the heading and location of an enemy unit in the company's sector but beyond engagement range. The commander was required to provide the location and heading of this enemy unit, and estimate if, and when, that unit would approach within 2,000 meters of his current location.

Table 6

Situational Awareness Items: "Seeing"

Current Situation	Future Situation
Number & type enemy damaged	Distance/direction to main unit
Size & type unit engaged	Heading of main enemy unit
Number & type unit approaching	ETA main unit < 2,000 meters
Size & type force approaching	Distance/direction next BP
Overall size & type unit confronting the task force	Impact of obstacle(s) on unit's next BP

Note. ETA = estimated time of arrival; BP = battle position.

The final two items assessed the commander's awareness of key information related to his unit's proposed future location. One item asked him to provide estimates of distance and direction to his unit's subsequent BP, and the final item asked him to assess the impact that reported obstacles might have on movement to, and occupation of, that BP.

Develop scoring guidelines. An objective measure of commander's SA is based on a comparison of the actual situation with the commander's assessment of the situation. Maintaining an accurate knowledge of the battlefield situation during free-play operations, however, is difficult for both commanders and SA trainers and evaluators. Simulation-based scenarios provide a capability to structure and know the battlefield situation.

The previously described SEND-based message sets standardize the information to be acquired and communicated during each vignette. Respondents' awareness of the simulated battlefield situation is dependent upon the actual information provided during the vignette in question. A crosswalk of message set content by SA items was developed for each vignette. This crosswalk provided the basis for determining the correct SA answers for each vignette. A crosswalk sample developed for one of the prototype vignettes is provided in Appendix F.

To meet the goal for SA instruments that could be objectively scored, the response formats required commanders to provide answers that precisely indicated their knowledge of the information requested. For plotting items, the response format required commanders to designate the map location of the item requested. For the "seeing" items, directed at comprehension and projection of the situation, a combination of fill-in-the-blank and multiple-choice response formats were used. Armor SMEs assisted in the construction of all response options to ensure appropriate and meaningful response alternatives.

Responses for each item were scored on a 10-point basis. SA assessment for each vignette included ten items (five each for the current and future situation) allowing for a maximum score of 100 points per vignette. Items were scored for relative accuracy with items of moderate accuracy being allotted 6 points, and items of low accuracy, 2 points. Armor SMEs assisted in the determination of high, medium and low accuracy. Given the memory-based nature of the SA assessment procedures and the lack of acceptable standards for SA, this scoring strategy is subject to revision. For prototype implementation, a guideline for scoring SA items which operationally defines high, medium and low accuracy for each item type is provided in Appendix G.

Generalization. Generalization of the prototype SA measures to different operational situations will require changes to the question items and response formats developed for the delay-in-sector-mission. The steps followed in SA development provide a basis for tailoring the measures to different training and assessment objectives. Note, that both the tactical C^2 BOS function of assess the situation (Table 1) and the SA model employed (Endsley, 1988) stress this assessment should include consideration of the commander's current and future situation. The assistance of armor SMEs in each step of developing SA measures is imperative.

Methodological issues with respect to assessing situational awareness were reviewed and incorporated in construction of the SA measures developed for prototype implementation. Utilizers may decide to modify the method and procedures provided, but modifications should include careful consideration of the methodological issues entailed (Endsley, 1988; Fracker, 1988; Sarter and Woods, 1991).

Simulation-Based Training and Assessment Facilities

The prototype methods developed were designed for training and assessing selected C^2 skills of future tank commanders. For prototype implementation, the CCD developed under the CVCC program served as the target future C^2 system, and the CCTB served as the target facility. The methods, however, can be readily adapted for training and assessment on other C^2 systems such as the M1A2's IVIS. And the CCTB utilities used in prototype implementation can be transferred to simulation-based training facilities such as CATTC or the proposed CCTT.

A brief description of the CCTB utilities and CVCC-equipped tank simulators targeted for prototype implementation is provided in this section. A more general description of the SIMNET-based technologies supporting the training and assessment facilities anticipated for method utilization was provided under Simulation-Based C^2 Training and Assessment.

In the CVCC tank simulators, the CCDs are mounted to the right of the commander's weapon station in each simulator as

depicted in Figure 1. CCD functionality including the digital terrain data base is hosted in a MASSCOMP 5600 computer. The CCD is projected on a 10.25-inch (26 cm), color, cathode ray tube (CRT) monitor with high resolution and equipped with a touch sensitive screen. The display itself occupies a 7- by 5.75-inch (17.8 by 14.6 cm) rectangular region in the lower right corner of the CRT monitor which reflects the projected space claim allotted for vehicle implementation in the M1 tank.

Each tank simulator's host processor provides the computer generated imagery for its current battlefield location situation including continuous updates and feedback on own and other vehicle dynamics. Each CVCC-equipped simulator includes a simulated SINgle Channel Ground/Airborne Radio System (SINCGARS) for CCD communications. For training and assessing multiple commanders simultaneously using the C^2 vignettes, the simulators can be initialized in an "isolate" mode. This mode prevents a simulator from receiving messages from other simulators networked by the Ethernet, and restricts reception to the prescribed message sets transmitted from the controller's SEND station.

Supporting CCTB utilities include an exercise control room equipped with a Management Command and Control Console for initializing the simulators at the designated battlefield locations for each vignette, and the PVD for monitoring battlefield events. A simulated SINCGARS at the controller's station provides a voice-digital link to each simulator allowing the controller to prompt the initiation and completion of each vignette. In addition, a SEND terminal located at the controller's station serves to transmit the operational overlays and the required message sets for each vignette to the vehicle commanders.

Additional CCTB assets include a classroom for initial orientation and training, and an "extended" classroom in the simulation bay where an CCD demonstration can be provided via a large screen, 57-inch (144 cm) diagonal, BARCO repeater monitor networked to a stand-alone CCD. An Ethernet links all simulators and the SEND stations to the DCA system. The DCA's Data Logger records all standard protocol data units during training and assessment exercises as well as instrumentation data packets generated with CCD utilization.

Procedure

Develop training and assessment procedures. For method utilization by training developers and analysts for future C^2 systems, required procedures will depend upon the training and assessment objectives to be addressed. General procedural recommendations for utilization of the C^2 vignettes and the SA measures are provided, and followed by more specific procedures developed for the implementation example.

The overview for any training or assessment exercise should provide a clear statement of the objectives. If future automated systems are involved, participants may first need familiarization training with these systems. This training should ensure that all C^2 system functionality required for the C^2 exercises is addressed including map manipulation and message reception, storage, and relay. The training program developed for the CVCC company-level evaluation includes a CCD familiarization training package (Atwood et al., in preparation). A training and testing schedule developed for prototype implementation is provided in Appendix H.

After this training is completed, it is recommended that participants be provided a series of formal and informal C^2 vignette training exercises in which they receive, process, and relay incoming battlefield reports and operational overlays. During the formal exercises, participant performance should be closely monitored and commanders should be given detailed feedback on their performance. During the informal exercises, participants should be allowed to "work" with the C^2 system without apprehension about performance evaluation.

The methods were designed to be used in conjunction, but can be used independently with modification. If the SA measures are being utilized with the C^2 vignettes, these practice exercises provide an opportunity to identify any misunderstandings about SA question wording or response requirements. For all training exercises, all questions or clarifications requested should be thoroughly answered.

A training or assessment exercise using both the C^2 vignettes and SA measures requires approximately 30 minutes. For CCTB implementation, this includes the time to reinitialize the simulators at new battlefield locations for the next exercise.

Both methods are designed to reduce carry-over and order effects in a C^2 assessment effort. For prototype implementation, parallel forms of the SA measures were developed to avoid an SA item-response set and the SEND utility was configured to counterbalance the order of the C^2 vignettes. The Controller's Log (Appendix A) provides a sample schedule and required controller procedures for counterbalancing vignettes and SA measures in the simultaneous assessment of four vehicle commanders across four C^2 vignettes.

Prototype implementation. The following set of detailed procedures were developed for the implementation example and are recommended for future utilization of the C^2 vignette and SA assessment methods.

For training and assessing multiple commanders simultaneously using the C^2 vignettes, all participants at the same duty level (e.g., platoon leader or company commander) can be assigned the same position in the force organization. For the sample

vignettes developed, for example, all platoon leaders were designated as leaders of the second platoon of Alpha company with an identical call sign, A21. Identical call signs for different simulators is made acceptable in the CCTB network configuration by assigning the simulators to different battalions.

Initial instructions to the commanders should clarify their role in the operational setting designed. Despite the simulation-based nature of the exercises, the commanders should be instructed to maintain the responsibilities of their duty position as required for an actual operational setting.

During each vignette, participant commanders are to receive, process, and relay standard battlefield communications such as Contact, Spot, and Intelligence reports. The commanders are to maintain awareness of the battlefield situation by processing as many of the reports received as possible in the time allotted. As part of their assigned role, they should be prepared to command their unit and to support adjacent units as the situation requires.

At the same time, the commanders are to maintain the awareness of their superiors and subordinates by forwarding or relaying as many of the incoming reports as warranted. Instructions should stress that relay decisions are ultimately their responsibility. Decisions about what to relay and what not to relay should include consideration of the trade-offs associated with information overload versus the receiver's "need to know." As commanders, they must continuously determine the C^2 priorities of the situation based on incoming reports.

For the vignettes developed, Alpha company always occupies a central sector within the task force. Alpha company's second platoon is assigned the central BP within the company's sector, for the both current and future (subsequent BP) situations. Commanders can be instructed to regard adjacent and aligned simulators, visible on the simulated battlefield, as members of the second platoon.

Five minutes prior to the start of each vignette, the commanders should be provided a 1: 50,000 scale paper map of the area and a map board. At the same time, the commanders should be provided the designated acetate operational and note overlays for the assigned vignette and a brief description of the battlefield situation, such as the OPORD extract, leading up to the vignette.

Participants' CCDs should be uniformly configured to depict the centered location of their unit and the operational overlay designated for the upcoming vignette. The map scale for each CCD should be standardized (e.g., initially set at 1: 50,000 scale), but the commanders should be allowed to change map scales at any time during the vignette.

Despite the interactive nature of C^2 activities, the vignettes are designed to minimize the amount of nonstandard interaction between message senders and receivers. Each commander should work independently as he receives a preset group of messages and "relays" information to surrogate receivers.

For incoming messages, the CCD provides permanent message records for the commanders which eliminate the need for clarification or retransmission from the controller's station. For messages prepared or transmitted by the commanders, no response is required or provided. The isolate mode, previously described, will ensure that the messages transmitted by each commander are not received by the other participants who are simultaneously engaged in other vignettes.

Immediately after completion of the vignette's message reception and processing phase, the commanders should be escorted out of their simulator to separate work areas for completion of the situational awareness measures. Upon leaving the simulator, each commander should return to the support personnel the map board, overlays, and any notes he might have made during the vignette concerning the information received.

At this work area, each commander should be given one version of both the SA plotting and "seeing" questionnaires, previously described. It is recommended commanders be given 10-minutes to record their answers. For each vignette, one questionnaire should pertain to the commander's current situation and the other to the future situation. Parallel forms for Plotting (e.g., F1(P), F2(P) in Appendix E) and "Seeing" (e.g., F1(S), F2(S) in Appendix E) should be provided to each commander in a counterbalanced sequence across the series of vignettes.

As each commander begins completing the SA items, support personnel should replace the operational and note overlays with another acetate sheet depicting only the commander's current BP and the BPs of the adjacent companies. This minimal set of control measures will direct each commander to the general area of operations, and provide a frame of reference to facilitate adaptation from the CCD's tactical display to the 1: 50,000 paper map scale. These materials should be given to the commanders as soon as possible to assist them in completing the SA items. Commanders may record plotted locations on a black-and-white xerox copy of the colored map sheet used during the vignette, and returned to them during the SA completion exercise.

When commanders have completed all items for both SA forms, they should "backbrief" their answers to the support personnel. This review of their responses should ensure commanders have completed all SA items in the required format.

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APPENDIX A

SAMPLE CONTROLLER'S LOG AND NOTES

Controller's Log for Phase III Platoon Leaders

Date _____
Controller ID _____

Before sending any measures be sure Data Logger is ON.

Session P
[Check RA & Cmdrs are prepared]
Frago/Overlay: **s-po** Cmdr's Messages: **s-plpl**

Message Start Time: _____

Message End Time: _____ (Start + 10 minutes)

SA End Time: _____ (End Time + 10 minutes)

Session A
[Check RA & Cmdrs are prepared]
Frago/Overlay: **s-ao** Cmdr's Messages: **s-alpl**

Message Start Time. _____

Message End Time: _____ (Message Start + 10 minutes)

SA End Time: _____ (Message End + 10 minutes)

Session B
[Check RA & Cmdrs are prepared]
Frago/Overlay: **s-bo** Cmdr's Messages: **s-blpl**

Message Start Time: _____

Message End Time: _____ (Message Start + 10 minutes)

SA End Time: _____ (Message End + 10 minutes)

Controller's Log for Phase III cont. Platoon Leaders

Date _____
Controller ID _____

Session C

[Check RA & Cmdrs are prepared]

Frago/Overlay: **s-co** Cmdr's Messages: **s-clpl**

Message Start Time: _____

Message End Time: _____ __ (Message Start + 10 minutes)

SA End Time: _____ (Message End + 10 minutes)

Controller ID _____

Before sending any measures be sure Data Logger is ON.

Session D

[Check RA & Cmdrs are prepared]

Frago/Overlay: **s-do** Cmdr's Messages: **s-dlpl**

Message Start Time: _____

Message End Time: _____ (Message Start + 10 minutes)

SA End Time: _____ (Message End + 10 minutes)

Copy and return original to principal investigator.

Controller's Notes for Phase III Platoon Leaders

Below is a record of the overlays and messages by file name to be sent to each of the four platoon leaders assigned this day to the Low Amount information condition. P denotes the practice session, followed by sessions A-B. Files are executable. You simply type file name (e.g., s-po, s-plpl) and select ENTER key.

Sessions	Overlays	Message Sets
Session P	s-po	s-plpl
	P3c 3/Bn	vplvpl 3/Bn
	P3c 2/Bn	vplvpl 2/Bn
	P3c 0/Bn	vplvpl 0/Bn
	P3c 1/Bn	vplvpl 1/Bn
Session A	s-ao	s-alpl
	P3a 3/Bn	v1lvpl 3/Bn
	P3b 2/Bn	v4lvpl 2/Bn
	P3a 0/Bn	v3lvpl 0/Bn
	P3b 1/Bn	v6lvpl 1/Bn
Session B	s-bo	s-blpl
	P3b 3/Bn	v6lvpl 3/Bn
	P3a 2/Bn	v3lvpl 2/Bn
	P3b 0/Bn	v4lvpl 0/Bn
	P3a 1/Bn	v1lvpl 1/Bn
Session C	s-co	s-clpl
	P3a 3/Bn	v3lvpl 3/Bn
	P3b 2/Bn	v6lvpl 2/Bn
	P3a 0/Bn	v1lvpl 0/Bn
	P3b 1/Bn	v4lvpl 1/Bn
Session D	s-do	s-dlpl
	P3b 3/Bn	v4lvpl 3/Bn
	P3a 2/Bn	v1lvpl 2/Bn
	P3b 0/Bn	v6lvpl 0/Bn
	P3a 1/Bn	v3lvpl 1/Bn

Before sending any measures be sure Data Logger is ON.

To Send Low Session, Type: (either)	To Send FRAGO, Type: (either)
s-plpl RTN	s-po RTN
s-alpl RTN	s-ao RTN
s-blpl RTN	s-bo RTN
s-clpl RTN	s-co RTN
s-dlpl RTN	s-do RTN

Note if planned schedule is disrupted, individual vignettes can be sent to individual commanders. But this may require "buffered" runs to transmit simultaneously--see principal investigator or technician.

*To send individual vignettes, type the name of the vignette and then the authorized network: 2B-3/Bn; 3B-2/Bn; 4A-0/Bn; and, 4B-1/Bn.

Examples below:

v6lvpl 1/Bn RTN
to send s-a vignette 1 to 4B

v1lvpl 0/Bn RTN
to send s-c vignette 3 to 4A

Amount:	Low - 9; Medium = 15; High = 21
Relevance:	Low = Vign 1+4; Medium = Vign 2+5; High = Vign 3+6
Situation:	A = Mission A, Location A (MA,LA); B = MB,LB; C = Mission C, Location C (MC,LC)
Location:	A = BP 123, ES838875; B = BP 121, ES 879797; C = BP 122, ES865864

Controller's Notes for Phase III cont. Platoon Leaders

The schedule below provides the counterbalanced order in which participants 13-16 will be assigned to complete vignettes and situational awareness questionnaires.

By Subject Overall Platoon Leaders
Low Information Amount (n=9)

Sess	Cmdr's Sim	Ss #	Vign OPORD	Relv Amt	Sim Loc	FRAGO Overlay	SA See	SA Plot
P	2B	13	P	M	C	C	2	2
A	2B	13	1	L	A	A	1	1
B	2B	13	6	H	B	B	2	2
C	2B	13	3	H	A	A	1	1
D	2B	13	4	L	B	B	2	2
P	3B	14	P	M	C	C	1	1
A	3B	14	4	L	B	B	2	2
B	3B	14	3	H	A	A	1	1
C	3B	14	6	H	B	B	2	2
D	3B	14	1	L	A	A	1	1
P	4A	15	P	M	C	C	1	1
A	4A	15	3	H	A	A	2	2
B	4A	15	4	L	B	B	1	1
C	4A	15	1	L	A	A	2	2
D	4A	15	6	H	B	B	1	1
P	4B	16	P	M	C	C	2	2
A	4B	16	6	H	B	B	1	1
B	4B	16	1	L	A	A	2	2
C	4B	16	4	L	B	B	1	1
D	4B	16	3	H	A	A	2	2

Amount: Low = 9; Medium = 15; High = 21
Relevance: Low = Vign 1+4; Medium = Vign 2+5; High = Vign 3+6
Situation: A = Mission A, Location A (MA,LA); B = MB,LB;
C = Mission C, Location C (MC,LC)
Location: A = BP 123, ES838875; B = BP 121, ES 879797;
C = BP 122, ES865864

APPENDIX B

SME GUIDELINES FOR MESSAGE SET DEVELOPMENT

1. All message types for C^2 vignettes are limited to: Spot, Contact or Intel.

2. Message amounts are set at the following:
   High = 21 messages/set
   Medium = 15 messages/set
   Low = 9 messages/set

3. Message relevance levels are set at the following:
   High = 100% In Alpha Company sector/set
   Medium = 66% In Alpha Company sector/set
   Low = 33% In Alpha Company sector/set

4. Each message will be limited to one type of "what" information (e.g., one type of enemy unit, one type of friendly unit, or one type of obstacle). Multiple "whats" will not be included.

5. All message elements are limited to the types of information available in the CCD message formats as specified below:

   a. What Tank, Helo, FWAir, Trucks, Troops, ATGM, PC except for Intel which includes under Friendly Units: Arty, C^2, Mech, Mortar, Scout, Support, Truck
   b. # 1-500
   c. Where
      1. High Relevance: grid locations within company sector, but not perpendicular to current BP (100 meters front and rear of commander's vehicle location)
      2. Low Relevance: grid locations outside company sector, but not perpendicular to current BP (100 meters front and rear of commander's vehicle location)
   d. Activity
      1. EnAct Ground Attack, Air Attack, Fire, Defend, Delay, Recon
      2. FrAct Ground Attack, Air Attack, Fire, Defend, Delay, Recon
   e. Heading
      1. EnHdg 1-360 degrees
      2. FrHdg 1-360 degrees
   f. Number Damaged, Number Destroyed
      1. # Dam 1-500
      2. # Des 1-500
   g. Obstacle Minefield, Abati, Tank Ditch, Blown Bridge (2 grid locations)
   h. As Of Now, -10 minutes, -30 minutes

APPENDIX C

MESSAGE SETS FOR PLATOON LEADERS

Message Sets for Vignette 1: Low Relevance, Location A[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Spot	LM	A23	En Tnk		3	17	822867		Atk	Def	Now
Intel		DO6	Fr Mech	4			791892			Def	-5
Spot	M	DO6	En Tnk		2	8	799838	10	Atk	Def	Now
Spot	LM	DO6	En Tnk		4	10	820831	8	Atk	Def	Now
Intel	M	YO2	En PC	1			883890		Rec		-20
Intel		YO2	Fr Supt	4			794915			Def	-5
Spot	LM	DO6	En Tnk		0	10	809841	1	Atk	Def	Now
Intel	LM	AO6	Mine	0			805911[c]				-20
Cont	M	A22	En FW	nr			832840				
Intel	M	YO2	En PC	2			785889	10	Rec		-5
Intel	LM	YO2	En Tnk	31			836844	30	Atk		-5
Cont	LM	DO6	En Tnk	nr			834829				
Intel		DO6	Mine	0			794874[c]				-20
Intel		YO2	Fr Sct	2			859845			Rec	-20
Spot	M	A24	En PC		0	2	820898		Rec	Def	Now
Intel		YO2	En Trck	2			839908	300		Def	-20
Cont		A22	En Helo	nr			842840				
Cont	LM	A22	En Tnk	nr			825860				
Intel	M	YO2	Fr Mort	4			830900			Def	-20
Intel	LM	YO2	En PC	10			829811	340	Atk		-20
Intel	LM	YO2	En PC	10			821811	34	Atk		-20

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; Aatk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES838875. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

Message Sets for Vignette 2: Medium Relevance, Location A[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Spot	LM	A23	En Tnk		6	14	851881		Atk	Def	Now
Spot	M	A23	En Tnk			3	847877		Atk	Def	Now
Spot		A24	En Tnk		1	2	852875		Atk	Def	Now
Cont	M	A22	En PC	nr			825850				
Intel		YO2	Fr C^2	2			805925			Def	-5
Spot	LM	YO2	En PC		5	30	881911		Atk	Def	Now
Intel	LM	YO2	Fr Sct	2			862869			Rec	-20
Intel		YO2	Abati				853919				-5
Intel	M	AO6	Mine				823879[c]				-20
Intel	LM	YO2	En Tnk	31			866862	300	Atk		-5
Spot	M	A22	En Tnk		0	2	846870		Atk	Def	Now
Intel	LM	YO2	Fr Mort	4			811890			Def	-20
Cont		A23	En Tnk	nr			862876				
Cont	LM	A24	En Trp	nr			869880				
Intel	LM	AO6	Mine				820918[c]				-20
Spot	LM	A24	En [illegible]		0	2	825876		Rec	Def	Now
Cont	M	A22	En Helo	nr			856853				
Intel		YO6	En Tnk	2			862876		Def		-5
Intel		BO6	Fr Mech	4			879921			Def	-20
Intel	LM	YO2	En Tnk	30			886894	1	Atk		-20
Spot	M	A24	En Trp		0	2	869880		Atk	Def	Now

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; AAtk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES838875. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

Message Sets for Vignette 3: High Relevance, Location A[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Spot	LM	A23	En Tnk		5	15	851864		Atk	Def	Now
Cont		A23	En Tnk	nr			853876				
Spot		A22	En Tnk		1	2	842872		Atk	Def	Now
Intel	M	YO2	En PC	10			839825	315	Atk		-20
Spot	M	A23	En Tnk		1	4	850875		Atk	Def	Now
Intel	LM	YO2	Fr Mort	4			850911			Def	-20
Intel	LM	YO2	Fr Sct	2			836841			Rec	-20
Cont		YO6	En Helo	nr			871841				
Intel	M	YO2	En Trck	2			795928	315		Def	-5
Spot	LM	A24	En PC		0	2	840891		Atk	Def	Now
Intel	LM	YO2	En Tnk	31			871836		Atk		-5
Intel	M	YO6	En PC	10			839831	315	Atk		-20
Intel	LM	AO6	Mine	0			828927[c]				-20
Cont		A22	En Trp	nr			834849				
Cont	LM	A22	En Helo	nr			864874				
Intel	LM	YO2	En Tnk	31			861841	345	Atk		-5
Intel	LM	AO6	Mine	0			813896[c]				-20
Intel	M	YO2	En Art	8			873829		Atk		-20
Cont		A24	En FW	nr			855834				
Spot	M	A22	En Tnk		0	1	832882		Atk	Def	Now
Intel		YO2	Fr C^2	2			812915			Def	-5

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; AAtk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES838875. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

Message Sets for Vignette 4: Low Relevance, Location B[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Intel	LM	YO2	En PC	35			918775	275	Atk		-20
Cont	LM	CO6	En PC	nr			940778				
Spot	LM	CO6	En PC		2	5	962798	300	Atk	Def	Now
Intel	M	YO2	Fr Sct	2			912765			Rec	-20
Intel	M	CO6	En Trp	4			951850	300	Rec		-20
Cont		A22	En Helo	nr			872752				
Intel		YO2	Fr C^2	3			891851			Def	-5
Spot	LM	A23	En PC		5	15	892781		Atk	Def	Now
Intel	LM	YO2	Fr Mech	4			935805			Def	-5
Intel	LM	YO2	En PC	2			898850	310	Rec		-20
Spot	M	A24	En PC		0	2	892825		Rec	Def	Now
Cont	M	DO6	En PC	nr			838749				
Intel		YO2	Fr Mort	4			883818			Def	-20
Intel		YO2	En FW	2			810801	310	AAtk		-20
Intel	LM	AO6	Mine	0			867806[c]				-20
Intel	LM	YO2	En PC	20			940788	300	Atk		-5
Intel	LM	YO2	En ATGM	4			944792	1	Atk		-5
Intel	M	YO2	Fr Supt	4			885895	350		Def	-20
Spot	M	YO2	En ATGM		0	4	945800		Atk	Def	Now
Intel		DO6	En PC	10			899783			Def	-5
Spot		DO6	En PC		0	2	835755		Rec	Def	Now

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; AAtk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES879797. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

Message Sets for Vignette 5: Medium Relevance, Location B[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Intel		YO2	Fr Trck	2			902892	10		Def	-5
Cont	M	A22	En Helo	nr			892769				
Intel	LM	YO2	En Trp	2			889751			Rec	
Intel	LM	YO6	En ATGM	4			856739	350	Atk		-20
Spot	LM	A24	En PC		0	2	851822		Rec	Def	Now
Cont	M	YO6	En Tnk	nr			850756				
Intel		YO2	En PC	4			918779	360	Atk		-20
Spot	M	YO6	En PC		7	11	855764		Atk	Def	Now
Spot	M	A22	En PC		0	3	889780		Atk	Def	Now
Spot	LM	A23	En PC		8	7	890795				Now
Intel		AO6	Fr Mech	4			847843			Def	-20
Intel		YO2	En PC	4			892749	360	Atk		-20
Spot	LM	YO2	En Tnk		2	2	850756	360	Atk	Def	Now
Intel	LM	AO6	Mine				857840[c]				-20
Intel	LM	YO2	Fr Mort	4			861822				-20
Spot		BO6	En FW		0	1	889828	50	Atk	Def	Now
Intel		YO6	En Trp	8			896768	360	Atk		-20
Intel	M	AO6	Mine				859817[c]				-20
Intel	LM	YO2	En PC	35			909753	310	Atk		-20
Spot	M	A24	En PC		3	5	898782		Atk	Def	Now
Spot	LM	A22	En PC		0	4	869880		Atk	Def	Now

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; AAtk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES879797. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

Message Sets for Vignette 6: High Relevance, Location B[a]

Type	LM[b]	From	What	Number/State Obs	Dam	Des	Where[a]	Dir	Activity En	Fr	As Of
Intel	LM	YO2	Mine	0			868807[c]				-20
Spot	M	A23	En PC		3	7	885788		Atk	Def	Now
Intel	LM	YO2	Fr Mort	4			864824			Def	-20
Intel	LM	YO2	En PC	35			881755	10	Atk		-5
Intel		AO6	Ditch	0			846820[c]				-20
Intel		YO2	En PC	1			882741	290	Rec		-20
Cont	M	YO6	En ATGM	nr			902771				
Spot	LM	A24	En PC		0	2	871824		Rec	Def	Now
Intel	LM	YO2	Fr Sct	2			895765			Rec	-20
Intel		A23	En Trp	6			887784	180	Atk		-20
Spot		A24	En PC		0	4	881782		Atk	Def	Now
Spot	LM	A23	En PC		5	15	871779		Atk	Def	Now
Spot	M	A22	En PC		2	2	881783		Atk	Def	Now
Intel	M	YO2	En ATGM	4			902771	300	Atk		-20
Intel	LM	AO6	Bln Bdg	0			870826				-20
Cont	LM	A22	En Helo	nr			918769				
Spot		A24	En ATGM		1	3	892784		Atk	Def	Now
Intel		YO6	En PC	2			903780	12	Atk		-20
Intel	LM	YO6	En Tnk	4			918769	50	Atk		-20
Cont	M	A22	En Trp	nr			884783				
Intel	M	YO2	En PC	10			918769	50	Atk		-20

Note. Obs = observed; Dam = damaged; Des = destroyed; Dir = direction; En = enemy; Fr = friendly; As Of = minutes; PC = personnel carrier; Sct = scout; Trp = troops; Helo = helicopter; Trck = truck; C^2 = command and control; Mech = mechanized infantry; Mort = mortar; FW = fixed wing air; Tnk = tank; ATGM = anti-tank guided missile; Supt = support; Atk = ground attack; AAtk = air attack; Def = defend; Rec = reconnaissance; Art = artillery; Bln Bdg = blown bridge; nr = not reported.

[a] Own location = ES879797. All other map locations have ES prefix.

[b] LM = messages used in both low (L) and medium (M) amount sets. All messages listed in order presented.

[c] Minefield and ditch locations equal center of mass, but commanders received coordinates for each endpoint.

APPENDIX D

SEND UTILITY FILE STRUCTURE FOR PLATOON LEADERS

LOW AMOUNT (n = 9 messages)

Test Vignettes

v1lvpl--situation A, low relevance = 1/3 in company sector
v2lvpl--situation A, medium relevance = 2/3 in company sector
v3lvpl--situation A, high relevance = 3/3 in company sector
v4lvpl--situation B, low relevance = 1/3 in company sector
v5lvpl--situation B, medium relevance = 2/3 in company sector
v6lvpl--situation B, high relevance = 3/3 in company sector

Practice Vignettes

plvpl---situation C, medium relevance = 2/3 in company sector
p2lvpl--situation C, medium relevance = 2/3 in company sector

MEDIUM AMOUNT (n = 15 messages)

Test Vignettes

v1mvpl--situation A, low relevance = 1/3 in company sector
v2mvpl--situation A, medium relevance = 2/3 in company sector
v3mvpl--situation A, high relevance = 3/3 in company sector
v4mvpl--situation B, low relevance = 1/3 in company sector
v5mvpl--situation B, medium relevance = 2/3 in company sector
v6mvpl--situation B, high relevance = 3/3 in company sector

Practice Vignettes

vpmvpl---situation C, medium relevance= 2/3 in company sector
vp2mvpl--situation C, medium relevance= 2/3 in company sector

HIGH AMOUNT (n = 21 messages)

Test Vignettes

v1hvpl--situation A, low relevance = 1/3 in company sector
v2hvpl--situation A, medium relevance = 2/3 in company sector
v3hvpl--situation A, high relevance = 3/3 in company sector
v4hvpl--situation B, low relevance = 1/3 in company sector
v5hvpl--situation B, medium relevance = 2/3 in company sector
v6hvpl--situation B, high relevance = 3/3 in company sector

Practice Vignettes

vphvpl---situation C, medium relevance= 2/3 in company sector
vp2hvpl--situation C, medium relevance= 2/3 in company sector

APPENDIX E

SITUATIONAL AWARENESS MEASURES

F1(S) 1 of 2

Situational Awareness: "Seeing" the Current Situation

The following questions ask about your awareness of the current situation. The first two questions ask about units reportedly **engaged** by your **company**. The next two questions ask about the main enemy unit reported but **not engaged** by your company. The final question asks your assessment of the total unit committed against the entire **Task Force** based on all reports received. For each item, either write your answer in the blank provided, or circle the one letter indicating the best answer.

1. Based on the reports sent to you, how many vehicles by type were damaged or destroyed in your **company** sector by your company? The numbers you enter should indicate the total number of vehicles by type reportedly destroyed or damaged by your company.

TYPE	NUMBER
Tank	_____
Pcs	_____
Other _____ (Specify)	_____

2. Based on the numbers and types of vehicles reported as destroyed and damaged in your **company** sector (question 1), estimate the size and type of enemy force your **company engaged**?

a. Mechanized Rifle Company (MRC)
b. Mechanized Rifle Battalion (MRB)
c. Mechanized Rifle Regiment (MRR)
d. Tank Company
e. Tank Battalion
f. Tank Regiment

3. Based on the reports sent to you, how many and what type of vehicles that were **not engaged** are still approaching to the front of your **company's** position?

TYPE	NUMBER
Tank	_____
Pcs	_____
Other _____ (Specify)	_____

4. Based on the numbers and types of vehicles reported approaching your **company** position but **not engaged** (question 3), estimate what size and type of unit is still approaching?

a. Mechanized Rifle Company (MRC)
b. Mechanized Rifle Battalion (MRB)
c. Mechanized Rifle Regiment (MRR)
d. Tank Company
e. Tank Battalion
f. Tank Regiment

5. Based on all reports received, what is your estimate of the overall size and type of unit committed against the **Task Force**?

a. Mechanized Rifle Company (MRC)
b. Mechanized Rifle Battalion (MRB)
c. Mechanized Rifle Regiment (MRR)
d. Tank Company
e. Tank Battalion
f. Tank Regiment

**********FOR RESEARCHERS ONLY**********

F1(S) (1) S# _____ (2) Sim # 2B 3B 4A 4B 5th sim
(3) Vign: Practice A B C D (4) Amount: H M L
(5) Date: _____ (6) RA _____

PT5359(a)

Situational Awareness: "Seeing" the Future Situation

The following questions ask about your awareness of the future situation. The first two questions ask about the main unit reported to your **company's** front. The third question asks about your estimate of when that unit may reach your current vehicle's position. And the final two questions ask about the distance and direction to your **company's** designated subsequent battle position, and the impact reported obstacle(s) may have on your company's movement to its subsequent battle position. For each item, either write your answer in the blank provided, or circle the one letter indicating the best answer.

1. From your vehicle's current position, how far in kilometers (km) and in what direction is the **main** unit **not engaged** that is approaching your **company's** front?

DISTANCE (to 1/2 km) from your current position? _____km

DIRECTION (N/NE/etc) from your current position?

_____

2. HEADING (N/NE/etc.) of main unit? _____

3. Based on a speed of 10 kilometers per hour, how many minutes should it take the **main** enemy unit (question 1) to move from its reported location to within 2 kilometers of your vehicle's current position?

a. Unit will not come within 2 kilometers of my position.
b. Six minutes.
c. Twelve minutes.
d. Eighteen minutes.
e. Twenty-four minutes.

4. From your vehicle's current position, how far and in what direction is your **company's subsequent** battle position?

DISTANCE (to 1/2 km) from your current position? _____km

DIRECTION (N/NE/etc) from your current position? _____

5. What **impact** will the reported obstacle(s) have on your **company's movement to** or **occupation of** your designated subsequent battle position.

a. No impact.
b. The obstacle is on my designated subsequent battle position, I will have to designate a new subsequent battle position.
c. The obstacle is very close to my designated subsequent battle position. My unit will have to be careful in occupying the position.
d. The obstacle is on the primary high speed route to my designated subsequent battle position.
e. The obstacle is not on the route but will canalize my unit's movement to my designated subsequent battle position.

**********FOR RESEARCHERS ONLY**********

F2(S) (1) S# _____ (2) Sim # 2B 3B 4A 4B 5th sim
(3) Vign: Practice A B C D (4) Amount: H M L
(5) Date: _____ (6) RA _____

PT 5859(b)

Situational Awareness: Plotting the Current Situation

Based on the information you received on your Command and Control Display (CCD) during this vignette, plot the locations of the items listed below on the map sheet provided. You are to plot the **actual** location as **last reported**, not a projected location such as where unit may have moved to since report reception.

As accurately as possible, for each of the items listed below:
(a) plot its location with an **"X"** on the map sheet, and
(b) write the item number beside the **X** (e.g. **"X1," "X2"**)

On this page, below each item, indicate with an **"X"** on the appropriate line that you either (a) plotted the item and specified number on the map sheet, or that you did not plot the item because (b) it was not reported or provided, or (c) you can not remember its reported or provided location.

1. largest enemy unit **engaged** by your **company**
   (a) ____ plotted and numbered
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

2. largest enemy unit approaching the front of your **company** sector, but **not engaged**
   (a) ____ plotted and numbered
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

3. friendly scout unit to **front** of your **company** sector
   (a) ____ plotted and numbered
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

4. target reference points (TRPs) to **front** of your **company** sector
   (a) ____ plotted and numbered
   (b) ____ not plotted, not provided
   (c) ____ not plotted, can't recall location

5. largest enemy unit **outside** of your **company** sector
   (a) ____ plotted and numbered
   (b) ____ not plotted, not provided
   (c) ____ not plotted, can't recall location

**********FOR RESEARCHERS ONLY**********

F2(P) (1) S# _____ (2) Sim # 2B 3B 4A 4B 5th sim
(3) Vign: Practice A B C D (4) Amount: H M L
(5) Date: _____ (6) RA _____

PT 5860(a)

Situational Awareness: Plotting the Future Situation

Based on the information you received on your Command and Control Display (CCD) during this vignette, plot the locations of the items listed below on the map sheet provided. You are to plot the **actual** location as **last reported**, not a projected location such as where unit may have moved to since report reception.

As accurately as possible, for each of the items listed below:
(a) plot its location with an **"X"** on the map sheet, and
(b) write the item number beside the **X** (e.g. **"X1," "X2"**)

On this page, below each item, indicate with an "X" on the appropriate line that you either (a) plotted the item and specified number on the map sheet, or that you did not plot the item because (b) it was not reported or provided, or (c) you can not remember its reported or provided location.

1. support unit to **rear** of your **company** sector
   (a1) ____ plotted and numbered; give type (a2)_____
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

2. your **company's subsequent** battle position
   (a) ____ plotted and numbered
   (b) ____ not plotted, not provided
   (c) ____ not plotted, can't recall location

3. obstacle to **rear** of your **company** sector
   (a) ____ plotted and numbered
   (b) ____ not plotted, not provided
   (c) ____ not plotted, can't recall location

4. enemy scout unit to **rear** of your **company** sector
   (a) ____ plotted and numbered
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

5. friendly mortar unit in your **company** sector
   (a1) ____ plotted and numbered; give type (a2)_____
   (b) ____ not plotted, not reported
   (c) ____ not plotted, can't recall location

**********FOR RESEARCHERS ONLY**********

F1(P) (1) S# _____ (2) Sim # 2B 3B 4A 4B 5th sim
(3) Vign: Practice A B C D (4) Amount: H M L
(5) Date: _____ _____ (6) RA _____

PT 5860(b)

APPENDIX F

SAMPLE CROSSWALK OF SITUATIONAL AWARENESS ITEMS BY VIGNETTE

Crosswalk of SA Questions and Vignette Information: Medium Amount, Low Relevance Vignette

	Situational Awareness Form			
	Current		Future	
SA Item	Seeing	Plotting	Seeing	Plotting
1	3[a](20 E-PC) 2 (2 E-PC)	3 (20 E-PC)	1 (35 E-PC)	13 (F-Spt)
2	3 (20 E-PC) 2 (2 E-PC)	1 (35 E-PC)	1 (35 E-PC)	Overlay
3	1 (35 E-PC)	6 (2 F-Scts)	1 (35 E-PC)	7 (Mines)
4	1 (35 E-PC)	Overlay	Overlay	15 (2 E-PC)
5	3 (20 E-PC) 2 (2 E-PC) 1 (35 E-PC)	18 (20 E-PC)	7 (Mines)	NR

Note. E-PC = enemy personnel carrier; F-Spt = friendly support vehicle; Overlay = operational overlay; F-Scts = friendly scouts; Mines = obstacle type; NR = not reported.

[a] First numerical entry per column is identification number of message(s) relevant to situational awareness item indicated. Second entry (in parentheses) identifies message contents such as number of units, if numerical, or other source of situational information (e.g., operational overlay).

APPENDIX G

SCORING GUIDELINES FOR SITUATIONAL AWARENESS MEASURES

Scoring for each item based on 10-point scale: 10 = High, 6 = Medium, 2 = Low, 0 = < Low.
Summary score based on percentage of available points obtained on each form for each vignette.

Plotting Items: Form 1(P), Future Situation;
Form 2(P), Current Situation

If information provided and plotted*:

10 = .5km from exact location
6 = >.5 to 1.5km from exact location
2 = > 1.5 to 3km from exact location
0 = > 3km from exact location; reported, not plotted

* If more than one element plotted/item (e.g., more than 1 obstacle) assign equal weight for each element with total points divided by number of elements plotted.

If information not plotted, because it was not provided:
5 = "B" (not plotted, not reported)
3 = "C" (not plotted, can't recall)

If information plotted, but not provided
0 = "A" (plotted, but not provided)

If information provided, but not plotted:
0 = "B" or "C"

"Seeing" Items: Form 1(S), Current Situation

Items 1 and 3 under NUMBER for Tank and PCS are # of vehicles for each type. Scoring based on correct # reported. Allot 80% for total # of tanks and PCs reportedly engaged (.8 x # of points allotted).

10 = 90% or >
6 = 70-89%
2 = 40-69%
0 = < 40%

Items 1 and 3 under OTHER for Type and Number are # of vehicles by type other than tanks and PCs. All OTHERs, if present in the message set, together account for 20% (.2 x # of points allotted). If two other subtypes, weighted by .1 etc.

Scoring Guidelines for SA cont.

Items 1 and 3 under OTHER cont.
10 = correct type and correct number
 6 = correct type, but incorrect number
 2 = incorrect type, but correct number
 0 = incorrect type and incorrect number

"Seeing" Items: Form 1(S), Current Situation cont.

Items 2, 4 and 5 are unit Size and Type
10 = correct echelon and type
 6 = adjacent echelon and correct type
     or correct echelon, but incorrect type
 2 = nonadjacent echelon and correct type
     or adjacent echelon and incorrect type
 0 = incorrect echelon and type

"Seeing" Items: Form 2(S), Future Situation

Items 1 and 4 Distance and Direction (Cardinal Directions (CD))
10 = 5 < .5km from exact location + 5 for correct CD
 6 = 3 > .5-1.5km from exact location + 3 for adjacent CD
 2 = 1 > 1.5 km-3km from exact location +1 for next adjacent CD
 0 = > 3km from exact location or > 90 degrees from correct CD
(Different point combinations possible)

Item 2 Heading (Cardinal Directions (CD))
10 = correct CD for direction
 6 = adjacent CD (45 degrees from correct CD)
 2 = next adjacent CD (90 degrees from correct CD)
 0 = > 90 degrees from correct CD

Item 3 Time
10 = correct
 6 = 6 minutes off
 2 = 12 minutes off
 0 = > 12 minutes off

Item 5 Obstacle Impact
10 = correct
 6 = closest option*
 2 = next closest option
 0 = other

* Options and correct answers as determined by subject matter experts (SMEs) are designated on SA Scoring Sheet (not provided as part of this report).

APPENDIX H

SAMPLE TRAINING AND TESTING SCHEDULE

Training

7:45-8:00	Participants at training/assessment facility.
8:00-8:30	Principal Instructor presents overview brief.
8:00-8:20	Support Personnel (SP) collect materials, complete checklist to make sure they have materials needed & map boards ready. Breakdown logs put on SIMs.
8:20-8:45	Trainers/SP do SIM, CCD and radio checks. Make sure CCD is ready to receive messages before you go to Demo.
8:30-8:45	CCD introduction in classroom using slides.
8:45-9:15	Trainers present Demo on BARCO monitor. SP at Demo to provide assistance, one to take notes on participants Comments/Questions asked for training purposes.
9:15-9:25	Break
9:25-10:25	SP assigned to Tcs in TOC/escort Tcs out to SIM SP present Structured Hands-On Practice
10:25-10:30	Vignette set-up/Participants Break
10:30-11:05	Vignette Portion of Structured Practice for more training on message reception, relay, and retrieval.
10:30-10:35	Script on Vignette Procedure #1
10:35-10:40	TC in SIM/OPORD provided/headsets on
10:40-10:50	Practice Vignette #1 (medium amount and relevance)
10:50-11:00	Situational Awareness
11:00-11:05	Feedback with SP in SIMs
11:05-11:20	Unstructured Practice
11:20-11:25	Supervised Practice set-up/Participants break
11:25-11:45	Supervised Practice
11:25-11:30	Script for Vignette Practice #2
11:30-11:35	TC in SIM/OPORD provided/headsets on

11:35-11:45	Practice Vignette #2 (medium amount and relevance) /SP fill out checklist/No SA
11:45-12:00	Retraining with SP/Feedback
12:00-12:45	Participants Lunch
12:45-1:00	Practice Vignette Preparation
12:00-1:00	Lunch/SP in SIMs at 1:00 ready to go
13:00-13:35	Practice Vignette
13:00-13:05	Script for Vignette Practice #3
13:05-13:10	TC in SIM/OPORD provided/headsets on
13:10-13:20	Vignette Practice #3/SP fill out checklist
13:20-13:30	Situational Awareness
13:30-13:50	Questions and Answer

Testing

13:50-14:20	Session A[a]	
	OPORD review	5 minutes
	Message processing phase	10 minutes
	SA assessment	10 minutes
	Set-up for next vignette	5 minutes
14:20-14:50	Session B	
14:50-15:00	Break	
15:00-15:30	Session C	
15:30-16:00	Session D	
16:00-17:30	Make-ups/Preparation for next day of evaluation.	

[a]Session A schedule repeated for all test sessions.