Providing Feedback on Unit Employment of Vehicular Command, Control and Communication Systems

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ABSTRACT

Command, control, and communication (C3) systems in Army combat vehicles set the stage for improved awareness of the tactical situation, enhancing the capability to implement changes in mission plans to exploit improved awareness. Reaping these benefits requires training in a collective context, because C3 is inherently a collective activity. This requirement makes it necessary for trainers to consider the stream of digital messages among nodes and operator interactions with systems—adding to the observation requirements that already burden collective trainers. Further, collective trainers must address the fact that many leaders view digital training as a detractor to unit training. The U.S. Army's III Corps identified the need for guidance on how trainers can provide units with diagnostic feedback. The project team used observations, interviews, and literature reviews to identify fifty digital proficiency performance goals arranged into nine topical areas (e.g., apply situational awareness in maneuver decisions) to be addressed by measurement guidance. The measurement guidance developed for each performance goal included a description of its tactical significance, the echelon(s) to be observed, tactical events that should trigger observations, and data to be applied in assessing performance. This approach is designed to help reduce trainer workloads by focusing on high-payoff digital activities. In describing data requirements, the team gave special attention to the possibility of using automated systems to collect and present information regarding the content of digital messages and operator interactions with digital systems to reduce the need for trainers to track these aspects of the situation on their own. The measurement guidance evolved into laminated, pocket-sized products that were distributed to leaders in the 4th Infantry Division and 1st Cavalry Division to support digital training. The product is also being used to define the information displays that need to be produced by digital after action review systems addressing digital data streams and operator interactions.

ABOUT THE AUTHORS

Dr. Larry Meliza is a research psychologist with the U.S. Army Research Institute. He has over 25 years of research/development experience in collective training that includes: describing training detractors; developing methods for describing collective training requirements that make it easier to plan, prepare, and conduct training; developing after action review systems, evaluating computer generated forces, and describing the impacts of force modernization on exercise control and feedback workloads of trainers.

Karen Lockaby has over 18 years of experience in Army training development and assessment. She has served in many projects supporting digitization of Army units and is the primary author for the Digital Operating Guide for Brigade and Battalion Staff and the FBCB2 Digital Operators Guide.

Dr. Bruce Leibrecht has over 34 years of experience in behavioral research and analysis. This experience includes measuring the impacts of digitization of Army combat vehicles on unit performance in a virtual environment at a time when digitization was still at the early concept stage. More recently he has been involved in describing the impacts of digitization experience on the behaviors and attitudes of units.

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The U.S. Army Objective Force will be "designed to provide innovative capabilities to cope with the new operational environment relying on leaders and Soldiers to out think and dominate our adversaries with superior speed of command and decisive action (Riggs, 2002)." The U.S. Army recognized that transition to the Objective Force will involve substantial changes in the way training is conducted. As a result, the U.S. Army approved "Methods and Measures of Commander-Centric Training" as a Science and Technology Objective (STO). The research and findings described by this paper are part of this STO. The paper focuses on the capability to provide diagnostic feedback to units regarding their employment of digital command, control, and communication (C3) systems.

Platform-based C3 systems for Army units offer the potential for improved situational awareness (SA) and understanding (SU). Because C3 activities are inherently collective in nature, leaders must be trained to operate and apply these systems in a collective context. The job of monitoring unit employment of platform-based C3 systems and providing units with feedback regarding how well they employed these systems is filled with challenges.

PROMISE OF PLATFORM-LEVEL DIGITIZATION

Force XXI Battle Command Brigade and Below (FBCB2) is primarily a platform-level (e.g., tank) C3 system. FBCB2 and the tactical internet provide a means of electronically distributing orders, text messages, and overlays. This distribution capability makes it easer for units to decide and implement substantial changes in mission plans in response to the evolving tactical situation. FBCB2 also includes features that facilitate unit awareness of the tactical situation as well understanding of the implications for future events. FBCB2, enabled by the global positioning system (GPS), displays icons showing the location of other friendly platforms to help reduce the probability of fratricides and help leaders track the location of subordinates. The system includes terrain analysis tools to support tactical decision making (e.g., if we take this route, at what point will we establish line of sight with the enemy). FBCB2 has the capability to cause information to be displayed in response to selected structured messages. For example, a vehicle commander may observe enemy vehicles and send a structured contact report, causing a geo-referenced icon showing the location of the observed enemy to be displayed on FBCB2 screens throughout the unit. Other threatening situations (e.g., contaminated areas) and safe situations (e.g., breach lane through a minefield) can also be displayed automatically through the use of structured messages. Finally, FBCB2 can sound alarms or display warnings if a platform is dangerously close to certain threatening situations (e.g., minefields).

TRAINING ISSUES

The Need to Train Units to Reap the Benefits of Digitization

Units do not automatically reap the benefits of digitization. Unit leaders and vehicle commanders must first learn how to operate their digital systems. Some of these procedural operator skills are highly perishable (Sanders, 1999), so they must train routinely with their systems. In addition, unit leaders and vehicle commanders must learn how to apply digital system capabilities to support tactical operations. It is the application of these systems to battlefield decision-making that is the focus of the current work. For example, a leader may be able to operate the various line-of-sight (LOS) tools within FBCB2 without being proficient in the application of these tools to support tactical decisions. A highly proficient leader may use the circular LOS tool, combined with information about suspected enemy locations, to predict where and when the unit will make contact with the enemy. He can assess which

route and location provides him the tactical advantage over the enemy. The circular LOS tool can also provide the leader with the optimal time and place to employ smoke to conceal his movement.

In earlier interviews, observations of training, and reviews of lessons learned papers and reports, the team identified a number of indicators of digital proficiency or non-proficiency (Dudley, Johnston, Jones, Strauss, and Meliza, 2001) Positive indicators of unit proficiency included:

- reduction in voice radio traffic concerning the locations of subordinate elements
- reliance on situational awareness displays to navigate under limited visibility situations
- immediate corrective actions taken by leaders when problems in unit performance were observed using digital SA displays

Interviews also revealed problems in the use of FBCB2 that included:

- users become confused as to which files contain the most recent versions of plan components
- elements believe they are sending and receiving friendly position data over the network when they are not
- individual systems are not set to automatically display geo-referenced icons, leaving users unaware of threat situations
- leaders incorrectly assume that all friendly elements are represented by icons
- contact reports that trigger geo-referenced icons showing enemy location are not updated as the enemy situation changes

Training Feedback Challenges

Training units to use digital system adds to the already heavy observation and analysis requirements of collective trainers. In addition to monitoring all of the activities applicable to pre-digital units, trainers must now track digital messages sent among various digital nodes and gain information about operator interactions with digital systems. Training digitized units is also made challenging by the fact that many individuals view digitization as a detractor to tactical training. Trainers now must link digital and tactical feedback, further increasing their workload.

Point-to-point digital message traffic can have the effect of pulling trainers out of a unit's tactical information loop. To keep track of the information being received by a unit and the information being transmitted within and across units and echelons a trainer would have to interact with multiple computers, each simulating the role of different nodes (e.g. a higher headquarters). This activity is much more complex than simply listening to multiple voice radio nets from one location. During early digital training exercises at the Army's National Training Center, observer/controllers (OCs) were able to view video taps that displayed whatever was on the screen of company commanders. If the company commander did not interact with the system periodically, the OCs tap displayed a screen saver. Platoon level OCs asked their unit counterparts what digital messages they had received in an effort to gain entrance to the unit's digital data flow (Brown, Anderson, Begley, and Meliza, 1999).

The development of digital after action review (AAR) systems that collect and organize digital messages facilitates the ability of trainers to monitor digital message traffic (Electronic Proving Ground, 2002; Faulkner, 2002). These systems provide the capability to implement a wide variety of AAR aids describing digital traffic. Substantial thought must be given to defining outputs that can meet the information needs of trainers and not overwhelm the trainer with a glut of digital data.

Collective trainers must also gain and examine information about user interactions with platform-based digital C3 systems. These systems give individual users the capability to control how they view the battle space and their ability to receive and use messages from others, including the GPS-enabled data on the location of friendly vehicles. The ability of leaders and vehicle commanders to individually control their view of the battle space (e.g., by setting filters that control update rates) creates a situation where the members of even the smallest of units can have substantially different pictures of the tactical situation. Unit leaders and vehicle commanders need to learn how to employ the control capabilities in a way that supports unit tactical performance.

On one hand, trainers need to avoid a situation where training on the operation of digital platform-based C3 systems is conducted at the expense of unit tactical training. On the other hand, the ability of these systems to enhance SA and SU is lost if the employment of these systems is uncontrolled. The solution to this dilemma is to limit the trainer's concerns regarding operator interactions to those linked closely to tactical performance.

GOALS AND OBJECTIVES

The 4th Infantry Division is the U.S. Army's First Digitized Division. The 1st Cavalry Division, collocated with the 4th ID at Fort Hood, TX under III Corps, has recently undergone digital transformation. The III Corps Chief for Digital Training requested that ARI prepare guidance for trainers to use in assessing the use of FBCB2 in collective exercises. This request also included defining specific information needs to be addressed by digital AAR systems.

One objective was to focus measurement efforts on digital activities that have direct tactical significance, and then to convey this significance to leaders and users. Among these digital applications, the team sought to focus on those that units appear to have trouble mastering. This approach helps address the problem of digital activities being viewed as a detractor to tactical training and offers the additional benefit of focusing the attention of trainers on a small number of high payoff digital events.

A second objective was to address digital activities that will remain relevant as digital C3 systems continue to evolve. The team avoided, for example, focusing on digital activities that are performed to work around problems with current system capabilities. This approach helps ensure that the guidance will not become out of date when new versions of software are fielded.

A third objective was to provide guidance for providing feedback that does not necessitate the availability of a digital AAR system but would help units apply these AAR systems. In the long run, information displays produced by digital AAR systems will help trainers manage the workload associated with training digitized units: however, in most training situations where collective digital exercises are currently conducted, there are no digital AAR systems to support training Until AAR systems are readily available, trainers may have to examine individual FBCB2s after an exercise to look at the messages sent up and down the chain of command by, for example, a platoon leader. At the same time, trainers can examine these FBCB2s to decide if and how users organize digital information and control their views of the battlespace. The tactic used by the team was to describe the information derived from breakouts of digital messages or breakouts of operator interactions with systems needed to assess a unit's application of FBCB2 with the understanding that the breakout data would be provided by AAR systems in the long term and by trainers seeking out this information in the near term by looking at one or more FBCB2 systems.

A fourth objective was to explore the possibility of using indicators of digital proficiency levels as a tool in tailoring training exercises and feedback to fit the estimated proficiency level of a unit. If a unit lacks the foundation for certain levels of digital applications, then practice and feedback efforts are better spent providing enabling foundations.

METHOD

The start point for this effort was to identify tactically significant FBCB2 capabilities that are not easily and readily employed. Information regarding the tactical significance of these capabilities came from unit descriptions of how digital systems changed the way they fight (Dudley et al, 2001), descriptions of how digital systems might be employed to a reduce fratricides and gain greater control over how and when contact is made with the enemy (Dudley et al., 2002), guidance for operating FBCB2 (Warrior-T, 2002), and lessons learned from the performance of digitized units at the NTC (Department of the Army, 2002).

Each major capability was described in terms of the actions involved in its application. For example, using FBCB2 to plan and execute movements is likely to involve all of the following: actions

- Post current operational graphics
- Post current obstacle overlays
- Use LOS and navigation tools to select routes
- Use circular LOS tools to reveal vulnerable areas of route
- Identify hazardous areas and check points
- Leaders disseminate route maps as overlays

Information regarding the extent to which units actually apply these capabilities and problems experienced during the applications were taken from interviews with experienced digital leaders, observations of training exercises, and interviews with personnel that support unit employment of digital systems. Interviews proved to be the most useful source of information, in that they made it possible to ask questions as to why FBCB2 capabilities were not being employed. In deciding whether each capability was being employed, the research team considered whether units were taking the actions involved in applying the capabilities. For example, some leaders reported that they do not use the FBCB2 in selecting routes or they use the FBCB2

display to select routes in the same way they would use a paper map. Others reported they used the FBCB2 in selecting routes but pointed out that they did not, for example, use the LOS tool. Due to the fact that certain actions support more than one major capability, failure to perform these actions typically influences multiple capabilities.

The team screened major capabilities and supporting actions to make sure that they had a strong link to enhancing tactical operations and addressed needs that would remain as digital systems evolve. The team also screened the capabilities and supporting actions in an effort to reduce duplications, resulting in the identification of a limited number of digital proficiency goals to be supported by measurement guidance. The majority of these proficiency goals were based upon the actions supporting major FBCB2 capabilities.

The team then prepared guidance for evaluating unit performance with respect to each digital performance goal. The guidance for measuring performance included a description of the tactical significance of the goal, identification of the echelon(s) to which the performance goal applies, a description of the tactical events that call for assessment of unit performance with respect to the goal, and the description of data sources that can be used in assessing performance with respect to the goal.

RESULTS

High Payoff FBCB2 Capabilities and Supporting Activities

The team identified twenty-two major capabilities, each supported by multiple actions. These capabilities and their tactical significance are as follows:

- Establish proper communications network-so blue (i.e., friendly) picture is accurate
- Clear queues and logs-to avoid frustration of sluggish systems
- Set filters and respond to alerts-enabling better SU and faster decisions
- Use file naming conventions-to retrieve critical information faster
- Perform maintenance and troubleshooting-to sustain continuous communications
- Relate threat to own/unit location-to protect blue forces and dominate the enemy
- Tailor SA picture-to enhance decisions through better SU
- Manage threat icons-to enhance threat picture
- Post obstacle overlays-to avoid blue attrition
- Apply LOS tool for terrain analysis-to enhance blue force protection
- Apply LOS tool for perimeter defense planning-to improve speed and accuracy
- Use FBCB2 to plan and control fire support-to enhance precision and avoid fratricide
- Use FBCB2 to support logistical planning/preparation-to bolster resupply procedures
- Construct/update overlays-to enhance common operating picture and SU
- Leverage FBCB2 in multiechelon wargaming-to optimize synchronization
- Prepare and manage messages/graphics-to facilitate information retrieval
- Disseminate messages/graphics to build complete common operating picture
- Confirm receipt of critical messages–to assure complete dissemination
- Use FBCB2 to plan and execute movements –to increase speed and precision
- Leverage FBCB2 in maneuver decisions–to enhance blue lethality and survivability
- Exploit FBCB2 in fratricide prevention–to minimize blue attrition

The findings regarding the value of major FBCB2 capabilities and the tendency of units to exploit these capabilities was considered by the sponsor to have immediate use for digital leaders. These findings were distributed to unit leaders within the 4th ID and 1st CAV in the form of a laminated, pocket-sized, booklet called "Leader's Primer for Exploiting FBCB2." Table 1 provides examples of the information provided in the primer. The brief introduction to the booklet explains that it can be used by leaders to zero in on high–priority FBCB2 capabilities, explain why digital skills are tactically important, and know what to look for as indicators of success. The "keys to success" are the performed actions performed in applying each capability. The booklet provides overall estimates of whether each capability is being employed at platoon and company versus battalion level, and it describes the data behind these estimates. In all cases, a leader can use the same approach for assessing the extent to which his/her own unit is taking advantage of FBCB2 by simply asking questions of unit members.

Table 1.

Portion of Table from Leader's Primer for Exploiting FBCB2

Major Capabilities— Tactical Importance	Keys to Success	Probability of Exploitation Bn----Co/Plt	Exploitation Pitfalls	Says Who?
☙ DIGITAL BASICS ❧				
Set filters and respond to alerts — enabling better SU and faster decisions	• Unit SOP specifies filter setting procedures • Filters are set in advance, according to mission • Filter settings produce clear, standard common operating picture (COP) • Filter settings enable hazard alerts • Users respond to alerts with appropriate action • Users adjust filter settings as necessary	Low----Low	Users at all echelons fail to achieve standard COP, often without realizing the significance of the COP. Alerts are filtered out or ignored. Vehicles enter minefields.	In interviews soldiers are unaware of SOPs for setting filters. Some say "Once my system is up I don't touch it."
Use file naming conventions — to retrieve critical info faster	• Unit SOP specifies file naming conventions • Order & overlay names are assigned per SOP • Folders are created IAW mission • Folders are identified with date time group (DTG) • Files are saved in correct folder • Users retrieve and post correct files readily	Low----Low	Users are unsure how to set up folders and name files, due to lack of SOPs or training. They find it difficult to find correct files, and may display incorrect overlays.	In interviews soldiers are unaware of SOPs for creating folders and naming files. Some say it takes too long to find the right file.

Preparation of Measurement Guidance for Trainers

The team identified fifty digital performance goals to be addressed by measurement guidance. These goals were based upon actions or combinations of actions supporting major FBCB2 capabilities.

In preparing measurement guidance, the team organized the performance goals into nine topical areas. Certain of these areas subsume or support more than one of the twenty-two capabilities described above. The topical areas are as follows:

- Perform precombat checks/precombat inspections
- Disseminate and manage messages and graphics
- Plan and execute movements
- Apply situational awareness in maneuver decisions
- Achieve battlefield dominance through collaborative planning
- Support logistical preparations unit-wide
- Control indirect fires
- Avoid fratricidal situations via SU
- Employ filter settings to create a common or user desired picture

Examples from columns two through five under the skill "Perform Precombat Checks/ Precombat Inspections" are provided in Table 2. The first column in Table 2 describes performance goals with a mention of the importance of each goal.

For example, "determine percentage of unit FBCB2s reporting to decide if tactical picture is correct." The second column identifies the echelon(s) to which the goal applies. The third column identifies the trigger for applying the performance goal. The fourth column tells the trainer where to obtain the data needed to decide whether the performance goal is being attained.

At the request of the project sponsor, the guidance for evaluating unit use of FBCB2 was published in the form of a laminated, pocket-sized booklet entitled "FBCB2 Exploitation Tool." Copies of the booklet were distributed to unit leaders and vehicle commanders in the 4th Infantry Division and the 1st Cavalry Division.

Within a single booklet, leaders can find out what they, their immediate subordinates, and their subordinate's subordinates should be doing with their FBCB2s to support operations. A single booklet supports the system operator, supervisor, and trainer (two echelons above) roles of unit leaders. As an added feature, the front of each booklet lists the fifty performance goals and describes their tactical importance.

Table 2

Guidance for Assessing Unit Performance with Respect to Digital Performance Goals

Performance Goal	Echelon	Trigger	Where to Get Data
Verify own and other blue icons on FBCB2 display to ensure interface with tactical internet (TI) is working	Operator	At a minimum, prior to start of mission	**Observe platform data:** View blue SA to see if there are gaps **Query Warfighters**: Ask operators how they know when they are sending and receiving SA data
Report gaps in blue situational awareness to higher and lower HQ, alerting network to degraded COP	Battalion Company Platoon Platform	User realizes blue picture is degraded (not due to his filter settings)	**View user-system interaction:** User performs troubleshooting to rule out problems with his platform (i.e., verifies that communications security {COMSEC} file is current, verifies Enhanced Position Location Reporting System {EPLRS} server is operational, checks filter settings) **Observe platform data:** Did user take the initiative and enter blue icons to prevent fratricide? **Query Warfighters:** Was correct COMSEC package loaded? Was notification of any Blue gaps made network wide to avoid fratricide?

Tailoring Observations to Fit Estimated Proficiency Levels

During interviews with leaders it became obvious that one could deduce the digital proficiency of a unit by asking questions. In many cases, for example, leaders noted that they did not have unit SOPs or they reported that they did not use certain FBCB2 features for various reasons. Armed with this information, a trainer can more easily identify training objectives, scenarios, and feedback requirements appropriate to a specific unit and conduct training in a more cost-effective manner. Selected examples of the training implications of various indicators of digital proficiency are provided below.

- If users do not identify information they will look for in digital displays, then any benefit gained from the system is largely a matter of chance (e.g., the user just happens to look at a display at the right time to observe and understand an important event). Feedback should focus on illustrating the information lost by not referring to displays in a systematic manner.

- If unit leaders and vehicle commanders lack confidence in the robustness of platform-based digital systems, they are likely to reduce their interactions with the system in an effort to avoid causing system crashes. The training situation should force use of FBCB2 features, and the lack of resulting system crashes should be emphasized during feedback sessions.

- If a unit lacks SOPs for controlling views of the battlespace, then it becomes important for the trainer to observe what, if anything, unit leaders are doing to make sure that subordinate leaders share a common operating picture (e.g., does the leader tell subordinates what overlays to post).

Two of the major variables influencing unit digital proficiency are unit SOPs and the difficulty of performing digital tasks. Unit SOPs are variables under the control of the unit being trained. Task difficulty is a variable that is largely under the control of digital system developers. These variables and their training implications are described in greater detail, below.

Unit Standing Operating Procedures (SOPs) as a Proficiency Enabler

Tactical units rely on SOPs to detail warfighting practices and conventions that all elements should follow. For digital operations, unit SOPs play a critical role in specifying the procedures for employing and exploiting the FBCB2 and other digital systems. The SOPs should procedurally link specific digital capabilities with basic tactical procedures. For example, operators and users need to know when/how they are expected to relay digital reports of enemy sightings and how to manage the updating of enemy icons resulting from these reports. In an important sense, the guidance contained in SOPs shapes the sender and receiver expectations for digital communications—cornerstone aspects of digital proficiency. The SOPs can also convey why it is important to use the digital capabilities. Further, procedural standards point to key targets for digital proficiency measurement (i.e., are units following their SOPs?). Ultimately unit-generated digital SOPs can become incorporated in tactics, techniques, and procedures used across the Army.

Digital warfighters have consistently reported that digital SOPs are very important for successful digital operations (e.g., Dudley et al., 2001). In the Army's groundbreaking digitization environment, a heavy burden fell on the shoulders of unit leaders to document how digital capabilities can be used and exploited, then incorporate the discoveries and lessons learned in the unit SOPs. The discovery and documentation process is progressive. For example, once units start reporting and posting enemy sightings via digital SPOT reports, the specifics of managing Red (i.e., threat) icons come into play. What changes in the Red situation should trigger updating of Red icons? How are updated Red icons to be detected and interpreted throughout the unit? What happens if the initial reporter of the enemy has to move? The progressive process means that SOPs must be updated frequently to support higher levels of digital proficiency.

Task Difficulty Impacts on Proficiency

The team interviewed soldiers upon their completion of Key Leader's Training at the III Corps Battle Command Training Center (BCTC). With the training fresh in their minds, soldiers could readily identify FBCB2 tasks that were in the "too hard to do" category. None of the soldiers and leaders interviewed felt that any of the FBCB2 applications were mentally too difficult to execute. They defined a task as "too hard" if it took too many keystrokes to accomplish. If the desired outcome took too long to achieve, the users did not pursue it. Some of the more common high-difficulty tasks are:

- Creating and retrieving overlays
- Using the navigation function
- Creating preformatted messages
- Executing a Net Join to rejoin a network

These skills may be perceived as too hard to do during operations as most require more than three keystrokes to get to the desired end result. If users are under the pressures associated with combat, they probably will not attempt functions that are too time consuming or not executed on a regular basis. In the chaos of combat, soldiers desire immediate response to information needs. They also revert back to the analog procedures to which they are more accustomed. As documented in previous ARI reports (Elliot,

Sanders, and Quinkert, 1996; Sanders, 1999), digital skills decay if not used regularly. Therefore, any task that is too cumbersome to execute will likely result in degraded skill proficiency.

Overlay creation is a time consuming process. One cause of frustration results from placing all Army standardized map symbols in a drop-down menu for selection. The user has to scroll through the list to find the correct symbol for the overlay. It is a tedious process to select the location on the map where the symbol goes, then orient the symbol in the proper direction, and change the color if so desired.

Units continue to struggle with finding the most recently received overlay, order, or message. When messages are shown in the flash-immediate-priority-routine (FIPR) queue, the message type is generic. For example, the engineer obstacle overlay is titled "obstacle." It does not tell the user the operations order to which the overlay pertains, or what rendition of previously sent overlays it is File naming conventions are taught in the FBCB2 Key Leader's Course, where the user learns how to name the message as he/she saves it (usually with a date/time group) and then file it in a message folder he/she must create.

The FBCB2 Navigation Tool has numerous steps for users who desire to build a strip map, use the route analysis function, or just keep the route displayed on the driver's screen. It is extremely helpful when maneuvering at night or in situations where visibility is limited. Instead of employing the tool, users typically apply the "center on" function. This function allows the operator to select a location that will remain at the center of the FBCB2 display regardless of the platform's own location. Drivers simply "center on" a location and drive to it. This method, while not as effective, is faster.

Preformatted messages were the result of User's Jury comments made during FBCB2 development. They are meant to expedite the creation of standard messages (for example, nuclear, biological, chemical (NBC) reports, SPOT reports, medical evacuation [MEDEVAC] requests). Using drop-down menus to enter information was thought to be easier, especially if the vehicle is on the move. However, the creators of messages become frustrated when they cannot edit the text or enter free text.

In a tank platoon of four vehicles, two vehicles (the platoon leader and platoon sergeant) host servers that connect the platoon to the lower tactical internet (TI). When these vehicles are eliminated from the platoon, the remaining vehicles have no server to transmit their data to the lower TI. The surviving vehicles must then perform a Net Join to link with a new communications hub so they receive information and transmit SA data via the lower TI. Net Join is another of those hard-to-do digital tasks.

Training is essential if users are to exploit the high-difficulty skills discussed above. These skills should be trained and reinforced in the classroom, in simulation exercises, and in the field. Their employment can result in faster, more informed decisions and, in the case of Net Join, may be key in preventing fratricide.

Changes in software that make these tasks easier to perform, or training exercise histories where performance of these tasks is forced can increase the probability that these tasks will be performed. Otherwise one is likely to find that these high-difficulty tasks are not being performed and special attention should be given to exercises that force use of these tasks or illustrate what is lost by not performing the tasks.

SUMMARY

Training units to employ digital C3 systems like FBCB2 presents a substantial challenge. This paper describes an effort to help trainers manage their workload by: focusing on high payoff applications of the platform-based FBCB2 system and providing guidance for trainers to use in evaluating unit performance with respect to these applications. In addition, the resulting product also provides leaders assistance in their roles as FBCB2 users and supervisors/mentors of system operators.

Cost-effective digital training can be enhanced to the extent that trainers consider the digital proficiency levels of units prior to the start of a period of training. Asking questions of units regarding the capabilities of FBCB2 they employ and the status of digital SOPs within the unit can quickly and easily help assess digital proficiency levels in a case where the proficiency levels have implications for practice and feedback.

REFERENCES

Brown, B. R., Anderson, L., Begley II, I.J., % Meliza, L.L. (1999). *Cognitive Requirements for Information Operations Training (CRIOT*). (ARI Study Report 99-02). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Department of the Army (2001). Division Capstone Exercise Phase I (DCX I) Initial Insights Memorandum (IIM).

Dudley, M. G., Hill, R., Johnston, J. C., Jones, W. S., LeGare, M., Leibrecht, B. C., Longoria, K., & Meliza, L. L. (2002). *Measuring digital proficiency: Assessment approaches and echelon considerations* (ARI Research Report 1791). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Dudley, M. G., Johnston, J. C., Jones, W. S., Strauss, C. P., & Meliza, L. L. (2001). *Making the transition from analog to digital warfighting: Changes in unit behavior and knowledge* (ARI Research Report 1785). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences

Electronic Proving Ground (2002). Data Collection, Analysis and Review System (DCARS) Online:www.epg.army.mil/ Instrumentation /DCARS.htm

Elliott, G., Sanders W, and Quinkert, K. A. (1996). *Training in a digitized battalion task force: lessons learned and implications for future training.* (ARI Research Report 1695). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Faulkner, L. (2002) "User-centered design and testing for a digital feedback system -Presented at the 2002 Interservice/Industry Training Systems and Education Conference.

Gerlock, D. & Meliza, L. (1999). "Supporting exercise control and feedback in the digital domain for virtual simulations"- Presented at the 1999 Interservice/Industry Training Systems and Education Conference

Riggs, J. M. (2002) "The Objective Force in 2015 White Paper-Final Draft." Director, Objective Force Task Force.

Sanders, W.R. (1999). Digital procedural skills retention for selected M1A2 Tank Intervehicular Information System (IVIS) Tasks. ARI Technical Report 1096. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences

Warrior-T (2002). Force XXI battle command brigade and below (FBCB2) operator, integrator, and decision maker shared individual tasks supporting ST20-101-5-ABCS. (3 Jul 2002 draft). Fort Hood, TX; Warrior-T Project Office.