DEFINING DIGITAL PROFICIENCY MEASUREMENT TARGETS FOR U.S. ARMY UNITS

John S. Barnett and Larry L. Meliza
U.S. Army Research Institute for the Behavioral and Social Sciences
Orlando, Florida

ABSTRACT

The U.S. Army is exploiting the advantages of networked computer systems to enhance battlefield situation awareness and command and control, a program known as *digitization*. Digital systems, as well as the procedures for using these systems, are evolving and will continue to do so for many years. The goal of the current effort is to support the evolution of digitization with measures of digital proficiency that retain their value across specific hardware and software products. The research identified high-profile problems in the performance of non-digital units likely to be addressed by the effective application of digital systems to help soldiers visualize the battlefield and increase the operating tempo (OPTEMPO) of units. Data from the U.S. Army Center for Army Lessons Learned (CALL) was analyzed to identify the more frequently occurring problems in the performance of non-digital units at the Army's National Training Center and Joint Readiness Training Center. These data were used to identify the mechanisms where digital systems might address each problem and found that over 92% of the approximately 200 high-profile problems could be addressed by one or more of over forty mechanisms (e.g., increased situation awareness makes it possible to use events rather than time to trigger many activities). Twenty-two skills U.S. Army personnel would need to implement these mechanisms (e.g., maintain awareness of expected versus actual locations of friendly units) were identified. This approach defined four linked targets for digital proficiency measurement: the impacts on high-profile problems in unit performance, increases in battlefield visualization/OPTEMPO, employment of digital mechanisms for addressing problems, and proficiency in skills enabling digital mechanisms.

ABOUT THE AUTHORS

Dr John Barnett is a research psychologist with the U.S. Army Research Institute where he conducts research in training and evaluation. He holds a Ph.D. in Applied Experimental and Human Factors Psychology from the University of Central Florida. He is a former U.S. Air Force officer with a background in aviation, operations planning, and command and control.

Dr. Larry Meliza is also a research psychologist with the U.S. Army Research Institute. He has many years of experience developing after action review systems supporting feedback sessions for collective training exercises in the networked simulator environment and describing the impacts of force modernization on exercise control and feedback for collective training exercises in the live field environment.

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The Army is investigating how best to employ digital technology to support the combat soldier, through a process referred to as *digitization* (Department of Defense [DoD], 2000). Selected units are being equipped with networked computer systems designed to quickly distribute combat-related information and help leaders and soldiers visualize the battlefield. These selected units are being transformed into *digital units*.

Fielding digital hardware and software is merely one step in the digitization process. Digitization also includes finding out how to best employ digital systems and deciding what changes need to be made in doctrine, organization, training, leadership, materiel, and soldiers (DOTLMS) to support the use of these systems. Units are still in the process of developing the tactics, techniques and procedures (TTPs) and standard operating procedures (SOPs) that guide employment of digital systems. Further, the U.S. Army is continually refining digital systems in response to user testing.

Our mission is to develop measures of the digital proficiency of units and individuals. The immediate challenges to this mission are that digital skills remain to be defined and the procedures for using these systems are still evolving. On the other hand, it is difficult to envision how digital skills can be defined and digital systems and procedures refined without measures of how well digital systems are being employed. In the absence of measures of proficiency in employing digital systems, what guides the refinement of digital TTPs? The solution to this problem is to focus on measurement targets that can be tied to combat effectiveness and that will remain constant as digital systems and procedures evolve. This paper describes how we addressed this targeting problem and the results.

DIGITAL SYSTEMS AND IMPACTS ON UNIT TRAINERS

Digital Systems

The U.S. Army has a number of automated data processing systems which support military operations. To a large extent, each system was designed to perform functions for a particular staff section, known as a Battlefield Operating System (BOS). A BOS is a set of related critical tactical activities which are grouped together for closer coordination (Department of the Army, 1997). (Table 1 shows how BOSs are related to specific digital systems.)

Table 1. *Digital systems supporting Battlefield Operating Systems*

BOS	Digital System
Intelligence	All-Source Analysis System (ASAS)
Maneuver	Maneuver Control System (MCS)
Fire Support (Artillery)	Advanced Field Artillery Tactical Data System (AFATDS)
Air Defense	Air and Missile Defense Warning System (AMDWS)
Mobility/Counter-mobility/ Survivability	None
Combat Service Support	Combat Service Support Control System (CSSCS)
Command and Control	No specific system

In addition to the systems shown in Table 1, the Force XXI Battle Command Brigade and Below (FBCB2) system supports the dissemination of information to and from individual platforms, such as tanks or infantry fighting vehicles.

Although each of these digital systems was developed independently, they are capable of sharing data over a network (TRW, 2000). Because interoperability exists among these systems, they are considered to be subsets of an overall digital system (i.e., a system of systems). To make sure that these systems work together, and to correct problems identified in user testing, each individual system has progressed through a number of versions. This process is expected to continue for several years.

Impact of Digital Systems on Trainers

Trainers are tasked with observing unit performance and using those observations to help guide After Action Reviews (AAR). AARs are interactive discussions in which a unit decides what happened, why it happened, and how to sustain or improve future performance.

Digitization has the unintended consequence of making life very difficult for trainers in collective training exercises by complicating their role as trainers and substantially increasing their workload (Army Training Modernization Directorate, 2000; Brown, Anderson, Begley, and Meliza, 1999; Gerlock and Meliza, 1999; Meliza, 1999). For trainers monitoring command and staff operations in a tactical operations center (TOC) environment, new observation requirements emerge. In addition to existing observation requirements, trainers in the TOC environment often find it necessary to monitor operator interactions with digital systems, interactions between system operators and users of the system (e.g., interactions between ASAS operators and the Intelligence Officer or S2), and interactions among operators of different digital systems.

Trainers at company level and below are often left out of many portions of a unit's tactical information loop. Instead of merely monitoring multiple voice nets to track communications within and across units, trainers have the additional duty of interacting with multiple computers to track the digital communications within versus across units. These trainers would also have to contend with the fact that they do not know which digital communications are being examined by their unit counterparts.

One means of reducing the workload for trainers of digitized units is to focus measurement efforts on assessing whether units and individuals are exploiting the capabilities of digitization and reaping the intended benefits. This approach is also consistent with our goal of developing measures of digital proficiency that will not lose value as digital hardware and software evolve.

EXPECTED BENEFITS OF DIGITAL SYSTEMS

Theoretically, digitization offers a number of advantages to combat units, including increased lethality and survivability (U.S. Army Directorate of Integration, 2000). Other advantages include increased responsiveness, deployability, agility, and sustainability (DoD, 2000). Digitized units are expected to be more lethal because they can identify targets and direct weapons onto those targets more quickly than *analog* (non-digital) units. They are more survivable because improved communications allows them to react to the enemy attacks more quickly to protect combat assets from destruction.

The use of digital systems is expected to increase the combat effectiveness of units through two general mechanisms First, it will help leaders and soldiers visualize the battlefield and gain a greater understanding of the tactical situation. Second, digital systems can increase the operating tempo (OPTEMPO) of a unit through the improved ability to share information.

Improved Battlefield Visualization

Battlefield visualization includes three steps; developing a mental model of the current state (tactical situation), envisioning a desired end state, and visualizing the sequence of activity to move from the current state to a desired end state. The improved capability of digitized units to visualize the battlefield gained through increased situation awareness (SA) combined with the use of wargaming tools included within the digital systems.

Increased SA begins with the capability of digital systems to provide global positioning system (GPS) position location data for friendly platforms. SA is increased further by enhanced reconnaissance, surveillance and target acquisition (RSTA) systems, such as unmanned aerial vehicles (UAVs) that provide data on the enemy situation. Finally, improvements in SA are due, in part, because information is presented in an improved form. Data on the location of threat situations (enemy forces, enemy minefields, contaminated areas, friendly minefields) can be provided in the form of overlays so that units can immediately see how these threats relate to friendly positions and control measures. Compare this to a situation where locations are provided in the form of map coordinates that must be transposed by each recipient.

The ready availability of processed information at all echelons seems to significantly increase situation awareness among commanders and soldiers. In an experiment by McGuinness, Foy, and Forsey (2000), military commanders were asked to command simulated forces using a digital interface similar to those used by U.S. Army digital units. The commanders were provided with information of enemy forces (red, or enemy SA), as well as status and position information of friendly forces (blue, or friendly SA).

They found commanders who used digital systems were able to provide much more detailed information on enemy forces than those who relied on conventional tools. These commanders also reported they felt they had a better appreciation of the status and location of friendly forces. They reported this enhanced awareness of the status and position of friendly forces to be the most useful benefit of digital systems.

The capability to visualize the battlefield is increased further when wargaming tools are used to take advantage of increased SA. These tools can be applied to gain greater understanding of the significance of SA data. For example, terrain analysis and range fan tools can be used to assess the impact of differing routes of advance on when and where friendly units are likely to be engaged by specific enemy weapon systems.

Increased OPTEMPO

Digitization allows combat units to increase their OPTEMPO, or the speed at which they can conduct combat operations. Units are able to collect information, make decisions, and implement those decisions more quickly than the enemy. This process of collecting, deciding, and implementing is known as a decision loop. Digitization allows units to get "inside the enemy's decision loop." That is, make decisions faster than the enemy (DoD, 2000).

Substantial evidence that digitization can increase OPTEMPO has been available for ten years. An early experiment with a pre-FBCB2 system called the Intervehicular Information System (IVIS) showed armor platoons equipped with IVIS completed missions faster and reported battlefield events with more accuracy. They also successfully executed more change of mission, obstacle bypass, battle position, and call-for-fire tasks (Du Bois & Smith, 1991). Similar experiments with company-level armor units using a system called the Combat Vehicle Command and Control System (CVCC) showed comparable advantages (Atwood, et al., 1991).

Increased awareness and understanding of the tactical situation provide digitized units with a time advantage in terms of mission planning and preparation activities. Digital systems help leaders gain information in a manner that better fits human sensory modalities and adds to the time advantage throughout a mission.

From the point of view of sensory modalities, most tasks performed by commanders and staff officers are primarily visual/spatial. Many tasks, such as route planning, terrain analysis, plotting artillery fans, etc., involve identifying spatial relationships between units and tend to use maps as planning tools. The most frequently used tools are templates and overlays, in which relevant data is overlaid onto a map of the objective geographical area. These tools are often supplemented by tactical reports which require the sender to identify the location of the event being reported. In the analog environment, information on locations must be translated into coordinates of some kind before it is sent. Often the sending unit would encode information about the location of an event (spatial) into coordinates (numerical/semantic) which are then transmitted to the receiving unit. The receiver must then recode the numerical information back into spatial data; typically by plotting the data on a map. The encoding and decoding of the information normally requires greater cognitive effort. This additional effort often slows down the transfer of information and increases the probability of errors (Sanders & McCormick, 1993).

Using digital systems and displays allows staff elements to manipulate spatial data on a visual display and send it without translating into coordinates. In addition, the data can be transmitted to a widely dispersed audience more quickly than was possible using paper maps and acetate overlays. The audience receives the data in visual form without having to convert from numerical data. Therefore, the recipients of the information not only receive it more quickly, but in a form they can readily use without complex data conversion. Initial observations suggest using digital tools may reduce planning time by as much as 84% (U.S. Army Directorate of Integration, 2000).

This time advantage is further enhanced by the capability of these systems to expedite many command and control activities. The additional time gained can be used to spend more time performing activities that often receive scant attention due to time pressures, or it can be used to start mission execution earlier.

Digital systems make it possible for evolving mission planning products to be shared in an electronic format among command and staff and subordinate units to make sure mission activities are synchronized. The electronic format also makes it possible to revise and redistribute planning products quickly. This means that the plans supporting mission execution can be updated and distributed in response to new information even after a unit has already initiated the mission.

WHAT IS IMPORTANT TO MEASURE?

While it may be possible to measure the expected benefits of digitization (lethality, survivability, responsiveness, deployability, agility, and sustainability), the results may be hard to interpret. That is, these benefits focus on outcomes and outcomes are influenced by variables in addition to unit proficiency employing digital systems. Further, the diagnostic value of these measurements would be limited. What is it that my unit has to do to become more agile? Which of the steps needed to ensure unit agility is my unit not already taking?

Impact of Digitization on High Profile Problems in Unit Performance

One way to begin measuring the impacts of digital systems on unit performance is to focus on high-profile problems in unit performance for which digitization might provide a high payoff. Trends analysis data provided by the U.S. Army Center for Army Lessons Learned (CALL) is an important source of information regarding such problems.

CALL has analyzed data provided by trainers at the U.S. Army's maneuver combat training centers to identify *needs emphasis* trends in the performance of units training at these centers. While the needs emphasis trends per se are described in broad terms, CALL's reports include descriptions of the specific problems that contribute to the trends. These problem descriptions tend to be highly diagnostic in nature.

Mechanisms Enabling Digitization to Address Problems in Unit Performance

Naturally, it is important to measure the extent to which unit employment of digital systems results in improved visualization of the battlefield and increased OPTEMPO. We want to measure how well units employ various mechanisms for gaining the visualization and OPTEMPO benefits. This allows us to make sure that we can relate measures of how units are employing digital systems with measures of high profile performance problems. That is, we need an audit trail linking performance problems to digital mechanisms for addressing these problems.

Digital Skill Proficiency

It is also important to measure digital skill proficiency. Ideally, we want to be able to focus on those digital skills with the greatest training value. Digital skills have a high training value to the extent they apply across versions of a system, different systems, and the span of a leader's career. Digital skills also to have a high training value to the extent they can be linked, fairly directly, to high profile problems in unit performance and mechanisms for improving battlefield visualization and increasing OPTEMPO.

IDENTIFYING HIGH-PROFILE PROBLEMS IN UNIT PERFORMANCE

The research effort began by examining the compendia of trends from the National Training Center (NTC) for the 3rd quarter of 1996 to the 2nd quarter of 1998 and the Joint Readiness Training Center (JRTC) for the 4th quarter 1996 to the 3rd quarter of 1997 (CALL, 2000). These reports were the most recent available. The trends are grouped by BOS.

CALL's trend analysis data was examined to identify the most frequently cited performance trends. Although high frequency trends may not be the critical factor in all situations, trainers will encounter these trends most often, and addressing these trends may have the most significant effect on unit performance. For this reason they were the focus of the measurement effort.

Needs emphasis trends for each BOS were graphed with trends being placed on the abscissa and frequency of occurrence on the ordinate scale (Figure 1 shows an example of these graphs). Predictably, the graphs indicated that although most negative trends occurred at a relatively low rate, each BOS had several trends tended which tended to recur during every NTC or JRTC rotation. A visual examination of the graphs indicated a definite inflection point for most BOS's where the slope goes from fairly steep to relatively shallow. This inflection point was chosen as the dividing line between high- and low-frequency trends. Those trends above the inflection point (more frequent) were chosen for further analysis. For most BOS's, this meant the top three trends, although for the command and control BOS the top five trends were selected, and for maneuver BOS the top four trends. The Air Defense BOS had only one high-frequency trend.

Next, we recorded the problems contributing to each trend. CALL needs emphasis trends include descriptions of specific problems that occurred within each trend. For example, under the needs improvement trend "fighting and observation positions/observation planning" a contributing problem is "smoke plans are rarely made and coordination of the targeting process between fire support and maneuver does not occur." Using this process, we identified over 200 problems in unit performance. We then identified those problems likely to be addressed by improved battlefield visualization or increases OPTEMPO.

The next step was to decide if the increased OPTEMPO or improved battlefield visualizations made possible by digitization were likely to help address each problem by analyzing how digital units would perform the same tasks, we decided that over 92% of the recorded problems could be addressed by the employment of digital systems.

To help visualize the combat effectiveness problems to be addressed by digitization required two additional steps. First, the problems were organized into digitally relevant categories. This categorization showed that all but two of the problems could be categorized into one or more problem categories (Table 2).

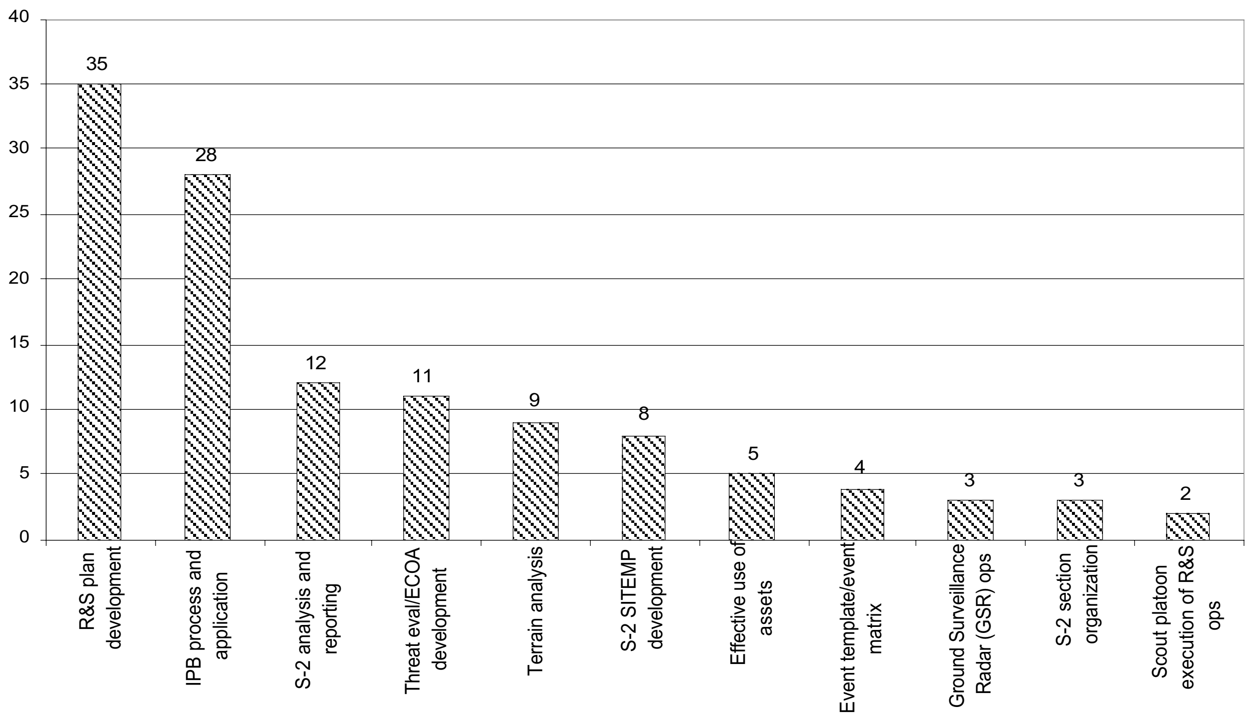

Figure 1. Frequencies of needs emphasis trends for intelligence BOS.

Table 2.
High-Profile Problems in Unit Performance and Digitization Potential

General Problem	Frequency	Digitization Potential
Lack of awareness of some aspect of the tactical (friendly or threat) situation	46	Battle Visualization (increased SA)
Lack of synchronization (within or across BOS's) in terms of time, space, or activities	48	Battlefield Visualization (increased SA, wargaming tools) and Increased OPTEMPO (sharing of evolving plan)
Lack of awareness of some aspect of the plan or lack input to the plan by a BOS or subunit	22	Increased OPTEMPO (Sharing of evolving plan)
Details missing from plan	31	Increased OPTEMPO (sharing of evolving plan)
Lack of understanding of the tactical situation	25	Battlefield Visualization (increased SA, wargaming tools)
Key elements of the plan produced late	13	Battlefield Visualization (increased SA) and Increased OPTEMO (sharing of evolving plan)
Inadequate mission preparation	13	Battlefield Visualization (increased SA) and Increased OPTEMPO(sharing of evolving plan)
Unit is highly vulnerable or lacks lethality	36	Battlefield Visualization (increased SA, wargaming tools)

DEFINING SPECIFIC MECHANISMS WHEREBY DIGITIZATION MAY ADDRESS HIGH-PROFILE PROBLEMS

Increased battlefield visualization and OPTEMPO are merely the starting points for describing how digitization can address high-profile problems in unit performance. For example, increased SA might be expected to make it easier for a unit to develop a precise maneuver plan with few contingencies. In turn, a precise maneuver plan makes it easier for representatives of the engineer BOS to decide how engineers can best support the maneuver plan.

Approximately 200 high-profile performance problems were analyzed to describe the mechanisms whereby digitization would be expected to influence performance. For example, digitization would be expected to address the problem "smoke plans are rarely made and coordination of the targeting process between fire support and maneuver does not occur" by multiple mechanisms. Increased awareness of the location of enemy forces, combined with the use of terrain analysis tools, makes it possible to predict where and when moving friendly forces are likely to be seen by the enemy. This allows the fire support element to plan to support the maneuver unit with smoke at a time and location when and where the maneuver unit is likely to benefit most. Since digital systems allow the unit to see where friendly forces are located, the unit can use the more precise trigger of unit location rather than the less precise trigger of time to initiate the smoke mission. In this way, if the pace of movement of the maneuver unit is faster or slower than expected, the unit can avoid a situation where smoke is provided too late or too soon to be of use to the unit. The fire support element has a general timeframe to support mission preparation activities, and a specific event trigger to initiate execution.

This process uncovered over forty mechanisms; most of which offered solutions to many different problems in unit performance. For example, the ability to use event-based rather than time-based triggers to initiate task execution has the potential to address a wide variety of problems where there is a lack of synchronization of activities among BOSs or among echelons within a BOS.

Representative mechanisms whereby improved battlefield visualization can address high profile problems in unit performance are as follows:

- Improved SA makes it possible to develop plans that are more precise
- More precise plans make it easier to identify gaps in the intelligence data needed to refine the plan
- Improved SA reduces data collection requirements, but makes these requirements more precise

Representative mechanisms whereby increased OPTEMPO can address high profile problems in unit performance are as follows:

- Parties responsible for executing orders have time and means to provide feedback regarding clarity and completeness of orders
- Increased OPTEMPO provides more time for mission preparation activities, such as rehearsals
- Increased OPTEMPO provides more time to consider alternate courses of enemy and friendly actions

IDENTIFYING CANDIDATE DIGITAL SKILLS

To exploit the advantages of digital systems, soldiers must develop the skills to use them proficiently. Our research seeks to identify those skills and develop means to measure them. Unfortunately, recent research into computer skills has been relatively limited. Little research has focused on identifying digital skills or on developing reliable, diagnostic measures of computer skills.

Previous Research

Potosky and Bobko (1998) discuss recent efforts to measure computer experience and ability. Studies which sought to measure computer experience used measures of frequency of use or length of time of computer ownership. Other studies used available tests of computer programming ability to assess computer usage ability. In their own research, Potosky and Bobko developed the Computer Usage and Experience (CUE) scale, which is a self-report measure of computer experience. However, they made no effort to equate computer experience to digital skills.

The Georgia Institute of Technology has conducted a series of studies concerning internet usage. The tenth and latest study measured skill levels of internet users (Kehoe, Pitkow, Sutton, Aggarwal and Rogers, 1999). The measure used four levels of skill; novice, intermediate, experienced and expert.

To discriminate between these levels, Kehoe, et al. (1999) created a list of twelve tasks related to internet usage. Tasks included items such as "created a web page" and "made a telephone call on line." They then asked respondents to list how many of the twelve tasks they had performed.

Respondents were classified based on the number of these tasks they had performed; novice, 0-3 tasks; intermediate, 4-6 tasks; experienced, 7-9 tasks, and expert, 10-12 tasks. No effort was made to distinguish qualitative differences between the twelve tasks; all tasks were weighted equally.

In a study of U.S. Army soldiers, Dyer and Martin (1999) investigated the computer background of infantrymen. They used a survey to examine the experience soldiers had with computers and their subjective perceptions of their own computer skill. In addition, they used an objective assessment of computer operator skill, which measured soldier's ability to recognize computer icons. They found officers in the Infantry Officer Basic Course (IOBC) had the most computer expertise, whereas in the other groups tested about half of the soldiers had limited computer operator skills.

As this review shows, the body of research concerning digital skills is presently relatively modest. Therefore, with minimal foundation for our investigation, we found it necessary to conduct some preliminary work to define our terms and establish boundaries for the problem.

A Working Definition of a Digital Skill

Our definition of a digital skill was an acquired, generalizable ability, normally gained through training and practice, to exploit the advantages offered by digital systems to accomplish the unit's mission more effectively. Using this definition, any ability a soldier or commander exhibited which used digital resources to accomplish a task which could not be done as well without such digital resources would be a digital skill.

The phrase *normally acquired through training and practice* is included to eliminate those actions which are so readily acquired they do not warrant attention, such as pushing a button or using a computer mouse. The intent of this research is to focus on skills which require some effort to acquire, since these would most likely be the limiting factors in training. *Generalizable* was included to indicate we were seeking skills which were not hardware or software specific, but generalizable across software versions. To the extent possible, we would also like to focus on skills that apply across systems and across the span of a leader's career.

User-Oriented Focus

Previous research into computer skills suggests that often the skills studied involved operating the computer hardware rather than using the product (cf. Kehoe, et al., 1999). Since we are more interested in how well units are able to apply the products of digital systems, we felt it necessary to distinguish between these two levels of skills. From our perspective, being able to use information produced or obtained through the operation of digital systems is generally a more important training objective.

Two sources of information helped us identify candidate digital skills. The first source was documentation regarding how digital systems were to be used and operated (Department of the Army, 2000; TRW, 2000; Warrior-T, 2000). The second source was information from a related effort to describe the evolution of digitization and digital skills within the U.S. Army's first digitized division, the 4th Infantry Division (4^{th} ID). In both cases, we were looking for digital activities that appeared to cut across specific digital systems or software versions.

Digital Skills and Skill Categories

Some of the skills identified were procedural skills for discrete tasks, but the majority tended to be decision skills. In general, retention of decision skills is good, while retention of procedural skills is not as great (Wisher, Sabol and Ellis, 1999). We identified twenty-two digital skills, divided into four categories (Table 3).

Network Skills. The central component of digitization was the network. We theorized that important digital skills would involve keeping the network operating. Based upon interviews conducted within the 4^{th} ID, we decided that multiple networking skills were warranted, because keeping the network operational had proven to be a substantial challenge.

Initially we viewed the network skills as being procedural skills with perhaps a small decision-making component; however, personnel interviewed within the 4^{th} ID stressed the importance of leaders and soldiers understanding the data flow within and among digital systems when attempting to define and address network problems.

In many training situations, other digital skills cannot be practiced unless the net is operational, and substantial effort is required to keep it operational. It is important that digitized units have confidence in the robustness of the network. End-product oriented measures of networking skills can serve the additional purpose of illustrating the robustness of digitization (e.g., you were able to react to a system crash without regressing to a pure analog mode).

Basic Operator Skills. These skills are those required to operate digital hardware/software systems and create products. These skills include such activities as deciding when to update reports and products and deciding whether any of the intended message recipients need to be alerted regarding the message or product using voice communications.

The basic operator skills are largely procedural skills. Recent work has shown that procedural skills involved in preparing and sending graphics and messages using digital systems tend to be highly perishable (Sanders, 1999). The operator skills defined in the current work also include decision making skill components, such as deciding who needs to be contacted, how they should be contacted, and when graphics or messages are updated.

Table 3. *Candidate Digital Skills*.

Network Skills
Prepare for, and recover from, system crashes or other periods of non-availability
Establish and check communications links and network connections
Protect network from operator error and malfunctions
Perform periodic checks of digital systems
Basic Operator Skills
Prepare and update plans, reports, and other messages
Exchange data with external databases
Create, modify, and employ overlays, templates, and graphics
Basic User Skills
Assess completeness of information on the tactical situation
Assess currency of information on the tactical situation
Assess completeness and clarity of planning products
Coordinate with others to acquire information
Identify situations where a physical terrain reconnaissance is required
Monitor changes in planning products
Exploitation Skills
Maintain awareness of own unit relative to threats
Compare expected and actual status of friendly units
Maintain awareness of trigger events and events addressed by execution matrices
Use SA data to move to a vehicle or control measure location
Use SA data and terrain analysis tools to select routes and positions
Use SA data to control unit movement and deconflict routes
Use SA data and terrain analysis tools to predict contact variables and support BOS integration
Monitor timing of planning activities
Define rehearsal objectives

Basic User Skills. User skills are those which relate to applying the products of digital systems. These skills go beyond the ability to simply create digital products and address the abilities to employ digital products to enhance mission performance. Activities identified as basic user skills address tactical decision making activities performed in both analog and digital environments. The difference is that these skills are employed using digital systems in the digital environment.

For example, developers of plans and recipients of plans should make sure that plans are complete in terms of details. In the digital environment, senders and receivers examine planning products that are in an electronic format.

All of the basic user skills listed in Table 3 address high-profile problems in unit performance. These skills are decision-making skills rather than procedural skills.

Exploitation Skills. Exploitation skills are those abilities which give digital units a significant tactical advantage over non-digital units. Like user skills, these skills address high-profile problems in unit performance. Unlike the case with basic user skills, the exploitation skills are enabled by digitization. That is, digital systems should make it easier to employ these skills to standard.

These skills demonstrate the advantages of digitization. Measures of how well unit members employ these skills can do double duty by being used to illustrate the power of digitization to units.

ADDRESSING MEASUREMENT OBJECTIVES

Multiple sets of draft measures of performance are being developed within this program. The first set is concerned with measuring whether high profile problems in performance are being addressed. The second is concerned with measuring whether the mechanisms for improving battlefield visualization and increasing OPTEMPO are being employed. The third set is concerned with measuring digital skill proficiency. At present, only the draft measures relevant to high profile problems in unit performance have been completed.

The next step in addressing measurement objectives is to define the data sources needed to apply each measure. The major data sources include: ground truth data (where are enemy and friendly units and threat situations actually located and what is their status); the contents of the final mission plan; the points in time when initial and interim plans are shared with the rest of the unit; observation of mission rehearsals, digital contact reports; requests for information (analog or digital), and start times for rehearsals and mission preparation activities.

SUMMARY AND NEAR TERM GOALS

The work described in this paper has defined four digital proficiency measurement targets.

- Assess impacts of digitization on high-profile problems in unit performance (and on each of the eight categories of performance problems)
- Assess impacts of digitization on ability of units to visualize the battlefield and increase their OPTEMPO
- Assess whether mechanisms enabling increased battlefield visualization and OPTEMPO to enhance unit performance are in evidence.
- Assess the degree to which the twenty-two candidate operator and user digital skills we identified are in evidence.

Our ongoing efforts are directed at drafting and refining measures of performance supporting each of these targets and identifying the types of data needed to apply each measure.

As the U.S. Army gains more experience using digital systems, TTPs and SOPs will be developed for using these systems. At that point, new measurements will need to be developed to assess compliance with TTPs and SOPs. A sister effort is monitoring TTP and SOP development within the 4th ID in an effort to identify trends. For example, do units attempt to standardize operations to make it easier to assess the currency of information?

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