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for the Behavioral and Social Sciences**

**Research Report 1903**

**Decision Making with Digital Systems**

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**July 2009**

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**U.S. Army Research Institute  
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# DECISION MAKING WITH DIGITAL SYSTEMS

## EXECUTIVE SUMMARY

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### Research Requirement:

The Army Battle Command System (ABCS) is a digital command and control system which enables leaders and commanders to share information, communicate orders, and track friendly and enemy locations on the battlefield. One of the intended benefits of the ABCS is to provide leaders and commanders with complete and accurate information so that they can be more effective decision makers. It is possible however that the high volume of information may have the opposite effect by overwhelming leaders with information or by obscuring critical information while highlighting irrelevant information.

An additional complicating factor is that units do not have frequent opportunities to train with ABCS systems. One of the few places that units do train using the ABCS is at the Joint Readiness Training Center (JRTC). There, units conduct brigade sized dressed rehearsals for combat operations. These training exercises offer a unique opportunity to see how units will employ their ABCS systems when deployed. In the present research effort, we sought to determine how well leaders and commanders using ABCS systems at JRTC employed those systems and whether they increased or decreased decision errors.

### Procedure:

Data were collected from the observer controllers (O/Cs) at JRTC through surveys and interviews. The O/Cs at JRTC are in a unique position to comment not only on the proficiency with which units employ their ABCS systems but also on the decision making proficiency of unit leaders and commanders.

Surveys were developed which focused on key capabilities of four major ABCS systems: the Army Field Artillery Tactical Data System (AFATDS), Maneuver Control System (MCS), Force XXI Battle Command Brigade and Below (FBCB2), and All Source Analysis System (ASAS). The O/Cs were asked to indicate how well units were trained on the system's capabilities as well as ways in which use of these capabilities aided in achieving mission objectives and conversely how failure to use these capabilities hindered achieving mission objectives. After completing the surveys, the O/Cs were interviewed. During the interviews, they were asked to discuss their survey responses as well as decision-making errors they observed and how digital systems had either increased or prevented those errors.

## Findings:

- With few exceptions, most units coming to train at JRTC are not fully trained to use their digital systems. Despite this, units are still able to leverage at least some system capabilities to support mission success.
- Expertise on all systems and system functions is not uniform. Overall, units seem to be most skilled at using FBCB2 and least skilled at using ASAS. Within systems, there were big differences in proficiency across system capabilities.
- The most common decision errors, regardless of the use of digital systems, were: making a decision with a critical piece of information missing but not recognizing that it is missing; making a decision based on a personal, salient, emotional or recent event, ignoring evidence that trends have changed; and making a decision based on information that has been discredited.
- The most dangerous decision errors were: making a decision based on a personal, salient, emotional or recent event, ignoring evidence that trends have changed; making a decision based on input from a small sample of individuals when input from a larger group is available; and making a decision with a critical piece of information missing but not recognizing that it is missing.
- Digital systems do not appear to increase decision errors significantly. Digital systems were rarely implicated in decision errors described by the O/Cs, and were more often described as protecting against errors than increasing them. Digital systems do not appear to greatly inhibit decision errors as might have been hoped, but it would be expected that with better training, those protective effects might become more apparent.
- O/Cs saw some ways in which digital systems could be improved. Specifically, systems should more effectively share information among themselves and military standards should be developed and added to systems to represent enemy weapons, activities, and units for COIN operations.

## Utilization and Dissemination of Findings:

The findings of this research should be of use to unit commanders preparing for deployment in that it highlights common deficiencies seen among units that are in their final stages of preparation before deployment. If unit commanders do not have time to do a complete assessment of their unit's digital proficiency, they may want to focus training and/or assessment on these frequently deficient areas. These findings should also be of interest to digital training developers because it identifies areas of digital training for which better training is needed. Finally, these findings should be of use to the leadership of JRTC as it can provide them with a context in which to provide feedback to the leadership of units training there.

# DECISION MAKING WITH DIGITAL SYSTEMS

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# Decision Making with Digital Systems

## Introduction

The Army's Force XXI modernization plan formalized a movement towards information age warfare in which the ability to gather, process, and disseminate information would give American forces an advantage on the battlefield. At the heart of this capability is a group of computerized information networks collectively known as the Army Battle Command System (ABCS). The ABCS systems provide commanders with an unprecedented amount of information about friendly and enemy forces within and beyond their areas of operations in near real time. In theory, this high flow of data to commanders should reduce the fog of war, giving them accurate, up-to-date situation awareness so that they can react faster and with greater precision to developments on the battlefield (Hall, 2000).

The ABCS systems were originally developed to serve individual warfighting functions such as fire support, maneuver, air defense, and Military Intelligence. Examples of the ABCS systems developed to support these functions are the Army Field Artillery Tactical Data System (AFATDS), the Force XXI Battle Command Brigade and Below (FBCB2), the Maneuver Control System (MCS), and the All Source Analysis System (ASAS) among others. Over time, military leaders have pushed to have these systems integrated so that information can be shared across them. In this way for example, the locations of enemy units can be fed from ASAS into MCS so that leaders can maneuver friendly forces into position or into AFATDS so that they can be targeted by appropriate fire support systems.

Data can be fed into the ABCS from unmanned aerial sensors (UASs) other sensors, and even from Soldiers on patrol. In addition to operational graphics and the locations of friendly and enemy units, information can be shared in many modalities from video to still photos to text messages. Although this high volume of multimodal data is intended to give leaders and commanders complete and current situational awareness, it is possible that it may paradoxically have the opposite effect by overwhelming leaders with information, or perhaps worse, obscuring critical information while highlighting irrelevant or incorrect information.

The 1988 shoot-down of Iran Air flight 655 by the U.S.S. Vincennes stands as a salient example that advanced information processing systems do not insulate humans from decision-making errors. On 3 July, 1988, the U.S.S. Vincennes equipped with the Aegis combat system was engaged in a surface battle with small Iranian attack boats when the ship's radar detected an aircraft (Iran Air flight 655) coming towards the Vincennes. The aircraft had just taken off from a military/civilian airport and was mistakenly identified as an F-14. The aircraft was not responding to calls from the Vincennes to identify itself. The ship's commander, busy dealing with multiple surface threats, had just seven minutes to decide whether to engage the aircraft. The commander believed his ship was being targeted by an Iranian F-14 and so he ordered the launch of surface to air missiles. Although he was later absolved of any wrongdoing, a review of the incident indicated that the design of the Aegis combat system made it difficult for the commander to process a high volume of information in the short period of time he had to make a decision (U.S. Department of Defense, 1988).

## *Decision making in an Imperfect Environment: Heuristics and Biases*

The commander of the Vincennes was not in a unique situation. Military commanders and leaders often must make decisions with incomplete information in a short period of time (Ross, Klein, Thunholm, Schmitt, & Baxter, 2004). Under ideal conditions, commanders might follow a formal decision-making process that would include an analysis of the situation in which a decision must be made, development of alternate courses of action (COAs), determination of the outcomes of all COAs, and finally the selection of the COA with the greatest utility. This process is formalized in the Army's military decision-making process (MDMP) (Hall, 2000; Headquarters, Department of the Army, 1997). The chief advantage of this process is that it has a high likelihood of generating optimal decisions but it requires a couple of key ingredients: accurate situation awareness and time.

When individuals do not have the luxury of these key ingredients, research has shown that they rely on heuristics or rules-of-thumb to make a decision (Simon, 1990). These informal rules, although generally useful, can also lead to systematic errors in judgment. Early research in this field identified three different heuristics which result in a variety of different types of biases: representativeness heuristic, availability heuristic, and anchoring and adjustment (Tversky & Kahneman, 1974, 1981). These heuristics and associated biases are described below.

**Representativeness Heuristic.** We tend to assume there is commonality among items of similar appearance. For example, if person A learns that person B likes science fiction novels, person A may make a whole host of assumptions about person B, based on what person A knows about people who like to read science fiction novels. Several biases can result from this heuristic. Generally they reflect a tendency to over-generalize even when it is not logical to do so:

- Insensitivity to baseline probabilities of outcomes. For example, in the example above people assign a much higher probability that Person B is a math or science major than would be predicted even given that liking science fiction novels is predictive of being a math or science major.
- Insensitivity to sample size. Small samples often have larger deviations from the mean than larger samples, but we often weight evidence from a small sample the same as from a larger sample.
- Misperceptions of chance. A random process may be seen as non-random when trends are seen in small samples. For example, if a coin is tossed three times and comes up heads each time, people often estimate the odds of another head as higher than 50%.
- Misperceptions about regression towards the mean. Outliers are often given undue attention.

**Availability Heuristic.** We tend to assume that what readily comes to mind is more likely to occur than what does not. Several biases can result from this heuristic (Harvey, 1998):

- **Familiarity:** If someone is familiar with a class of events, it is attached to a higher likelihood of occurrence.

- **Saliency:** events that are more vivid or salient are more easily recalled and thought to occur with greater frequency.
- **Absence of evidence:** The fact that evidence is missing, when logically it should be present is often overlooked because the absence of evidence is less salient than the presence of evidence.
- **Recentness:** recent events are more easily recalled and are thought to be more likely to occur.
- **Illusory correlation:** Events happening about the same time are seen as more likely to be associated.
- **Oversensitivity to consistency:** multiple reports of some event are given greater weight even though they are not independent (e.g., they all derive from the same source).
- **Ease of construction:** scenarios that are easy to imagine are seen as more likely.

**Adjustment and Anchoring.** We tend to use initial values as anchors when making estimates about some value; however, we tend to under adjust from these initial values<sup>1</sup>.

- **Persistence of discredited information:** Even when information is shown to be invalid, people often fail to discount it in decision making
- **Acquiescence:** once a critical mass of information is accumulated, additional evidence is ignored.

### *Information Systems and Biases in Decision making*

Information systems such as the ABCS have been developed to support human information processing, yet we are only beginning to examine the impact that these systems have on decision-making biases. Turpin and du Plooy (2004) reviewed the literature and found evidence that biases from all three heuristics listed previously could be enhanced by information systems. For example, salient graphics and video can increase saliency and familiarity biases.

There is also evidence that information systems may introduce new biases. Mosier, Skitka, Heers, and Burdick (1998) describe the automation heuristic and resulting bias as uniquely associated with automated decision aids. They describe the automation heuristic as a tendency to assume that output from systems that monitor and process information for us is accurate. This heuristic seems related to the availability heuristic, in that the output of the decision aid may be more salient than other contradictory information.

Mosier, et al. (1998) say that this heuristic can result in errors of omission and commission. Errors of omission occur when decision makers fail to take action when an automated system does not inform them of an imminent problem. For example, pilots might fail to monitor engine instruments if they believe that an automated system will alert them to problems. Errors of commission occur when individuals follow the recommendation of an automated system, even though other information indicates it is an unwise choice. For example,

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<sup>1</sup> Although this under adjustment may seem maladaptive, there is evidence that it is an accurate way of forecasting when looking at a series of observations from nature and is inaccurate primarily for artificial trends used in laboratory experiments (Harvey, 2007).

a pilot might follow a navigational system's directions even though landmarks or other instruments indicate it is in error.

Still other decision errors might be the result of overwhelming the decision maker with information. Folds, Blunt, and Stanley (2008) examined potential decision-making biases that could result from voluminous amounts of data being fed to decision makers. Their hypothesis was that high volumes of information would force decision makers to use heuristics thereby increasing their use of various decision biases.

In this series of experiments, decision makers not only had to deal with high volumes of data, but they had to process, voice, text, still images, and videos while performing an incident identification task. The participants were trained to identify potential terrorist activities from data elements (video, voice, text messages, icons on a map, or computer graphics - as from a sensor). Participants were to identify a select set of six types of incidents including sniper fire, armed insurrection, and sabotage. These were to be distinguished from false alarm opportunities - events that looked like incidents but lacked critical indicators (e.g., peaceful demonstrations, gunfire from police, automobile accidents). The false alarm opportunities were presented in ways that favored particular biases so that reporting a particular false alarm incident was interpreted as utilizing that bias. Across the four experiments, the most frequent biases observed were saliency and oversensitivity to consistency, which are examples of the availability heuristic. The experimenters also found that providing training on avoiding decision traps was an effective way to reduce errors.

Research into the ways that information systems promote or protect us from decision biases has not yet extended to systems used by the Army (i.e. the ABCS systems). The purpose of the present research is to begin that investigation by examining decision making by leaders of units using ABCS systems while training at the Joint Readiness Training Center (JRTC).

### *Technical Objectives*

There is a saying: "It is a poor craftsman who blames his tools." If it is the case that ABCS systems have increased decision-making errors, this may have as much to do with how the systems are used as it does with the design of the systems themselves. For this reason it was important to measure the proficiency with which units employed their digital systems.

In the present research, we examined the relationship between the use of ABCS systems and decision making by commanders/leaders training at JRTC. To accomplish this, we decided to survey and interview observer/controllers (O/C's) who have seen units employing these systems in tactical operations centers (TOCs) as well as in vehicles. O/Cs undergo lengthy training so that they can observe and provide feedback to units training at JRTC. Most of the O/Cs have observed multiple units and are in an ideal position to comment on the proficiency with which units use ABCS systems, the decision-making errors of the commanders, and the relationship between the two.

Surveys were developed that focused on key capabilities of four major ABCS systems: FBCB2, ASAS, AFATDS, and MCS. The O/Cs were asked to indicate how well units were

trained on these capabilities, ways in which use of these capabilities aided in achieving mission objectives, and how failure to use these capabilities hindered achieving mission objectives. After completing the surveys, the O/Cs were interviewed. During the interviews, they were asked to discuss their survey responses, as well as decision-making errors they observed.

We chose this approach (talking to the O/Cs) over a more involved project using data collectors to observe multiple units at JRTC because of the lower cost and greater speed of accomplishing the former. Although this approach is more qualitative than quantitative, we feel it identifies key issues and measures that can serve as the groundwork for future, more quantitative examinations of decision making with digital command and control systems.

## Method

### *Participants*

A total of 21 observer controllers participated in this research. There were three non-commissioned officers (NCOs - all sergeants first class) and 18 officers (8 majors, 10 captains). Eleven of them (52%) were infantry, three (14%) were armor, two were field artillery (10%), and there was one from each of the following fields: military intelligence, signal, transportation, air defense, and logistics. All O/Cs were selected because they had experience observing units with ABCS systems. Thirteen (62%) observed at the battalion level and eight (38%) observed at the company level. O/Cs were all male. Additional demographic information about the O/Cs is presented in the results section.

### *Selection of Decision-Making Errors*

The field of research on heuristics has grown considerably since Tversky and Kahneman (1974) first published their research, to the point that the field is literally flooded with heuristics (Shah & Oppenheimer, 2008). To get the O/Cs to identify decision-making errors they had observed without overwhelming them with a long list of possible errors, we decided to narrow the field. The six decision errors examined by Folds, Blunt, and Stanley (2008) were examined in the present report (see Table 1).

The six decision-making errors we chose represent all three decision-making heuristics originally described by Tversky and Kahneman (1974, 1981). Rather than use the sometimes obtuse descriptions of these errors found in the psychological literature, we opted to provide simple descriptions of these errors along with militarily relevant examples to help the O/Cs translate the abstract descriptions into actual decision-making errors. These six errors are summarized in Table 1 (see also Appendix C).

Table 1

*Decision-making Errors Used in the Present Research*

Heuristic	Description of Decision-Making Error
Availability	Make a decision with a critical piece of information missing, but it is not recognized that it is missing
Availability	Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed
Availability	Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources are consistent (because they originate from the same primary source).
Adjustment	Make a decision based on information that has been discredited
Representativeness	Make a decision assuming that simultaneous, similar events are causally related when there is no evidence to support this conclusion
Representativeness	Make a decision based on input from a small sample of individuals when input from a larger group is available.

*Survey Instruments, Interview Questions, and Read Ahead Package*

The O/Cs first completed a demographic survey. In it, they described their duty assignments, number of units observed, and systems they observed in use while at JRTC. They also listed how long they had served in the Army and their leadership and staff positions indicating whether or not they were performed while deployed on a combat tour. They were also asked to indicate the types of units in which they had served (Armor, Bradley, Stryker, or Light Infantry). Finally, they indicated types of individual and collective training they had received on each of the ABCS systems and they rated their overall proficiency on these systems using a three point scale (basic, medium, and high).

Next, the O/Cs commented on the various capabilities of ABCS systems. Between five and nine major capabilities were identified for each ABCS system (see Appendix A). The capabilities for each system were described to the O/Cs who then made a series of ratings regarding the proficiency with which units utilized the capabilities.

The capabilities of each system were derived from the Digital Proficiency Level Tables found in Leibrecht, Lockaby, Perrault, and Meliza (2004a) and the Digital Tactical Operations Center Integration Guide found in Leibrecht, Lockaby, Perrault, and Meliza (2004b). These sources were condensed and refined by subject matter experts on the research team to yield the capabilities lists found in the surveys (see Appendix A).

In addition to the capabilities of these four systems, there are capabilities that result from sharing information across systems. Examples included the ability to successfully network all systems together or maintain a complete and accurate friendly force common operating picture (COP). Five of these cross-system capabilities were included in a cross-system survey given to each O/C.

The O/Cs were only asked to make ratings of systems they had observed at JRTC. The O/Cs made three sets of ratings based on the capabilities lists for each system. First, they made

overall ratings of unit proficiency on a three point scale: T (trained), P (practice needed), or U (untrained). Next they indicated whether use of the capabilities had contributed to reaching mission objectives. Finally, they were asked to indicate whether failure to use any capability had contributed to failure to meet any mission objective.

For the first set of ratings, each O/C indicated the number of units he had observed as an O/C at JRTC. Then for each capability, he rated how many of those fell in a category of T, P, or U. In the second set of ratings, the O/Cs indicated the number of units in which use of each capability contributed to mission success. Next, they indicated which contributing factors played a role. These contributing factors were: good operator skills, good employment skills, familiarity with unit standing operating procedures (SOPs), ability to cope with hardware problems, and ability to cope with software problems. The final set of ratings mirrored the second set except that O/Cs were rating the number of units in which failure to use any capability contributed to mission failure (mission failure was defined as failing to meet any mission objective). Similarly, the contributing factors were: poor operator skills, poor employment skills, unfamiliarity with unit SOP, inability to cope with hardware problems, and inability to cope with software problems.

Structured interviews were conducted after the O/Cs completed their surveys (see Appendix B). The first part of the interview was used to follow up on comments made on the surveys. Specifically, O/Cs were asked to give examples of situations where the use of various system capabilities contributed to mission success or where their misuse or lack of use led to mission failure.

In the second part of the interview, O/Cs were asked to describe decision-making errors they had observed in units equipped with digital systems. As we were not interested in evaluating the decision-making abilities of individual commanders, there was no need for O/Cs to identify specific units. A decision-making error was defined as a decision that resulted in a failure to meet all mission objectives. For each error described, they were asked if they thought it matched any error on our list of six common decision errors (see Table 1).

After an O/C indicated he could not think of any other decision-making errors he had observed, we asked him to look at the list of six common decision errors and select the one he thought was made most often by leaders of units employing ABCS systems. O/Cs could also write in a decision error if they were not satisfied with the six choices given. None of the O/Cs described novel decision errors. After making a choice, O/Cs were asked if the error was made differentially across echelon, mission type, mission phase, staff section, or the rank or experience of the decision maker. If the O/C indicated variation across any of these dimensions, he was asked to explain the nature of that variation. Each O/C was then asked to identify the most dangerous decision-making error he had observed and whether or not the error was made differentially across the same six factors. O/Cs were also asked to look at each of the six common decision-making errors and indicate how digital systems might protect against and increase the likelihood of each type of error.

Once the O/Cs finished commenting on each of the six decision errors, they ranked the factors that contributed to mission success (e.g., good operator skills, good employment skills,

familiarity with SOP, etc.) from most to least important. Likewise, O/Cs ranked the five factors that contributed to mission failure (e.g., poor operator skills, poor employment skills, unfamiliarity with SOP, etc.) from most to least important. In the final two questions of the interview, O/Cs described ways in which ABCS systems could be re-designed to overcome decision-making errors and whether they had any final comments regarding ways in which digital systems have improved or hindered decision making.

The read-ahead package (Appendix C) was provided to the O/Cs one month prior to the interviews. The package contained a brief statement explaining the purpose of the research, the system capabilities for each system, and a summary of the six common decision-making errors we wanted to examine. To help the O/Cs better grasp the decision-making errors, two examples of each error were provided. In each case, one example involved a digital system and the other did not.

### *Procedure*

The O/Cs were interviewed over a period of three days. Two O/Cs arrived at a time and they were separately interviewed by the two authors. Each interview lasted approximately two hours. On arrival, the O/Cs were given a demographic information sheet to complete and a copy of the read-ahead materials. Although the O/Cs had received the read-ahead materials one month prior to the interview, we asked them to re-read the materials to insure that they were all familiar with the concepts they would be questioned about in the surveys and interviews. After completing the demographic survey, the interviewer checked it to determine which digital systems the O/C had observed in use at JRTC and handed him the appropriate survey forms including the cross-system survey.

Complete surveys were checked by the interviewer for completeness and clarity before the interview was begun. Interviews were recorded with the consent of the O/Cs.

## Results

### *Demographic Data*

The O/Cs had all observed at least one unit training at JRTC. The maximum observed by anyone was 26 units and the mean number of units observed was 9.1. Ten of the eighteen officers were formerly enlisted and the average time in service for all O/Cs was 12.9 years. The O/Cs held a variety of leadership positions as can be seen in Table 2. Most of the O/Cs had served in infantry units (62%), one third (33%) had served in Bradley units, 19% served in armored units, and 14% had served in Stryker units. All but one of the O/Cs had combat experience. Eighteen of the 21 had served in Operation Iraqi Freedom and five had served in Operation Enduring Freedom.

Formal Training on ABCS systems received by the O/Cs is shown in Table 3. Only eight (38%) of the O/Cs had received individual training on at least one system and twelve (57%) had received some collective training on at least one system. As can be seen in Table 3, most training received by the O/Cs was for FBCB2.

Table 2  
*Leadership Positions Held by O/Cs*

	NCO		Officer	
	Total	Held in Combat	Total	Held in Combat
Squad/Team Leader	3	1	4	0
Platoon Leader/Sergeant	3	3	13	3
Company Cdr/1SG	1	0	13	11
Company/Bn Staff	1	0	16	12
Bde/Div Staff	0	0	10	6

*Note.* Cdr = commander; 1SG = first sergeant, Bn = Battalion, Bde = Brigade, Div = Division, Because O/Cs could hold multiple positions the overall total exceeds 21.

Although a minority received formal training on ABCS systems, three quarters (76%) had used at least one of the systems while deployed to a combat theater. Comparing across systems, FBCB2 was by far the most frequently used in theater with two thirds (67%) reporting that they had used FBCB2 while deployed. Three (14%) reported they had used MCS and three had used AFATDS. None reported using ASAS while deployed. The average duration for system usage in a combat theater was 10.3 months for FBCB2, 11.3 months for AFATDS, and 7.7 for MCS.

Table 3  
*Training on Digital Systems*

Training	FBCB2		ASAS		MCS		AFATDS	
	n	%	n	%	n	%	n	%
Individual Training	6	21	1	25	4	25	3	27
Any Collective Training	8	29	2	50	5	42	3	27
Motorpool Training	5	18	0	0	0	0	2	18
Field Training Exercise	4	14	0	0	1	8	2	18
Command Post Exercise	5	18	1	25	2	17	1	9

*Note.* % indicates the percentage of those who received training on each system. Because O/Cs had more than one type of training, total n per system can exceed 21.

When asked to rate their own proficiency on these digital systems, those who had used them were most likely to say that they had a basic level of proficiency (see Table 4). Basic was defined as being able to use the system to perform a limited set of functions, yet being unfamiliar with many aspects of the system. The medium level of proficiency was described as being knowledgeable about most of the system's functions and quirks, but having limited troubleshooting ability. The high level of proficiency was described as having advanced knowledge of the system and extensive troubleshooting abilities. As shown in Table 4, only two individuals rated themselves as having a high level of proficiency on FBCB2. Nobody rated themselves high on any of the other systems.

Table 4  
*Self-Ratings of Proficiency on ABCS Systems*

	FBCB2		ASAS		MCS		AFATDS	
	n	%	n	%	n	%	n	%
Never Used	3	14	14	67	7	33	16	76
Basic	13	62	6	29	13	62	4	19
Medium	3	14	1	5	1	5	1	5
High	2	10	0	0	0	0	0	0

Note. Total n = 21.

Most of the O/Cs had some experience and/or training on the ABCS systems used by Soldiers they observed at JRTC. Of the O/Cs who observed units using FBCB2, 18 of 19 (95%) had used and/or been trained on this system. The corresponding percentages of O/Cs for the other systems were: 9 of 11 (82%) for MCS, all four (100%) for ASAS, and 3 of 4 (75%) for AFATDS.

It is important to emphasize that the O/Cs were asked to evaluate use and training on system *capabilities* (e.g., communication, planning, navigation, targeting capabilities). It was not necessary for the O/Cs to be expert operators of the systems to make evaluations about how effectively these capabilities were being used. The O/Cs could often tell just by watching the performance of the unit, how well they were being used. For example, if a convoy equipped with FBCB2 got lost, it would be apparent that the operators were not able to use this system for navigation. The O/Cs were also privy to conversations among unit members about their proficiency, training, and opinions on ABCS systems.

### *General Survey Responses*

Before looking in detail at the survey responses to each system, it is helpful to compare the survey responses across systems. To caveat these comparisons, it is important to realize that all systems were not observed with equal frequency across the O/C sample. FBCB2 was the most frequently observed system (see Table 5) observed by 90% of the sample. MCS was the next most frequently observed (52%) followed by ASAS and AFATDS (19% each). On average the O/Cs observed between 5 and 7 units using each system.

Table 5  
*Digital Systems Observed by Observer/Controllers*

System	# O/Cs who observed units using the system	Avg. no. units observed	Minimum no. of units observed	Maximum no. of units observed
FBCB2	19	6.89	2	16
ASAS	4	6.50	1	9
MCS	11	5.09	1	11
AFATDS	4	6.00	1	9

Three O/Cs observed and rated all four systems, one observed three systems, five observed two systems, and the rest observed and rated only one system. All O/Cs were asked to

provide ratings for cross system use. It was reasoned that even if they only observed one system they could still comment on how well the operators of that system distributed information to and used information from other systems. One O/C who had observed only one unit declined to complete the cross-system survey because he felt he did not have enough experience to comment on the questions.

As described above, the O/Cs examined a list of major functions of each system and made a series of ratings about the proficiency of the units they had observed. To provide some cross-system comparisons, the responses of each O/C have been collapsed across the system capabilities to yield mean ratings from each O/C for each system (Figure 1). As each O/C observed different numbers of units, the ratings were standardized by calculating the percentage of units observed by each O/C. Throughout the results section, this same approach was used to standardize responses across O/Cs.

The first set of questions in the survey for each system had the O/Cs group units into three categories: trained, practice needed, and untrained (T, P, and U). These ratings were collapsed across the system capabilities to yield mean ratings from each O/C for each system and for the cross-system evaluation. These mean percentages are summarized in Figure 1.

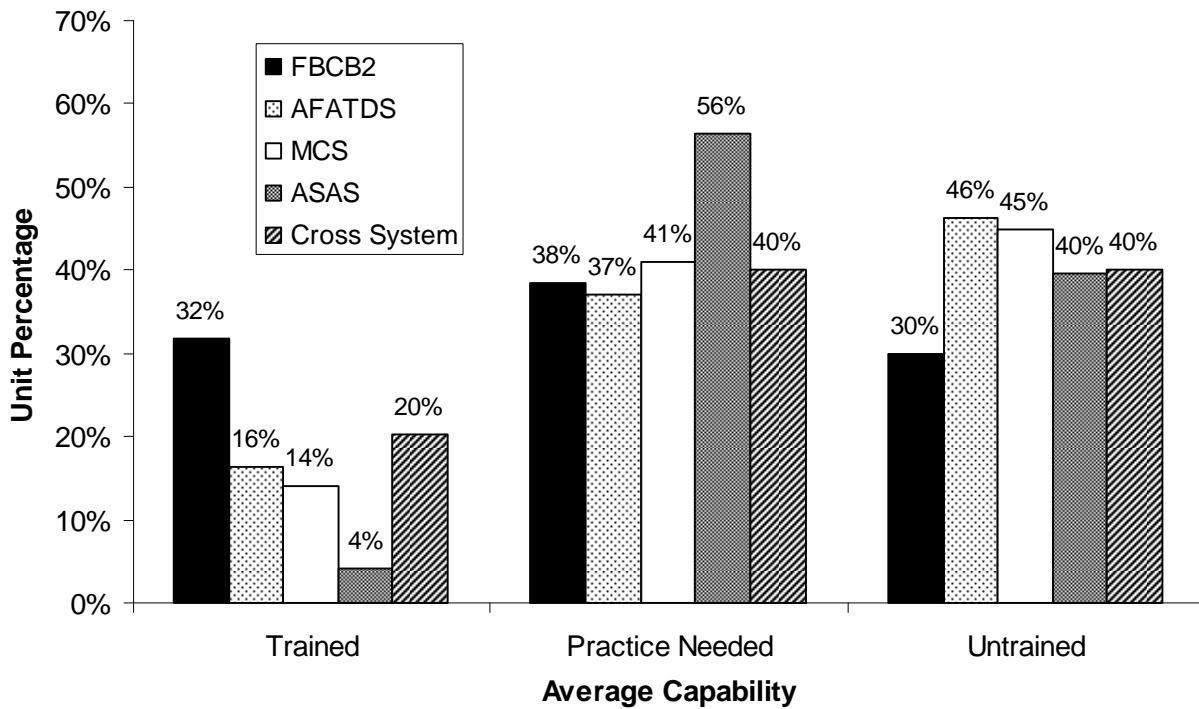


Figure 1. Mean percentage of units rated as trained, needing practice, or untrained on four digital systems and cross-system integration.

With the exception of FBCB2, the percentage of units rated as needing practice or untrained was at least double the percentage rated as trained. Units appeared to be most proficient with FBCB2, as the highest percentage of units were rated as T and the lowest percentage were rated as U for this system.

In the next two questions, O/Cs rated the frequency with which several factors either contributed to mission success or mission failure. The factors contributing to mission success were good operator or employment skills, familiarity with unit standing operating procedure (SOP), and ability to cope with hardware and software problems. The factors contributing to mission failure were poor operator or employment skills, unfamiliarity with digital SOP, and inability to cope with hardware or software problems. By averaging the mean across all functions for each O/C, we get an overall picture of how these factors impacted the use and employment of these digital systems. The mean ratings for each capability are in Appendix D.

As shown in Table 6, operator and employment skills and familiarity with unit SOP appeared to be the biggest factors contributing to mission success for all systems. The ability to cope with hardware or software problems was a less critical driver of mission success. Regarding specific systems, the percent of units employing good operator and employment skills for ASAS was about half the rate of other systems. This result mirrors data in Figure 1 showing the percent of ASAS units rated as trained was substantially lower than the other systems, and the percent needing practice on ASAS was substantially higher than other systems.

Table 6  
*Percentage of Units in Which Factors Contributed to Mission Success Across Systems*

System	Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
FBCB2	61%	56%	38%	19%	17%
MCS	41%	32%	18%	12%	14%
ASAS	25%	24%	17%	1%	17%
AFATDS	48%	51%	47%	25%	25%
Cross-System	59%	50%	27%	18%	17%

*Note.* Percentages are averaged across all O/Cs who provided ratings for each system.

As shown in Table 7, unfamiliarity with SOP was the biggest contributor to mission failure (the only exception being ASAS). Poor employment and operator skills were more problematic than the inability to cope with hardware or software problems. Overall, there was very little variability across systems with the exception of ASAS operator skills. Compared to the other systems, nearly twice the percentage of units observed using ASAS appeared to have poor operator skills. Taking this result together with the results in Table 6 and Figure 1 suggests that users of ASAS were less proficient than users of other systems.

Table 7

*Percentage of Units in Which Factors Contributed to Mission Failure Across Systems.*

System	Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
FBCB2	27%	29%	35%	19%	19%
MCS	26%	31%	34%	18%	17%
ASAS	55%	38%	36%	13%	25%
AFATDS	28%	33%	36%	17%	11%
Cross-System	25%	33%	40%	12%	13%

*Note.* Percentages are averaged across all O/Cs who provided ratings for each system.

When averaged across all system capabilities, the O/C comments indicate several things. First of all, of the four systems, unit proficiency was greatest for FBCB2 and worst for ASAS. Second, of the five factors examined, employment and operator skills were the most critical determinants of mission success. No or unfamiliarity with SOP was the biggest contributor to mission failure. The ability to cope with hardware and software problems played a lesser role in determining mission success and failure. Finally, units were more likely than not to possess the operator and employment skills to leverage systems for mission success.

### *Survey and Interview Responses for FBCB2*

In this section, the results for the nine system capabilities of FBCB2 are discussed in more detail. O/Cs provided ratings for each of these capabilities on a T-P-U scale and also indicated whether use of or failure to use a capability contributed to mission success or failure respectively. Following the survey, O/Cs were asked to provide examples to support their ratings in the interview. The survey and interview responses for each capability are summarized together. For a list of the nine FBCB2 capabilities, see Table 8.

*Support Navigation.* The 19 O/Cs who observed units that employed FBCB2 indicated that just over two-thirds of units who used FBCB2 were sufficiently trained to use it for navigation. This was the only capability for which a majority of those units were adequately trained (Table 8). Nearly all of the units (89%) were able to leverage this capability to support mission success (Table 9).

In the interview, the O/Cs were asked to describe instances where use of system capabilities contributed to mission success and failure to use system capabilities contributed to mission failure. As would be expected from the survey responses, nearly all O/Cs said that units were able to use FBCB2 for navigation. Those who had observed Stryker units noted that they were especially proficient. Similarly platoons (plts) and companies (cos) that operate across multiple areas of operation (AOs) such as the chemical recon plts, the military police (MP) plts, and the brigade (bde) signal cos tend to have a high level of proficiency at navigation.

Unfamiliarity with unit SOP was often cited as a reason that units failed to leverage the navigational capability. Failures meant that units and vehicles got lost, or worse, traveled down

routes with known threats. Failure could occur both within the vehicle (i.e., the vehicle commander or driver failed to follow SOP and use FBCB2 for navigation) or within the TOC (i.e., the TOC did not follow SOP to properly track subordinate elements, and therefore couldn't warn them if they traveled into danger areas).

Table 8  
*Proficiency Ratings of Nine FBCB2 Capabilities*

FBCB2 Capabilities	% of Units		
	T	P	U
Support navigation	69	28	3
Distribute messages, warnings, reports	42	44	17
Receive, develop, and distribute a common battlefield picture	32	35	33
Access prepared messages, reports, and requests	33	48	19
Support clearance of fires, maneuver decisions, avoid fratricide	29	47	24
Prepare and distribute orders	27	45	28
Conduct a circular and/or line of sight analysis.	23	30	47
Process and display platform status information.	18	38	44
Develop and distribute unit task organization/reorganization data.	13	32	55

Note: T = trained, P = practice needed, U = untrained. Percentages averaged across 19 O/Cs.

*Distribute messages, warnings, reports.* The second most trained function, distributing messages, warnings, and reports, was executed at a trained proficiency by 42% of the units observed. Slightly more (44%) were rated as needing training but only 17% were rated as untrained. Despite this, a majority (58%) of the units were able to use this capability to support mission success. Failure to use it contributed to mission failure only 16% of the time.

Many O/Cs noted units used FBCB2 to distribute messages as a backup when FM radio communications were not possible (i.e., if their radio communications were hampered by terrain etc.). Most of the vehicles at JRTC use the satellite version of FBCB2 known as Blue Force Tracker (BFT) which does not depend on a clear line-of-sight for communication. Units or vehicles that failed to use this capability in radio dead zones suffered reduced situation awareness (SA) increasing the likelihood of mission failure.

*Develop and distribute unit task organization.* As shown in Table 8, few units (13%) were trained to proficiency on this capability and over half (55%) were untrained. Despite this lack of training, failure to use this capability contributed to mission failure in less than a third (27%) of the units. On the other hand use of this capability contributed to mission success in only 17% of the units, indicating that this capability was not critical.

The interview responses reflected the survey responses. Many of the O/Cs commented that the Stryker units were the only units that were proficient with this function. Other units were seen to task organize and reorganize so inefficiently that the unit commanders would lose track of which units were Failure to develop and This sometimes led to confusion about which troops were assigned to which tasks. One O/C described a tyranny of task organization because leadership was not tracking where its subordinate elements were and as a result did not task organize effectively.

Table 9

*Percentage of Units Using or Failing To use FBCB2 Capabilities*

FBCB2 Capabilities	% of Units	
	use contributed to mission success	failure to use contributed to mission failure
Support navigation	89	13
Distribute messages, warnings, reports	58	28
Support clearance of fires, maneuver decisions, avoid fratricide.	50	34
Receive, develop, and distribute a common battlefield picture	40	44
Access prepared messages, reports, and requests	35	23
Prepare and distribute orders	28	25
Process and display status information	21	22
Conduct a circular and/or line of sight analysis	21	26
Develop and distribute unit task organization/reorganization data.	17	27

*Note.* Percentages are averaged across 19 O/Cs

*Process and display platform status information.* Few units (18%) were well trained on this capability and almost half (44%) were rated as untrained. In only about one fifth (22%) of the units did failure to leverage this capability contribute to mission failure (Table 9). Similarly, only about a fifth (21%) leveraged it for mission success suggesting this function is not critical. The interview responses reflected the surveys as O/Cs commented that not many units used FBCB2 to display status information with the exception of the Stryker units. No clear examples were given of how failure to use this capability would lead to mission failure or how use would lead to success.

*Prepare and Distribute Orders.* More units were rated as needing practice (45%) than were rated as trained (27%) or untrained (28%). As with displaying status information, use of this capability didn't often contribute to mission success, but failure to use it didn't contribute to mission failure in many units either (Table 9).

This was explained in the interview because distributing orders was generally not done using the preformatted messages in part because attached graphics took too long to transmit over the network. One O/C mentioned that he saw a unit transmit a fragmentary order (FRAGO) which arrived 1.5 hours later. Another O/C mentioned that a FRAGO sent by the battalion commander never arrived. For these reasons, units preferred to use free text messages or radios to disseminate orders. Examples of mission failure provided by the O/Cs had more to do with the failure to communicate FRAGOs and other orders than the failure to transmit them using FBCB2.

*Receive, develop, and distribute a common battlefield picture.* Nearly one third of the units (32%) were rated as trained to use this capability and a similar percent were rated as untrained (Table 8). Use of this capability supported mission success in 40% of the units

observed and failure to use it contributed to mission failure in 44% of the units. This suggests this is a relatively important system capability.

In the interviews, many of the O/Cs commented that only the Stryker units effectively used FBCB2 to maintain a common operational picture (COP). One O/C said that by the end of a rotation most units could maintain an accurate COP. Others said that units relied more on a system called Command Post of the Future (CPOF) than FBCB2 to maintain an accurate COP. Problems occurred when that information wasn't pushed down to the vehicles. This may have been because units have found it difficult to have CPOF automatically feed information to FBCB2. One O/C said he had never seen a unit succeed at this, but he had heard it was being done in the major combat theaters. Because of this, the units had to manually transfer information across systems. Casualties resulted when the TOCs failed to feed threat information to vehicles via FBCB2 providing them with advance warning.

*Access prepared messages reports and requests for edit and/or transmission.* One third of all units (33%) were listed as trained on this capability, less than a fifth (19%) were listed as untrained, and nearly half (48%) were rated as needing practice. Use of this capability contributed to mission success in just over a third (35%) of units, but failure to use it contributed to mission failure in less than a quarter of all units (23%). This suggests this capability is not very important.

These ratings were reflected in the interviews. Several O/Cs commented that few units were well trained to use preformatted reports and messages although others indicated that this was not difficult for any unit they observed. There were no examples given of how use of this capability contributed to mission success or mission failure.

*Conduct a circular and/or line of sight analysis.* Only about a quarter of all units (23%) were trained on this capability and almost half (47%) were untrained. Nevertheless use of this capability didn't contribute to mission success in many units (21%) and failure to use it didn't contribute to mission failure in many units (26%) suggesting that this capability is not a critical one.

In the interviews, the use of the line-of-sight (LOS) or circular line-of-sight (CLOS) was not seen by many O/Cs. It was used by one unit to set up their traffic control points and it was used by the signal companies to set up FM retransmission sites.

*Support clearance of fires, maneuver decisions, and fratricide avoidance.* As seen in Table 8, only a quarter of the units were rated as trained on this capability, and a similar number (24%) were untrained. Despite this, OCs indicated that half of all units (50%) were able to leverage this capability to support mission success and failure to use this capability contributed to mission failure in about a third of all units (34%).

Almost all of the O/Cs commented in the interviews that only the Stryker units truly utilized FBCB2 to clear fires. In fact a Stryker BN took a novel approach and used the danger area alert function for danger areas and obstacles to warn units if they entered an area targeted by

the field artillery batteries. A couple of O/Cs added that FBCB2 is not the primary system used to clear fires.

Not many examples were given of how the failure to use FBCB2 to clear fires contributed to mission failure. One O/C described a fratricide that resulted because a leader relied only on FBCB2 to clear for fire even after being told a unit was near the target.

### *Survey and Interview Responses for MCS*

There were 11 O/Cs who observed units using MCS. Unit proficiency was rated on seven system capabilities. In the survey, O/Cs did not see high rates of proficiency on MCS across the units (Table 10). A frequent comment in the interviews, was that units were transitioning to CPOF and so many times MCS was not used except as a backup system. Nevertheless, units did appear to use some of its capabilities to contribute to mission success (Table 11).

*Use decision support tools to support planning and execution.* As can be seen in Table 10, less than a fifth (19%) of the units observed were trained to proficiency for using decision support tools and over half (61%) were rated as needing practice. As with FBCB2, a low percent of units rated as trained did not mean that they could not leverage this capability for mission success. In fact, two thirds of units observed used this capability in a way that contributed to mission success (Table 11).

Several O/Cs commented that mechanized units and Stryker units had the greatest proficiency using MCS. One stated that even the heavy units only use MCS Light at the co level, above that, they use CPOF. The light units use CPOF almost exclusively. Beyond, this general comment, O/Cs stated that few units use this capability well but many can use it adequately. One O/C commented that in one unit a weak understanding of unit SOP contributed to mission failure.

*Conduct mobility analysis of the terrain.* Few units (15%) were rated as well trained to use this capability, and a little over a third (35%) were rated as needing practice (Table 10). Fully half were untrained. As can be seen in Table 11, less than half (38%) were able to use this capability to promote mission success and in 40% of the units, failure to use this capability contributed to mission failure. The O/C comments reflected these ratings. Few units were seen to use this capability and the better units were heavy or Stryker. One commented that failure to use it didn't necessarily mean the mission failed, but it definitely didn't help the mission when they didn't use this capability.

Table 10  
*Proficiency Ratings on Seven MCS Capabilities*

Major MCS Capabilities	% of Units		
	T	P	U
Use decision support tools to support planning and execution.	19	61	20
Update friendly/enemy unit locations and battlefield geometry.	19	69	12
Prepare and send orders	16	39	45
Conduct mobility analysis of the terrain.	15	35	50
Analyze different courses of action.	12	25	63
Conduct other tactical planning activities	11	14	75
Access up-to-date situational information from other systems.	8	43	49

*Note.* T = trained, P = practice needed, U = untrained. Responses are averaged across 11 O/Cs.

*Analyze different courses of action.* Most units (63%) were untrained on this capability, a quarter were rated as needing practice and 12% were rated as trained. As can be seen in Table 11, only 17% were able to leverage this capability for mission success, but failure to use it contributed to mission failure in only 38% of the units. In the interview, one O/C said that only the Stryker unit used this capability well. Many of the O/Cs said that units used CPOF rather than MCS for this task.

*Conduct other tactical planning activities.* As seen in Table 10, only 11% of units were trained to use this capability and three quarters were untrained. Less than a third (27%) leveraged it for mission success, but failure to use it contributed to mission failure in only 38% of the units observed. The O/C comments largely reflected these ratings. Few units were seen to use this capability. Those that did, primarily exported maps and imagery to PowerPoint. It was noted that this was dependent on good operators. One of the O/Cs mentioned that in one unit a single skilled sergeant was critical in the unit’s success with this capability.

*Access up-to-date situational information from other systems.* Of all capabilities, this one had the lowest rate of proficiency among the units observed (8%). More than two fifths (43%) were rated as needing practice and nearly half were rated as untrained. As can be seen in Table 11, a little over a third were able to leverage this for mission success, but in over half, failure to use it contributed to mission failure suggesting this is a critical MCS function.

In the interviews, the O/Cs said that it usually took several days for units to develop proficiency in accessing information from other systems. They also mentioned that the TOCs took time to improve their analog skills to deal with system failures and loss of connectivity. One O/C noted that a unit was successful only after the contractors helped them. Several O/Cs mentioned that units didn’t use these capabilities because they were using CPOF. One O/C described MCS as “wall candy” because the unit displayed it on their screen, but they lacked the SOP and operator skills to use its capabilities. He cited an instance in this unit when there was a six hour lag between troops encountering an IED and news of it reaching the TOC.

Table 11

*Percentage of Units Using or Failing to Use MCS Capabilities*

Major MCS Capabilities	% of Units	
	Use contributed to mission success	failure to use contributed to mission failure
Update friendly/enemy unit locations and battlefield geometry.	67	27
Use decision support tools to support planning and execution.	62	24
Conduct mobility analysis of the terrain.	38	40
Access up-to-date situational information from other systems.	35	56
Conduct other tactical planning activities	27	38
Prepare and send orders	22	41
Analyze different courses of action.	17	38

*Note.* Responses are averaged across 11 O/Cs.

*Prepare and send orders.* Few units were rated as trained on this capability (16%) and most were rated as either needing practice (39%) or untrained (45%). Likewise few (22%) were able to leverage this capability to support mission success but failure to use it contributed to mission failure in 41% of the units suggesting this is a critical MCS function.

In the interviews, those who noted there were successes noticed it in only a few units (heavy, Stryker). Several examples of failure to use this capability were described. Most said that units simply didn't use this capability. Both a lack of SOP and operator skills were cited as contributing factors. One O/C felt that as more units begin to use CPOF, the ability to communicate orders to subordinate units will improve at the BN level.

*Update friendly/enemy location and battlefield geometry.* Most units were seen as either trained (19%) or needing practice (69%). Few (12%) were seen as untrained. This capability was the one most units (67%) were able to leverage for mission success while failure to use it contributed to mission failure in only about a quarter (27%) of the units.

The O/C comments primarily reflect that units successfully used this capability. Several O/Cs mentioned that this was sometimes the only MCS capability units could use effectively. One O/C said that a unit only used the map at first but eventually began to place red and blue icons on it. Unfortunately they were static and were only updated when the executive officer (XO) or commander asked them to update it, which wasn't often. Several O/Cs mentioned that MCS was used as a backup for CPOF in a number of units. Failures were noted when units lacked the operator skills and SOP to effectively use the system.

## Survey and Interview Responses for ASAS

Only four O/Cs observed units using ASAS. There were nine major capabilities for which units were rated. As can be seen, few units were deemed to be fully trained on any of these capabilities (Table 12) and this was reflected in the interview comments. As can also be seen in Table 13, the O/Cs blame the failure to use this system's capabilities as a contributor to mission failure in many units (Table 13).

Table 12  
*Proficiency Ratings on Nine ASAS Capabilities*

Major ASAS Capabilities	% of Units		
	T	P	U
Integrate, process, and correlate enemy information	25	63	13
Provide rapid access to enemy dispositions and activities	6	85	09
Fuse reports and data to place enemy entities on maps.	6	60	34
Support the creation, maintenance, and dissemination of a threat/enemy COP and database.	0	81	19
Support rapid attack of high priority/critical targets as identified.	0	56	44
Provide probable identification of enemy units	0	53	47
Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.	0	53	47
Support IEW planning and monitor the execution of collection, surveillance, and EW plans	0	50	50
Provide alarms when specified information is identified Support to decision making and execution of the operation.	0	6	94

*Note:* IEW - intelligence and electronic warfare, COP - common operational picture. Responses are averaged across 4 O/Cs.

When discussing the individual capabilities of ASAS, the O/Cs frequently mentioned that the design of the system was the root of many problems. The system, they said, was designed for the conduct of major combat operations (MCO) rather than a counter insurgency (COIN) fight. For example, in MCO, the enemy is expected to be organized into hierarchically structured units with traditional military roles and weapon systems. In a COIN fight, the enemy units are loosely associated cells with non-traditional weapons, roles, and tactics. When using ASAS to *provide probable identification of enemy units* or to *support rapid attack of high priority/critical targets as identified*, or to *integrate, process, and correlate enemy information*, units did not have standard 2525 military symbols to represent enemy units or activities. To cope with this shortfall, units would improvise their own symbols and labels, but a lack of standardized solution made it difficult to combine one unit's data with another unit's data. As one O/C described it, ASAS was meant to be a top-fed system with most of the intelligence flowing down from higher echelons. In a counterinsurgency fight, it must be bottom-fed, so different unit SOPs hurt the effort to detect critical pieces of information.

Table 13

*Percentage of Units that Used and Failed to Use ASAS Capabilities*

Major ASAS Capabilities	% of Units	
	Use contributed to mission success	failure to use contributed to mission failure
Integrate, process, and correlate enemy information	63	13
Provide rapid access to enemy dispositions and activities	40	29
Support the creation, maintenance, and dissemination of a threat/enemy COP and database.	31	69
Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.	28	72
Support rapid attack of high priority/critical targets as identified.	25	66
Fuse reports and data to place enemy entities on maps.	24	54
Provide alarms when specified information is identified		
Support to decision making and execution of the operation.	6	69
Provide probable identification of enemy units	3	53
Support IEW planning and monitor the execution of collection, surveillance, and EW plans	0	100

*Note:* IEW - intelligence and electronic warfare, EW - electronic warfare, COP - common operational picture

Because of these shortcomings, some of the units were using CPOF to track enemy activity. However, as pointed out by one O/C, CPOF can only be used as a substitute for some of the functions of ASAS. For example, CPOF is not designed to create archives of enemy activity or to analyze archives to identify patterns that might be useful for predicting future enemy activity. Thus the substitution of CPOF for ASAS meant that units lost some critical capabilities.

*Survey and Interview Responses for AFATDS*

There were nine capabilities for which unit proficiency was rated. Four O/Cs observed units that were using AFATDS. In general, O/Cs noted that currently, AFATDS is not heavily utilized because there is a limited role for artillery and fire support in an urban environment. There were few comments on this system in the interviews. The comments that were made indicated that units are not well trained to use this system. For example, for *Integrate all fire support systems via a data distributed processing system*, O/Cs said that units rarely use this capability except during counter-fire missions. O/Cs also said that units were not tracking ammo use and were allowing batteries to run out. They also said that units sometimes lacked the equipment needed to get all necessary sensor feeds into ASAS. The O/Cs had no comments about any other system capabilities.

Table 14

*Proficiency Ratings on Nine AFATDS Capabilities*

Major AFATDS Capabilities	% of Units
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	T	P	U
Facilitate fire support planning for current and future operations.	38	11	50
Manage critical resources and collect and forward intelligence and target information.	31	19	50
Facilitate adjustment and override of fire support coordination and control measures.	31	44	25
Provide up-to-date battlefield information, target analysis, and status for fire support elements.	25	25	50
Facilitate coordination of sensor cueing in support of target development and counterfire operations.	17	44	39
Coordinate target damage assessment.	06	19	75
Integrate all fire support systems via a data distributed processing system.	0	94	06
Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.	0	50	50
Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.	0	28	72

Table 15

*Percentage of Units that Use and Fail to Use AFATDS Capabilities*

Major AFATDS Capabilities	% of Units	
	Use contributed to mission success	failure to use contributed to mission failure
Facilitate adjustment and override of fire support coordination and control measures.	75	0
Facilitate coordination of sensor cueing in support of target development and counterfire operations.	61	39
Integrate all fire support systems via a data distributed processing system.	58	50
Facilitate fire support planning for current and future operations.	50	25
Provide up-to-date battlefield information, target analysis, and status for fire support elements.	50	25
Coordinate target damage assessment.	50	5
Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.	50	50
Manage critical resources and collect and forward intelligence and target information.	50	3
Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.	28	72

As can be seen in the ratings in Table 14, units were seen as mostly needing practice or as untrained. As with other systems, this apparent lack of training didn't mean that units were unable to use this system. For most capabilities, at least half of the units were able to leverage it for mission success. On the other hand, for half or more of the capabilities, failure to use it contributed to mission failure.

## Survey Responses for Cross-System Capabilities

All but one of the O/Cs provided ratings of cross system capabilities. The one O/C who declined to rate cross-system capabilities had only observed one unit and did not feel qualified to complete the ratings. Less than a third of all units were rated as trained on any of the cross system capabilities assessed (Table 16). Over a third of the units were rated as untrained on four of the five capabilities.

*Properly network systems together.* Only 30% of all units were rated as trained (Table 16). Slightly more were rated as needing practice or as untrained (35% each). Still 43% were able to do this in a way that supported mission success and only 23% contributed to mission failure by failing to use this capability (Table 17). Most of the O/Cs said that at least some units were able to do this successfully. As with the individual systems, most had noticed that Stryker units were often the only units that did this well. One O/C remarked that all units start out with the systems talking to each other but within 12 - 48 hours, problems start to emerge because the units don't know how to troubleshoot. Several O/Cs said that some units were overly reliant on contractors to establish connectivity. A few O/Cs said that some units were completely unable to establish connectivity and used all their systems in a stand-alone mode.

Table 16  
*Proficiency Ratings on Five Cross-System Capabilities*

Assessment of Cross-System Capabilities	% of Units		
	T	P	U
Properly network systems together	30	35	35
Maintain an accurate and complete “friendly force” COP	25	46	29
Use digital systems to track the flow of the battle and to maintain situational understanding.	23	40	38
Maintain an accurate and complete “enemy force” COP	13	42	45
Share appropriate information to conduct targeting planning and operations	10	35	50

*Maintain an accurate and complete “friendly force” COP.* More units were rated as needing practice (46%) than as trained (25%) or as untrained (29%). The majority of units (57%) were able to use this capability to support mission success and only a fifth (20%) contributed to mission failure by failing to use this capability.

In the interviews, many of the O/Cs commented that the units were generally good at using this capability, once again with Stryker units being the most capable. One O/C pointed out that there was a problem because although Bde and Co commanders were tracking locations of subordinate units, they were not tracking task and purpose of those units. He described a situation where a Bn commander could not understand how a high value target slipped past a traffic control point (TCP). What the Bn commander didn't realize was that although a vehicle was in position, the TCP had not been set up. Another noted that connectivity was only possible within the stationary command post. In general, poor understanding of SOP or poor operator or employment skills were the biggest factors leading to failure for this function. Units that failed

often lacked the analog skills to track friendly forces so leaders often had no idea where subordinate elements were located until the digital systems came back online.

*Maintain an accurate and complete “enemy force” common operating picture (COP).* Most units were either rated as needing practice (42%) or as untrained (45%). Only 13% were rated as trained. More units contributed to mission failure by failing to use this capability than contributed to mission success by using it (42% vs 27%). In the interviews, the O/Cs generally noted that some units did this well but many failed to do it. Poor operator training and SOP were the most common reasons for failure. Several O/Cs noted that although units tend to plot incidents and enemy activity, they rarely used this information to understand what the enemy was doing. For example, a mortar point of origin might be posted on the map yet this would not prompt further analysis. Another O/C made a similar comment, noting that commanders only saw enemy forces after an event but that information wasn't used to determine the enemy's current plan or location.

Table 17

*Percentage of Units that Use and Fail to Use Cross-System Capabilities*

Cross-System Capabilities	Percent of Units	
	Use contributed to mission success	failure to use contributed to mission failure
Maintain an accurate and complete “FRIENDLY force” common operating picture (COP)	57%	20%
Use digital systems to track the flow of the battle and to maintain situational understanding.	49%	23%
Properly network systems together	43%	23%
Maintain an accurate and complete “ENEMY force” common operating picture (COP)	27%	42%
Share appropriate information to conduct targeting planning and operations	24%	27%

*Share appropriate information to conduct targeting planning and operations.* Half of all units were rated as untrained on this capability. Over one third was rated as needing practice (35%) and 10% were rated as trained. A minority of units used this capability to support mission success and a minority contributed to mission failure by failing to do this, hinting that this is not a critical function. In the interviews the O/Cs said that some units could do this well. Problems that contributed were poor SOP and operator skills. Some O/Cs noted that units were not very proficient at targeting because they tended to track enemy actions rather than plotting likely locations of the enemy.

*Use digital systems to track the flow of the battle and to maintain situational understanding.* Almost a quarter (23%) of all units were rated as trained, 40% were rated as needing practice and 38% were rated as untrained. Almost half (49%) contributed to mission success by using this capability and in only 23% did failure to use this contribute to mission failure. Most O/Cs said that units do well tracking their own forces with the Stryker units being consistently identified as very proficient at this. One O/C said that leaders often focus on the

units in contact rather than what's coming down the road that might affect that fight. For example, the unmanned aerial sensors (UASs) were frequently sent up to watch the fight rather than what was going on around the fight. Several O/Cs mentioned that problems were usually because of poor SOP or employment skills rather than hardware problems.

### *Decision-Making Errors Observed*

To provide additional context in which to understand decision errors with digital systems, O/Cs were asked to describe all decision-making errors, regardless of whether digital systems played a role. The O/Cs generated a total of 80 examples of decision-making errors they had observed (Table 18). Examples were about equally distributed across the three heuristics when comparing the average number of examples per type of error per heuristic. There were three availability heuristic errors with an average of 14.3 examples each. There was one adjustment error with 15 examples, and there were two representativeness errors with an average of 11 examples.

*Make a decision with a critical piece of information missing, but it is not recognized that it is missing.* Several of the O/Cs mentioned that missing information is common. Many of the examples were cases of critical information not getting to the right people at the right time. Several gave examples of Soldiers at traffic control points (TCPs) stopping and then releasing a high value enemy combatant wanted by adjacent units. In one of the more dramatic cases, the mayor of a town had arrived at a forward operating base (FOB) to speak to the field artillery commander. The guards at the entry control point (ECP) had not been made aware of the meeting and wouldn't allow him to enter. When he called the commander on his cell phone, the commander asked to speak to the guards. The mayor approached them with his cell phone. They ordered him to stop but he continued to approach so they shot and killed him.

Other examples had to do with a failure to confirm information from sectarian sources. In some cases, leaders would hear from the dominant group (Sunni or Shia) and not realize that the minority group was being intimidated into keeping quiet about mistreatment by the majority.

Some examples of problems stemming from the use of digital systems were given. In one case, a unit was using commercial software (*Macromedia Breeze*). The software, which facilitates online collaboration, was not designed with a military user population in mind. Thus, although it facilitates online communication, it does not have the capacity to store or analyze information. O/Cs said that units using this software were not effectively tracking trends to predict enemy activity.

Table 18  
*Frequency of Examples of Decision-Making Errors*

Decision Error	Frequency
Make a decision with a critical piece of information missing, but it is not recognized that it is missing (availability)	20
Make a decision based on a personal, salient, emotional or recent event ignoring	16

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information suggesting that trends have changed (availability)	
Make a decision based on information that has been discredited (adjustment)	15
Make a decision based on input from a small sample of individuals when input from a larger group is available (representativeness)	12
Make a decision assuming that simultaneous, similar events are causally related when there is no evidence to support this conclusion (representativeness)	10
Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources originate from the same primary source (availability)	7
<b>Total</b>	<b>80</b>

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In another example, an O/C said that digital systems tend to compartmentalize information and limit how it is shared. He described an incident in which an AH-64 spotted a vehicle with a large cylinder parked on the road at 2 am. The local battalion checked it out and didn't find anything suspicious. That Bn didn't know that a chlorine tanker had been hijacked in a town south of their area of operations (AO) or that division level analysis suggested a chlorine IED attack was being planned. The next day, a chlorine vehicle borne improvised explosive device (VBIED) was detonated next to the police station in their AO. Another O/C said that a unit was using their UAS but had no way to quickly communicate information gained from the UAS to the units it was observing.

*Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed.* The most common example given for this type of error had to do with commanders making quick reactions to incidents without taking the time to sort everything out. Several O/Cs mentioned cases of company commanders detaining villagers after an attack when in fact the villagers had nothing to do with it. A couple of O/Cs mentioned that sometimes leaders are too quick to use lethal force rather than thinking about other non-lethal options they have.

In a related comment, one O/C talked about the importance of training Soldiers and leaders to see things in shades of gray rather than black and white. For example, a civilian leader may be looking the other way when the enemy takes action in his town but is also allowing the unit to patrol the city. Locking up the civilian leader is not always the best course of action because second order effects may be worse. For example, the leader who takes his place may be worse or the population may grow hostile towards U.S. forces there. In this case, a better course of action may be to try to reform the civilian leader.

Finally, one O/C said that he felt that if the commander or leader didn't have a relationship or background with the source, he was more likely to be objective about reacting to information from that source. This O/C described a situational training exercise where an informer fed commanders false information to get them to do his bidding. The O/C was impressed with the number of commanders that didn't immediately react to this information, but who took the time to gather both sides of the story.

*Make a decision based on information that has been discredited.* There was no single type of situation that characterized this type of error. One O/C said he had seen commanders disregard information about a town because they believed they knew the town and didn't want to believe that things had changed. Other O/Cs mentioned that this type of error stems from poor information management SOPs. For example, if a source was discovered to be bad, units would stop taking new information from that source, but there was rarely an effort to go back and pull out intelligence already gathered from that source or reanalyze conclusions which may have been based on that bad information.

*Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources originate from the same primary source.* There were only a few example of this type of error given. One O/C described a mission in which brigade thought that they had two reports of a high value target being in a city when in fact they had only one. In another case, a patrol was ambushed and another patrol reacted to provide support. When reports went up that two units were in contact, they were listed as separate engagements. Even after the O/Cs hinted that the commanders should look more carefully, this error was not corrected for six hours.

*Make a decision assuming that simultaneous, similar events are causally related when there is no evidence to support this conclusion.* Examples provided here included cases of events happening at the same time (e.g., ambush or IED attack, protests) being linked because they occurred together. Two O/Cs mentioned a battalion commander who believed that the Sunni and Shia were working together because an explosively formed projectile (EFP), which was a signature of the Shia, was used in a predominantly Sunni village. A couple of O/Cs said more often, the problem was the opposite: that leaders and commanders failed to see that events occurring together were connected.

*Make a decision based on input from a small sample of individuals when input from a larger group is available.* Several O/Cs gave examples of company commanders forming conclusions about the disposition of a population based on input from only a few key civilian leaders. They noted the importance of talking to lots of people and getting the view of the common man. Others mentioned battalion commanders sometimes relying too much on their staffs rather than their company commanders for an understanding of their AOs.

## Most Common Errors

The O/Cs were asked to think about all the decision errors they had observed in units training at JRTC and identify the one they had observed most often: either one of the six common decision errors or a novel error. Although they were asked to identify a single error, four could not choose between two errors and one identified three errors. As can be seen in Table 19, making a decision with a critical piece of information missing was most frequently identified as the error seen most often. This was followed by making a decision based on a salient or emotional or recent event, and making a decision assuming simultaneous events are causally related when they are not.

After identifying the error they had seen most often, the O/Cs were asked to indicate whether their choices varied by echelon, mission phase, rank/experience, staff section, or mission type. Whenever the O/Cs indicated that their choice varied by a factor, they were asked to explain why.

Table 19  
*Most Common Decision Errors*

Error	No. examples provided	Factors that impacted error				
		Echelon	Mission Phase	Rank/ Experience	Staff Section	Mission Type
Critical information missing	12	6(50%)	7(58%)	10(83%)	8(67%)	8(67%)
Based on personal, salient information	6	5(83%)	5(83%)	6(100%)	2(33%)	6(100%)
Simultaneous events assumed to be related	5	2(40%)	1(20%)	5(100%)	4(80%)	1(20%)
Relied on input from small sample	2	2(100%)	2(100%)	2(100%)	0	0
Information has been discredited	1	0	1(100%)	0	1(100%)	0
Didn't realize secondary sources are all related	1	0	0	1(100%)	1(100%)	0
<b>Total</b>	<b>27</b>	<b>15(56%)</b>	<b>16(59%)</b>	<b>24(89%)</b>	<b>16(59%)</b>	<b>15(56%)</b>

Note. The values under "Factors that impacted error" represent the number of examples in which the factor was cited as impacting that error. The percent in parentheses is that number as a percent of all examples of the error.

When decision errors varied by echelon, it was the lower echelons that made more errors. This was attributed primarily to less experienced leaders at lower echelons. Errors were more likely during execution as this is when emotions run higher and there is less time to react. A couple said that errors were more critical during the planning phase however. As might be expected, errors were more often made by less experienced, lower ranking individuals, although almost all O/Cs said that experience was more important than rank. The S2 and S3 staff sections were, not surprisingly, the most likely sections to make critical decision errors. These two staff

sections make most of the critical operational decisions. There was no clear consensus on which was more prone to errors.

The mission type on which errors were most common depended on the type of error. For making a decision with a critical piece of information missing, a variety of missions were seen as more susceptible. For example, convoy missions, mounted patrols, and route clearance were all seen as susceptible to this type of error because they would often lack information about the location of IEDs along their routes. Missions in which units were dispersed were also susceptible because communication among those units was less efficient. One O/C said that any mission with time critical information is more susceptible to this type of error. For error B, make a decision based on salient, emotional, or recent experience, almost all O/Cs agreed that anytime contact is made with the enemy, this type of decision error is more likely because emotions are running high.

### *Most Dangerous Errors*

The O/Cs were also asked to identify the most dangerous decision errors they had seen. As with the most common errors, they were also asked to indicate whether the echelon, mission phase, rank/experience of the decision maker, staff section, or mission type mattered. As can be seen in Table 20, the most dangerous error was to make a decision based on recent, salient, or emotional experience ignoring information that trends have changed. The second most frequently identified dangerous error was to make a decision based on a small sample, when information from a larger sample was available. Interestingly this error was not seen as happening very frequently as discussed above (Table 19).

When commenting about the factors that affected their choices, many of the O/Cs discussed how the five contributing factors impacted the *likelihood* of the mistake rather than the *dangerousness* of the mistake. O/Cs said that mistakes were both more dangerous and more likely at lower echelons. In the case of making a decision based on personal, salient information, this was because the lower echelons were closer to the action and therefore more likely to be emotional in their responses.

Most O/Cs said that errors were either more frequent or more dangerous during the execution phase. A couple said that they were more dangerous during planning because this affected execution. The O/Cs all said that with more experience, leaders and commanders were less likely to make decision errors. One said that in the case of combat experience, it was not experience per se, but how well the experience matched their current mission. For example, someone with experience from Afghanistan might not have experience that is relevant for Iraq.

Table 20

*Most Dangerous Decision Errors*

Error	No. examples provided	Factors that impacted error				
		Echelon	Mission Phase	Rank/ Experience	Staff Section	Mission Type
Based on personal, salient information	9	5(56%)	5(56%)	7(78%)	4(44%)	4(44%)
Relied on input from small sample	7	5(71%)	4(57%)	5(71%)	5(71%)	3(43%)
Critical information missing	5	4(80%)	3(60%)	3(60%)	1(20%)	1(20%)
Information has been discredited	1	0	1(100%)	1(100%)	1(100%)	1(100%)
Didn't realize secondary sources are all related	1	1(100%)	1(100%)	1(100%)	1(100%)	1(100%)
Simultaneous events assumed to be related	1	1(100%)	0	0	0	1(100%)
<b>Total</b>	<b>24</b>	<b>16(67%)</b>	<b>14(58%)</b>	<b>17(71%)</b>	<b>12(50%)</b>	<b>11(46%)</b>

Note. The values under "Factors that impacted error" represent the number of examples in which the factor was cited as impacting that error. The percent in parentheses is that number as a percent of all examples of the error.

Many of the O/Cs who commented, said that the S2 and S3 were the places where decision errors have the biggest impact. Finally, there were not too many comments about mission type. The most common comment was that errors were more dangerous during combat or offensive types of missions. One said that they were more likely during non-lethal than lethal missions because the response to contact is trained in battle drills whereas non-lethal missions are less scripted.

*Decision Errors and Digital Systems*

The next set of questions in the interview focused on the six common decision errors and how digital systems either protect leaders from making them or increase the likelihood of those errors.

For each error, the O/Cs were asked to discuss ways in which digital systems might protect against that decision error and ways that digital systems might increase that error. As can be seen in Table 21, most of the O/Cs' comments were about digital systems generally (i.e., unspecified), but some were about specific systems. Overall, there were more instances of digital systems protecting against decision errors than cases of them contributing to decision errors.

In the case of making a decision when information is missing (error A), the ability of these systems to rapidly share information on the battlefield was frequently cited as a reason digital systems reduce the likelihood of this error. When asked how digital systems might increase this type of error, comments were centered on operator errors. For example, if operators don't regularly update systems or assume that all information in the system is accurate without

confirming it, then this type of error can increase. A couple also said that the volume of information can overwhelm operators causing them to overlook a critical piece of information. Only one O/C mentioned interoperability problems as a contributor to this error.

Table 21  
*Digital Systems and Decision Errors*

Digital System	Protect/Increase	Error (# Examples Provided)						Total
		A	B	C	D	E	F	
FBCB2	increase	4	2	1	1		1	9
	protect	5	3	2	1	1	5	17
ASAS	increase			1				1
	protect	1	1		1	2		5
MCS	increase							0
	protect		1					1
CPOF	increase	1		1	1			3
	protect		1				1	2
Unspecified	increase	10	8	14	7	9	9	57
	protect	14	7	12	8	8	9	58

Note: Decision errors are: A - make a decision with a critical piece of information missing; B - make a decision based on a personal, salient, or emotional event; C - make a decision based on information that has been discredited; D - make a decision based on secondary sources that all derive from the same primary source; E - make a decision assuming simultaneous, similar events are causally related; and F - make a decision based on input from a small sample of individuals. None of the O/Cs mentioned AFATDS. Several O/Cs mentioned CPOF and so it is included here

Digital systems protect individuals from making decisions based on emotional, recent, or salient experiences (error B) by giving them the big picture. For example, one O/C said that a company commander or platoon leader can see what is happening all over town to contrast with his own experiences. A couple of O/Cs also said that the process of using a digital system to analyze information might force leaders and commanders to think more objectively and less emotionally about events. When discussing ways that digital systems might increase this type of error, all of the O/Cs comments centered on misuse of the systems. For example, O/Cs said that if information is not updated or is mismanaged, then this error might be more likely.

Protection from making a decision based on information that has been discredited (error C) was accomplished primarily by good operator skills. For example, many O/Cs said that as long as the information is regularly updated and discredited information is purged from the system, there should be no problems. Several noted that digital systems can't discredit information on their own. Thus, the systems increase the rate of this error when operators don't remove bad data.

Operator errors also play a role in rates of making a decision based on the assumption that multiple reports are independent, when in fact they all originate from the same source (error D). The O/Cs mentioned stories of multiple reports confusing leadership into thinking a large-scale attack was underway when in fact it was only a small attack. Others mentioned that having a time-stamp on the information could help to reduce redundant reports being confused as being independent. Several mentioned that when high volumes of information are being entered into

the system, this error is more likely to happen. Conversely, O/Cs said that systems protect against this error when they accurately identify the sources of information.

Assuming that simultaneous events are causally related (error E) can be prevented by digital systems that allow users to analyze data to better understand trends and see whether events are truly connected or not. One O/C said that the reach-back capability of systems can be a huge help for analysts trying to understand trends. The O/Cs said that large amounts of data presented by digital systems might increase the likelihood that users would see patterns where there are none. Many of the O/Cs said that this type of error is primarily due to operator error and inexperience.

Many of the O/Cs said that making a decision based on input from a small sample when information from a larger sample is available (error F) is less likely because digital systems allow commanders easy access to input from all units across their AO. For example, the ability of FBCB2 to share information across the unit helps commanders to always see the big picture. On the other hand O/Cs said that digital systems can increase this error if commanders, believing they have all the information they need, don't get out of the TOC and talk to their subordinate commanders or tour the AO. In other words, they may miss important information they would get through face to face communication with others.

### *Factors That Contribute to Success and Failure*

The O/Cs were asked to look at the factors that contribute to mission success and mission failure and rank them in importance. The factors that contribute to mission success were good operator skills, good employment skills, good SOP, able to cope with hardware problems, and able to cope with software problems. The factors that contribute to mission failure were the converse of these, (e.g., poor operator skills, unable to cope with hardware problems). The rankings of these factors can be found in Table 22.

Operator and employment skills and SOP for using digital systems were more critical contributors to both mission success and mission failure than was the ability to cope with hardware or software problems. This can be seen when looking at the mean ranks of these factors as well as the distribution of ranks assigned to these factors. For example, good operator skills, employment skills, and SOP were frequently ranked number one, but ability to cope with hardware and software problems never were. The latter two were also frequently ranked last, but good operator and employment skills were never ranked last.

Table 22

*Ranking of Factors that Contribute to Mission Success and Failure*

Factor	Frequency of rankings					Mean rank
	1st	2nd	3rd	4th	5th	
Factors that contribute to mission success						
Good operator skills	7	8	6			1.95
Good employment skills	9	6	4	2		1.95
Good SOP	5	6	8		2	2.43
Able to cope with software problems			1	12	7	4.30
Able to cope with hardware problems		1	2	6	11	4.35
Factors that contribute to mission failure						
Poor operator skills	9	5	6	1		1.95
Poor SOP	7	8	3		3	2.24
Poor employment skills	4	7	9	1		2.33
Unable to cope with software problems		1	2	9	8	4.20
Unable to cope with hardware problems	1		1	9	9	4.25

Note: Values under "Frequency of Rating" are the number of times each factor was assigned a rank of 1 - 5.

When looking at the factors that contributed to mission failure, poor operator skills, employment skills, and SOP were clearly more important than the inability to cope with hardware and software skills. As with the factors contributing to mission success, the mean ranks and distribution of ranks show this.

*System Redesign and Final Comments*

O/Cs suggested ways that they would redesign ABCS systems to help minimize the decision-making errors they had observed. The most common comment was to have the systems more interoperable. For example, some O/Cs mentioned that MCS and CPOF should be able to feed all their data into FBCB2. Otherwise, FBCB2 just gets used for navigation. Another suggestion to improve cross communication among systems was to increase bandwidth so that systems can transmit large graphic files without crashing.

Many O/Cs also said that the software needs to be standardized both so that operators can maintain proficiency on these systems and to improve system interoperability. The O/Cs noted that the constant stream of software upgrades negates prior training and requires new training. Non standard interfaces also mean that common tasks, such as building an overlay, must be done differently depending on the system in use. This means that training on one system rarely transfers to other systems. Several O/Cs noted that a single system designed to do everything might be the best way to overcome these challenges.

A couple of O/Cs said it was necessary to improve the ability of systems to archive and track historical data. This was especially true for CPOF. This capability is necessary if units are to analyze trends and understanding how current enemy activity fits into any patterns that are developing. It would also make it easier to brief commanders on recent enemy activity.

Related to this, one O/C mentioned again the importance of improving the standardized military graphics. For example, there are no standard symbols to distinguish between the many types of IEDs. This results in individual units adopting their own standards making it almost impossible to compare or “synchronize” databases across different units.

When asked to share final comments about how digital systems have helped or hindered decision making, virtually all responses had to do with a need for greater training. Some said that the systems work well, but Soldiers just don't know how to use or employ them or units lack effective SOP. Others spoke more specifically about a need for better training on how to integrate the systems or use preformatted messages. One O/C complained that people spend too much time processing mountains of data and by the time their summary is done, it is overcome by events. Finally, a couple of O/Cs worried that Soldiers' are forgetting how to perform tasks like planning, analysis, and navigation without digital systems.

## Discussion

As described in the introduction, the purpose of this research effort was to provide a qualitative look at how digital systems have impacted decision-making errors in units training at JRTC. To provide a context for understanding this interaction, digital system proficiency and general decision-making errors were also examined.

It was clear that units coming to JRTC need more training on digital systems. From the T/P/U ratings to their comments, O/Cs indicated that only a minority of units were fully trained to use their ABCS systems. Despite the fact that few units were rated as trained, they were still able to leverage at least some system capabilities in ways that contributed to mission success. Indeed, for all systems, a majority of the units were able to leverage at least one capability for mission success, so being fully trained was not a prerequisite for being able to employ the system. The percent of units that leveraged system capabilities for mission success varied from 89% (for the use of the navigational capabilities of FBCB2) to less than 10% (for several of the ASAS capabilities).

When looking at the contributing factors, good operator skills, employment skills, and SOP all contributed to mission success more than the ability to cope with hardware and software problems. Similarly, poor operator skills, employment skills, or SOP detracted from mission success more than the inability to cope with hardware or software problems. This does not mean that the ability to troubleshoot problems was not a concern, but it clearly indicates that a greater priority should be given to training on operator and employment skills and SOP.

One suggestion for improving SOP is to incorporate information management with digital systems into mission planning and rehearsal. Evans, Reese, and Weldon (2007) found that when information management was emphasized during the planning process, it enhanced mission accomplishment 83% of the time. When it wasn't emphasized during planning, good information management only enhanced mission accomplishment 33% of the time.

The current operating environment may have also contributed to low levels of training on some of the systems, specifically MCS and AFATDS. Units were encouraged to use CPOF in lieu of MCS so that they would gain experience with the system they were likely to use in theater. AFATDS was not used much because of the limited use of artillery around population centers. Units, knowing that these systems would not be used much in theater, may have focused their training on other skills that they believed to be more critical.

Of all the digital systems, units were best trained on FBCB2, but even for this system less than a third were rated as trained on seven of the nine system capabilities examined. Units were best at using the navigational capabilities of this system. Units also used the system for messaging, although primarily as a backup for voice communication when out of radio range. It appears that one of the key capabilities of FBCB2 - to prepare and distribute orders - was not used by many units. One of the main reasons for this was that these orders are slow to transmit over the lower tactical internet because of the large size of graphic messages.

Units were generally not seen as highly proficient on MCS (fewer than a fifth were rated as trained on any system capability). Units had difficulty getting information into MCS from other systems. Because the integration of the blue and red force pictures is a critical function of MCS, this was a significant problem. Nevertheless, two thirds of units were able to use MCS to update friendly and enemy locations on the battlefield.

The greatest training deficiencies were seen for ASAS. Fewer than 10% of the units were rated as trained on eight of the nine system capabilities. Less than a third of the units were able to leverage seven of the nine capabilities for mission success. Units were not using this system to help predict enemy activity. Other problems resulted from a mismatch between the high intensity conflict for which ASAS was designed and the counterinsurgency conflict that it is currently being used for. Problems such as the lack of military standard graphics to depict various types of IEDs or insurgent cells made it difficult for units to effectively employ ASAS.

Fewer than a third of all units were rated as trained on eight of the nine AFATDS capabilities. Nevertheless, at least half of the units were able to leverage eight of the nine capabilities for mission success.

Overall, units were good at leveraging cross-system capabilities. For example, a majority of units were able to maintain an accurate friendly and enemy force picture and network systems together, but some weaknesses were noticed. Specifically, units often lacked the analog skills to continue to track friendly forces when digital systems went down. Others had trouble when the TOC had to be moved.

The overall picture then is one of good news and bad news. The good news is that units are able to leverage at least some capabilities of their digital systems to accomplish their missions. The bad news is that few units are fully trained to use these systems and so they remain a largely underutilized resource in operational units. Given this state of affairs, it might be expected that units would have a relatively high rate of decision errors when using digital systems. The responses of the T/Ms to questions about decision errors did not support this expectation.

First of all, when T/Ms were asked to describe all decision errors they had seen, digital systems were implicated in only two of the six types of errors. Digital systems were implicated in the most commonly recalled decision error: making a decision with a critical piece of information missing, but not knowing it is missing. T/Ms gave many examples of information not making its way across the unit so that the right people had the necessary information to make a decision. Problems arose for both the top-down flow of information as when patrols were not aware they were approaching a known danger area as well as the bottom-up flow of information as when headquarters were not aware of the locations of subordinate units. When digital systems were implicated in this type of error, it was due to challenges associated with sending information from one system to another as well as poor information management by the users.

These findings are consistent with a report on information management at JRTC (Evans, Reese, & Weldon, 2007) which also found problems with the dissemination and control of information. Data in that research were collected by O/Cs over seven rotations. O/Cs completed checklists on Battalions, Companies, and Platoons. Across all echelons examined, 56% had ineffective practices for disseminating information that degraded mission accomplishment.

The only other decision error for which digital systems were mentioned as contributors was: making a decision based on the consistency of multiple secondary sources. Interestingly, the Folds, Blunt, and Stanley (2008) report found this was a common error of users of their information system. In contrast, that error was the least commonly reported in the present report. One possible explanation for this discrepancy is that in the Folds et al., report, decision makers were deliberately fed multiple redundant reports, whereas at JRTC, the information given to decision makers depended on the ongoing operations. In other words, leaders and commanders training at JRTC may not have been exposed to as many redundant reports as the decision makers in the Folds et al., research. The present report did agree with Folds, Blunt, and Stanley (2008) that making a decision based on a personal, salient, emotional, or recent even was a common error.

Another reason that digital systems do not appear to increase decision errors is that the T/Ms indicated slightly more examples of digital systems protecting against decision errors (58 examples) than promoting them (57 examples). T/Ms were asked to indicate ways in which digital systems both promote and protect against decision errors. They were free to list as many examples as they could think of for both categories. This is admittedly indirect proof of the protective effect of digital systems, but should also be remembered that the reasons O/Cs gave for digital systems increasing errors rarely had to do with system design. In most cases, O/Cs said errors were increased by the misuse of the systems.

Although decision errors were not related to system design, the O/Cs did have some suggestions for system redesign. The most common system problem reported was difficulty getting the systems to share information. Another critical improvement would be the ability to track historical data especially in CPOF, which is rapidly replacing MCS. Finally, the systems could be better adapted for a COIN mission. The military standard graphics do not allow units to track counterinsurgency weapons (e.g., different types of IEDs), activities, and units in a way

that is commonly understood across multiple AOs. This has hindered efforts to synchronize data across AOs so that higher echelon commander can see the broader picture of enemy activity.

## Conclusions

- With certain exceptions, most units coming to train at JRTC are not fully trained to use their digital systems. Despite this, units are still able to leverage at least some system capabilities to support mission success.
- Expertise on all systems and system functions is not uniform. Overall, units seem to be most skilled at using FBCB2 and least skilled at using ASAS. Within systems, there were big differences across system capabilities. This was true when looking both at T/P/U ratings and at the ability of units to leverage functions to support mission success.
- The most common decision errors either with or without digital systems were: making a decision with a critical piece of information missing but not recognizing that it is missing; making a decision based on a personal, salient, emotional or recent event, ignoring evidence that trends have changed; and making a decision based on information that has been discredited.
- The most dangerous decision errors were: making a decision based on a personal, salient, emotional or recent event, ignoring evidence that trends have changed; making a decision based on input from a small sample of individuals when input from a larger group is available; and making a decision with a critical piece of information missing but not recognizing that it is missing.
- Digital systems do not appear to increase decision errors significantly. Digital systems were rarely implicated in decision errors described by the O/Cs, and were more often described as protecting against errors than increasing them. Digital systems do not appear to greatly inhibit decision errors as might have been hoped, but it would be expected that with better training, those protective effects might become more apparent.
- O/Cs saw some ways in which digital systems could be improved. Specifically, systems should more effectively share information among themselves and military standards should be developed and added to systems to represent enemy weapons, activities, and units for COIN operations.



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Appendix A  
SURVEY FORMS

## O/C Demographic Information and Training and Experience on ABCS Systems



**Purpose:** This survey is being conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences. The purpose for collecting demographic information and information about your training and experience with ABCS systems is to provide some context for your responses to questions that will be asked regarding your observations of units rotating through JRTC.

Your responses to this questionnaire are completely anonymous and you will not be asked to provide any information that would identify you personally (e.g. name, social security number, etc.)

### **PRIVACY ACT STATEMENT**

Public Law 93-573, called the Privacy Act of 1975, requires that you be informed of the purpose and uses to be made of the information collected.

The Department of the Army may collect the information requested in this survey under the authority of 10 United States Code 2358. Providing information is voluntary. Failure to respond to any particular questions will not result in any penalty.

The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

**1. List the duty assignments you have had at JRTC, starting with the most recent.**

Duty assignments:	from: mm/yy	to: mm/yy
current:		

**2. List any other duty assignments as an O/C not at JRTC (e.g. NTC)**

Duty assignments:	from: mm/yy	to: mm/yy

	at JRTC	Other
<b>3. Number of units you observed as an O/C (#)</b>		
<b>4. Number of units you observed as an O/C that brought and used digital ABCS systems (#)</b>		
<b>5. Of the ABCS systems listed to the right, which ones were used by individuals you were responsible for observing as an O/C? (check all that apply)</b>	<input type="checkbox"/> FBCB2 <input type="checkbox"/> ASAS <input type="checkbox"/> MCS <input type="checkbox"/> AFATDS	<input type="checkbox"/> FBCB2 <input type="checkbox"/> ASAS <input type="checkbox"/> MCS <input type="checkbox"/> AFATDS

**6. Your current Rank \_\_\_\_\_.**      **Your current Branch/PMOS/Specialty \_\_\_\_\_.**

**7. Please indicate how long you have served in the following capacities:**

Capacity	years/months
Time in service (Army)	
Enlisted service	
Commissioned service	
Current rank	

**8. Which leadership positions have you held?**

position	years/months	In combat?	
Time as a squad leader		<input type="checkbox"/> yes	<input type="checkbox"/> no
Time as a platoon sergeant		<input type="checkbox"/> yes	<input type="checkbox"/> no
Time as a 1 <sup>st</sup> sergeant		<input type="checkbox"/> yes	<input type="checkbox"/> no
Time as a platoon leader		<input type="checkbox"/> yes	<input type="checkbox"/> no
Time as a company XO		<input type="checkbox"/> yes	<input type="checkbox"/> no
Time as a company commander		<input type="checkbox"/> yes	<input type="checkbox"/> no

**9. Which staff positions have you held? (Specify the echelon (BN, BDE, etc.) and position or title (AS3, S3 Air, S2 NCO, etc.))**

Staff positions (echelon and title)	years/months	In combat?	
		<input type="checkbox"/> yes	<input type="checkbox"/> no
		<input type="checkbox"/> yes	<input type="checkbox"/> no
		<input type="checkbox"/> yes	<input type="checkbox"/> no
		<input type="checkbox"/> yes	<input type="checkbox"/> no
		<input type="checkbox"/> yes	<input type="checkbox"/> no
		<input type="checkbox"/> yes	<input type="checkbox"/> no

**10. Indicate the types of units in which you have served.**

Armor \_\_\_\_ BFV \_\_\_\_ Stryker \_\_\_\_ Light Infantry \_\_\_\_ Other (Specify) \_\_\_\_\_

**11. Combat Experience:** OIF \_\_\_\_; OEF \_\_\_\_; Other (Specify) \_\_\_\_\_

12. How many hours of formal individual system operator training have you received for each of the digital systems listed below.

Training		FBCB2	ASAS	MCS	AFATDS
<b>No Operator Training (check)</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Online Course</b>	<b>Hours</b>				
<b>Trained in OBC</b>	<b>Hours</b>				
<b>NET Training</b>	<b>Hours</b>				
<b>NET Delta Training (trained on changes and upgrades)</b>	<b>Hours</b>				
<b>Digital Master Trainer Course</b>	<b>Hours</b>				
<b>Other: _____</b>	<b>Hours</b>				

13. Indicate the types of collective unit training you have had with the following systems. Place an "X" in all appropriate boxes.

	FBCB2	ASAS	MCS	AFATDS
No collective unit training Received				
Company or Platoon Motorpool training				
Company or Platoon FTX at home station				
Company or Platoon FTX at a CTC				
CPX training in a digital training facility				
CPX training at home station				
CPX training at a CTC				
Other:				

14. Have you ever used any digital systems while deployed on a combat tour?  YES  NO

If you answered YES, complete the table below. If you answered NO go on to question 15.

System and Version	Combat Theater	Duty position when using this system	Number of months you used this system in theater

15. Overall how would you rate your proficiency on each system?

Basic – You can use the system to perform a limited set of functions but there are many aspects of the system with which you are unfamiliar.

Medium – You are comfortable with the system and are knowledgeable about most of its functions and quirks. You have limited troubleshooting abilities.

High - You have advanced knowledge of this system and can troubleshoot many problems. You frequently are asked to help others who have difficulty with the system.

Check the appropriate boxes:

System	Never Used	Basic	Medium	High
FBCB2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ASAS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MCS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AFATDS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



## Use of FBCB2/BFT by Units Training at JRTC

A-6

**PURPOSE.** This survey is intended to capture your ratings of the ABCS capabilities employed by units training at JRTC. Once you have completed this survey, you will be asked follow-up questions regarding your responses. We are conducting this survey for the purpose of providing feedback to trainers and training developers of ABCS systems.

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The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

## Assessment of Digital System Capabilities

1. How many units have you observed in which the individual(s) you were observing operated or employed FBCB2?  
 \_\_\_\_\_

2. To the best of your ability, indicate the number of units you observed operating or employing FBCB2, that you would rate as T (Trained), P (practice needed) or U (untrained) for each of the FBCB2 capabilities listed below.

NOTE: Totals across each row should equal the number of units you indicated in question 1.

- T** = trained, meaning that the task can be performed to standard without significant shortcomings
- P** = practice needed, meaning that the task is performed with some errors
- U** = untrained, meaning that the task cannot be performed to standard

A-7

Major FBCB2 Capabilities	Number of Units		
	T	P	U
1. Support navigation (knowing your position, map displays, and route selection aids to a selected destination).			
2. Distribute C <sup>2</sup> I messages (alerts/warnings/messages/reports, i.e. calls for fire, SALT, etc).			
3. Develop and distribute unit task organization/reorganization data.			
4. Process and display status information (provided by weapon systems, sensors, and support platforms and units).			
5. Prepare and distribute orders (Warning, Operations, and FRAGOs – text and overlays).			
6. Receive, develop, and distribute a common battlefield picture (known locations of other friendly, enemy elements, control measures, and graphics).			
7. Access prepared messages, reports, and requests for edit and/or transmission.			
8. Conduct a circular and/or line of sight analysis for selected locations.			
9. Support clearance of fires, maneuver decisions, and fratricide avoidance.			

Comments:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**3. Indicate the number of units you observed using FBCB2, in which use of the FBCB2 capabilities listed below contributed to mission success.**

Major FBCB2 Capabilities	Number of units in which use of this capability contributed to mission success	Number of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Support navigation (knowing your position, map displays, and route selection aids to a selected destination).						
2. Distribute C <sup>2</sup> I messages (alerts/warnings/messages/reports, i.e. calls for fire, SALT, etc).						
3. Develop and distribute unit task organization/reorganization data.						
4. Process and display status information (provided by weapon systems, sensors, and support platforms and units).						
5. Prepare and distribute orders (Warning, Operations, and FRAGOs – text and overlays).						
6. Receive, develop, and distribute a common battlefield picture (known locations of other friendly, enemy elements, control measures, and graphics).						
7. Access prepared messages, reports, and requests for edit and/or transmission.						
8. Conduct a circular and/or line of sight analysis for selected locations.						
9. Support clearance of fires, maneuver decisions, and fratricide avoidance.						

Other factors that contributed to mission success:

**4. Indicate the number of units you observed using FBCB2, in which failure to use the FBCB2 capabilities listed below contributed to mission failure.**

Major FBCB2 Capabilities	Number of units in which failure to use this capability contributed to mission failure	Number of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Support navigation (knowing your position, map displays, and route selection aids to a selected destination).						
2. Distribute C <sup>2</sup> I messages (alerts/warnings/messages/reports, i.e. calls for fire, SALT, etc).						
3. Develop and distribute unit task organization/reorganization data.						
4. Process and display status information (provided by weapon systems, sensors, and support platforms and units).						
5. Prepare and distribute orders (Warning, Operations, and FRAGOs – text and overlays).						
6. Receive, develop, and distribute a common battlefield picture (known locations of other friendly, enemy elements, control measures, and graphics).						
7. Access prepared messages, reports, and requests for edit and/or transmission.						
8. Conduct a circular and/or line of sight analysis for selected locations.						
9. Support clearance of fires, maneuver decisions, and fratricide avoidance.						

Other factors that contributed to mission failure:



## Use of MCS by Units Training at JRTC

A-10

**PURPOSE.** This survey is intended to capture your ratings of the ABCS capabilities employed by units training at JRTC. Once you have completed this survey, you will be asked follow-up questions regarding your responses. We are conducting this survey for the purpose of providing feedback to trainers and training developers of ABCS systems.

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The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

## Assessment of Digital System Capabilities

1. How many units have you observed in which the individual(s) you were observing operated or employed MCS?  
\_\_\_\_\_

2. To the best of your ability, indicate the number of units you observed operating or employing MCS, that you would rate as T (Trained), P (practice needed) or U (untrained) for each of the MCS capabilities listed below.

NOTE: Totals across each row should equal the number of units you indicated in question 1.

- T** = trained, meaning that the task can be performed to standard without significant shortcomings
- P** = practice needed, meaning that the task is performed with some errors
- U** = untrained, meaning that the task cannot be performed to standard

II-V

Major MCS Capabilities	Number of Units		
	T	P	U
1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.			
2. Conduct mobility analysis of the terrain.			
3. Analyze different courses of action.			
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).			
5. Access up-to-date situational and decision support information from other ATCCS systems.			
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).			
7. Update friendly/enemy unit movement locations and battlefield geometry.			

Comments:

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\_\_\_\_\_

3. Indicate the number of units you observed using MCS, in which use of the MCS capabilities listed below contributed to mission success.

Major MCS Capabilities	Number of units in which use of this capability contributed to mission success	Number of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.						
2. Conduct mobility analysis of the terrain.						
3. Analyze different courses of action.						
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).						
5. Access up-to-date situational and decision support information from other ATCCS systems.						
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).						
7. Update friendly/enemy unit movement locations and battlefield geometry.						

Other factors that contributed to mission success:

4. Indicate the number of units you observed using MCS, in which failure to use the MCS capabilities listed below contributed to mission failure.

Major MCS Capabilities	Number of units in which failure to use this capability contributed to mission failure	Number of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.						
2. Conduct mobility analysis of the terrain.						
3. Analyze different courses of action.						
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).						
5. Access up-to-date situational and decision support information from other ATCCS systems.						
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).						
7. Update friendly/enemy unit movement locations and battlefield geometry.						

Other factors that contributed to mission failure:



## Use of ASAS by Units Training at JRTC

A-14

**PURPOSE.** This survey is intended to capture your ratings of the ABCS capabilities employed by units training at JRTC. Once you have completed this survey, you will be asked follow-up questions regarding your responses. We are conducting this survey for the purpose of providing feedback to trainers and training developers of ABCS systems.

**PRIVACY ACT INFORMATION:** Public Law 93-573, called the Privacy Act of 1975, requires that you be informed of the purpose and uses to be made of the information collected.

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The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

## Assessment of Digital System Capabilities

1. How many units have you observed in which the individual(s) you were observing operated or employed ASAS? \_\_\_\_\_

2. To the best of your ability, indicate the number of units you observed operating or employing ASAS, that you would rate as T (Trained), P (practice needed) or U (untrained) for each of the ASAS capabilities listed below.

NOTE: Totals across each row should equal the number of units you indicated in question 1.

**T** = trained, meaning that the task can be performed to standard without significant shortcomings

**P** = practice needed, meaning that the task is performed with some errors

**U** = untrained, meaning that the task cannot be performed to standard

Major ASAS Capabilities	Number of Units		
	T	P	U
1. Integrate, process, and correlate enemy information (input information from different sources).			
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.			
3. Provide probable identification of enemy units (using analysis tools).			
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.			
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.			
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).			
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.			
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.			
9. Support rapid attack of high priority/critical targets as identified.			

Comments:

3. Indicate the number of units you observed using ASAS, in which use of the ASAS capabilities listed below contributed to mission success.

Major ASAS Capabilities	Number of units in which use of this capability contributed to mission success	Number of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Integrate, process, and correlate enemy information (input information from different sources).						
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.						
3. Provide probable identification of enemy units (using analysis tools).						
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.						
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.						
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).						
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.						
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.						
9. Support rapid attack of high priority/critical targets as identified.						

Other factors that contributed to mission success:

4. Indicate the number of units you observed using ASAS, in which failure to use the ASAS capabilities listed below contributed to mission failure.

Major ASAS Capabilities	Number of units in which failure to use this capability contributed to mission failure	Number of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Integrate, process, and correlate enemy information (input information from different sources).						
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.						
3. Provide probable identification of enemy units (using analysis tools).						
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.						
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.						
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).						
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.						
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.						
9. Support rapid attack of high priority/critical targets as identified.						

Other factors that contributed to mission failure:



## Use of AFATDS by Units Training at JRTC

A-18

**PURPOSE.** This survey is intended to capture your ratings of the ABCS capabilities employed by units training at JRTC. Once you have completed this survey, you will be asked follow-up questions regarding your responses. We are conducting this survey for the purpose of providing feedback to trainers and training developers of ABCS systems.

**PRIVACY ACT INFORMATION:** Public Law 93-573, called the Privacy Act of 1975, requires that you be informed of the purpose and uses to be made of the information collected.

The Department of the Army may collect the information requested in this survey under the authority of 10 United States Code 2358. Providing information is voluntary. Failure to respond to any particular questions will not result in any penalty.

The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

### Assessment of Digital System Capabilities

1. How many units have you observed in which the individual(s) you were observing operated or employed AFATDS? \_\_\_\_\_

2. To the best of your ability, indicate the number of units you observed operating or employing AFATDS, that you would rate as T (Trained), P (practice needed) or U (untrained) for each of the AFATDS capabilities listed below.

NOTE: Totals across each row should equal the number of units you indicated in question 1.

- T = trained, meaning that the task can be performed to standard without significant shortcomings
- P = practice needed, meaning that the task is performed with some errors
- U = untrained, meaning that the task cannot be performed to standard

Major AFATDS Capabilities	Number of Units		
	T	P	U
1. Facilitate fire support planning for current and future operations.			
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.			
3. Coordinate target damage assessment.			
4. Integrate all fire support systems via a data distributed processing system.			
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.			
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.			
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.			
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.			
9. Facilitate adjustment and override of fire support coordination and control measures.			

Comments:

3. Indicate the number of units you observed using AFATDS, in which use of the AFATDS capabilities listed below contributed to mission success.

Major AFATDS Capabilities	Number of units in which use of this capability contributed to mission success	Number of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Facilitate fire support planning for current and future operations.						
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.						
3. Coordinate target damage assessment.						
4. Integrate all fire support systems via a data distributed processing system.						
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.						
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.						
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.						
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.						
9. Facilitate adjustment and override of fire support coordination and control measures.						

Other factors that contributed to mission success:

4. Indicate the number of units you observed using AFATDS, in which failure to use the AFATDS capabilities listed below contributed to mission failure.

Major AFATDS Capabilities	Number of units in which failure to use this capability contributed to mission failure	Number of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Facilitate fire support planning for current and future operations.						
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.						
3. Coordinate target damage assessment.						
4. Integrate all fire support systems via a data distributed processing system.						
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.						
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.						
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.						
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.						
9. Facilitate adjustment and override of fire support coordination and control measures.						

Other factors that contributed to mission failure:



## Cross-System Capabilities Used by Units Training at JRTC

**PURPOSE.** This survey is intended to capture your ratings of the ABCS capabilities employed by units training at JRTC. Once you have completed this survey, you will be asked follow-up questions regarding your responses. We are conducting this survey for the purpose of providing feedback to trainers and training developers of ABCS systems.

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The Department of the Army may collect the information requested in this survey under the authority of 10 United States Code 2358. Providing information is voluntary. Failure to respond to any particular questions will not result in any penalty.

The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

The questions in this section pertain to the ways in which information is shared across systems. From the standpoint of the system(s) you observed being used, answer the following questions.

1. Responses in this section are based on your observation of which system(s) - check all that apply:

- FBCB2
  MCS
  ASAS
  AFATDS

2. How many units have you observed in which individuals you were observing operated or employed any of the four ABCS systems listed in question 1? \_\_\_\_\_

3. To the best of your ability, indicate the number of units you observed using any of the four ABCS systems listed in question 1, that you would rate as T (trained), P (practice needed), or U (untrained) for each of the capabilities listed below.

NOTE: Totals across each row should equal the number of units you indicated in question 2.

- T** = trained, meaning that the task can be performed to standard without significant shortcomings  
**P** = practice needed, meaning that the task is performed with some errors  
**U** = untrained, meaning that the task cannot be performed to standard

A-23

Assessment of Cross-System Capabilities	Number of Units		
	T	P	U
1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks.)			
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units)			
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted)			
4. Share appropriate information to conduct targeting planning and operations. (i.e FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information)			
5. Use digital systems to track the flow of the battle and to maintain situational understanding. (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up)			

Comments:

4. Indicate the number of units you observed using any ABCS system listed in question 1, in which use of the capabilities listed below contributed to mission success.

Cross-System Capabilities	Number of units in which use of this capability contributed to mission success	Number of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks.)						
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units)						
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted)						
4. Share appropriate information to conduct targeting planning and operations. (i.e FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information)						
5. Use digital systems to track the flow of the battle and to maintain situational understanding. (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up)						

Other factors that contributed to success in using cross-system capabilities:

5. Indicate the number of units you observed using any ABCS system listed in question 1, in which failure to utilize the capabilities listed below contributed to mission failure.

Cross-System Capabilities	Number of units in which failure to use this capability contributed to mission failure	Number of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks.)						
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units)						
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted)						
4. Share appropriate information to conduct targeting planning and operations. (i.e FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information)						
5. Use digital systems to track the flow of the battle and to maintain situational understanding. (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up)						

Other factors that contributed to failure to effectively use cross-system capabilities:



Appendix B  
INTERVIEW QUESTIONS

**Interview Questions for JRTC O/Cs  
Decision making in Units with Digital C<sup>3</sup> Systems**

Survey Follow-On:

Before starting with this set of questions, ask any necessary follow-up questions from the completed survey form.

Present the survey sheet to the O/Cs so that they can see their responses. Ask them:

- For each capability where you indicated use by at least one unit contributed to mission success (or failure to use it contributed to mission failure), describe a situation or situations exemplifying this particular use of (or failure to use) the capability.
- As you describe the situation(s), explain how the contributing factors played a role.

(Have list of factors available for reference – list and codes provided below.)

Survey Follow-on example of contribution to: <input type="checkbox"/> mission success <input type="checkbox"/> mission failure
System: <input type="checkbox"/> FBCB2 <input type="checkbox"/> ASAS <input type="checkbox"/> MCS <input type="checkbox"/> AFATDS <input type="checkbox"/> CROSS SYSTEM
Function:
Description:

*Note:* The table above was repeated and expanded on the actual interview form.

Interview Questions and Data Collection:

I will now ask you some questions regarding decision-making errors that you've observed in units equipped with digital systems. I realize that your answers are based on your best assessment and judgment from what you observed and understood when a decision was made. We are **not** attempting to evaluate the decision-making abilities of commanders and staff nor are we trying to compare the performance of specific units. Rather, our intent is to try and determine if and how the digital systems either contributed to or hindered decision making.

You saw a list of decision-making errors that have been studied by psychologists. Please refer to the reference sheet in front of you that lists the various types of decision-making errors.

1. Describe any decision-making errors you have observed and if possible, note which of the categories you feel it exemplifies. (Use "A-F" for quick reference.). If you have observed the same error made by many units, simply describe the error in a generic way and indicate the approximate frequency of the error. We define a decision-making error as a decision which resulted in a failure to meet all mission objectives. For each example, try to describe **who** made the error, **what** was the **error** and its **consequences**, and **why** do you think the error was made?

Question 1: Example of Decision-Making Error
Category of Error:
Error category generated by <input type="checkbox"/> O/C <input type="checkbox"/> Interviewer
Description:

*Note:* The table above was repeated and expanded on the actual interview form.

2. On your survey form you indicated that you have observed \_\_\_\_\_ (#) units with ABCS systems. Each of these units executed many missions and members of these units made multiple decisions for each mission. Keeping in mind the vast number of decisions that are made, what is the type of decision-making error you have observed **most often**? You may choose one of the six types on the list before you or you can describe a common error you have observed that is not on that list. Please Note whether your response is dependent on the echelon of command (i.e. BN, vs. CO), the mission type (i.e., offense or defense), mission phase (i.e., planning, execution, or recovery), staff section (i.e., S2, S3), and/or rank/experience.

Check the response below:

- A:** Make a decision with a critical piece of information missing, but it is not recognized that it is missing.
- B:** Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed.
- C:** Make a decision based on information that has been discredited.
- D:** Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources are consistent because they originate from the same primary source.
- E:** Make a decision assuming that simultaneous, similar events are causally related, when there is no evidence to support this conclusion.
- F:** Make a decision based on input from a small sample of individuals when input from a larger group is available.
- Other type:** Describe:
- Unable to choose:** Describe reason:

Qualifiers:

Does your choice vary by echelon?  yes  no if yes, explain:

Does your choice vary by mission type?  yes  no if yes, explain:

Does your choice vary by mission phase?  yes  no if yes, explain:

Does your choice vary by staff section?  yes  no if yes, explain:

Does it vary by rank/experience of the decision maker?  yes  no if yes, explain:

3. Which type of decision-making error do you think is **most dangerous?** Once again, choose from the list before you or feel free to describe a decision-making error that is not on the list. Please Note whether your response is dependent on the echelon of command (i.e. BN, vs. CO), the mission type (i.e., offense or defense), mission phase (i.e., planning, execution, or recovery), staff section (i.e., S2, S3), and/or rank/experience.

Check the response below:

- A:** Make a decision with a critical piece of information missing, but it is not recognized that it is missing.
- B:** Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed.
- C:** Make a decision based on information that has been discredited.
- D:** Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources are consistent because they originate from the same primary source.
- E:** Make a decision assuming that simultaneous, similar events are causally related, when there is no evidence to support this conclusion.
- F:** Make a decision based on input from a small sample of individuals when input from a larger group is available.
- Other type:** Describe:
- Unable to choose:** Describe reason:

Qualifiers:

Does your choice vary by echelon?  yes  no if yes, explain:

Does your choice vary by mission type?  yes  no if yes, explain:

Does your choice vary by mission phase?  yes  no if yes, explain:

Does your choice vary by staff section?  yes  no if yes, explain:

Does it vary by rank/experience of the decision maker?  yes  no if yes, explain:

4. Now I'd like you to comment on each of the types of decision-making errors and assess how digital systems might have prevented or caused these errors. If any of the factors listed at the bottom of the reference sheet in front of you can be identified that either helped or hindered the decision making, please specify. (Have list of factors available for reference – list and codes provided below.)

**A:** Make a decision with a critical piece of information missing, but it is not recognized that it is missing.

**B:** Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed.

**C:** Make a decision based on information that has been discredited.

**D:** Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources are consistent because they originate from the same primary source.

**E:** Make a decision assuming that simultaneous, similar events are causally related, when there is no evidence to support this conclusion.

**F:** Make a decision based on input from a small sample of individuals when input from a larger group is available.

*Note:* Each of the errors listed in A - F above were followed up with two questions:

1. Of the digital systems you have observed in use as an O/C, how do they protect against this type of error?
2. Of the digital systems you have observed in use as an O/C, how do they increase the likelihood of making this type of error?

5. In the questionnaire you were asked to consider some factors that contribute to mission success or mission failure (the list of factors is here in front of you). Now what we would like you to do is think about those factors and rank order them.

First, think of the 5 factors that contribute to mission success. Given that all factors are important, some are surely more important than others. Tell me which of the factors is the most likely to contribute to mission success, then rank the remaining factors from most to least likely.

#1: \_\_\_\_\_ (Most important)  
#2: \_\_\_\_\_  
#3: \_\_\_\_\_  
#4: \_\_\_\_\_  
#5: \_\_\_\_\_ (Least important)

Now think the five factors that contribute to mission failure. Tell me which of these factors is most likely to contribute to a mission failure, then rank the remaining factors from most to least likely.

#1: \_\_\_\_\_ (Most likely)  
#2: \_\_\_\_\_  
#3: \_\_\_\_\_  
#4: \_\_\_\_\_  
#5: \_\_\_\_\_ (Least likely)

6. Do you have any ideas of how ABCS systems could be re-designed to help overcome the decision-making errors you have observed?

7. Do you have any other comments that you can offer to help us understand how digital systems have either helped or hindered decision making?

## DECISION-MAKING ERROR REFERENCE LIST

- **A:** Make a decision with a critical piece of information missing, but it is not recognized that it is missing.
  
- **B:** Make a decision based on a personal, salient, emotional or recent event ignoring information suggesting that trends have changed.
  
- **C:** Make a decision based on information that has been discredited.
  
- **D:** Make a decision based on the consistency of multiple secondary sources, not realizing that all those sources are consistent because they originate from the same primary source.
  
- **E:** Make a decision assuming that simultaneous, similar events are causally related, when there is no evidence to support this conclusion.
  
- **F:** Make a decision based on input from a small sample of individuals when input from a larger group is available.

## LIST OF FACTORS THAT CONTRIBUTE TO MISSION SUCCESS OR MISSION FAILURE

Contribute to success	Contribute to Failure
<ul style="list-style-type: none"> <li>• Good operator skills</li> <li>• Good employ-ment skills</li> <li>• Personnel were familiar with SOP</li> <li>• Able to cope with hardware problems</li> <li>• Able to cope with software problems</li> </ul>	<ul style="list-style-type: none"> <li>• Poor operator skills</li> <li>• Poor employment skills</li> <li>• No SOP or unfamiliar with SOP</li> <li>• Unable to cope with hardware problems</li> <li>• Unable to cope with software problems</li> </ul>

## Appendix C

### READ AHEAD PACKAGE

# Assessment of Decision Making by Units Equipped with Digital Systems

## READ-AHEAD PACKAGE

### Dear Survey-Interview Participant:

Thank you in advance for participating in the U.S. Army Research Institute's assessment of decision making by units equipped with digital systems. The input you provide will help improve digital training for system operators and leaders.

As the contemporary operational environment continues to evolve and more units receive digital systems, the Army is trying to keep pace with changing needs. Your practical knowledge and observations of digitally equipped units' decision-making offer an excellent source of input. The survey-interview session aims to capture your insights and opinions regarding problem areas and how to improve training on the use of digital systems.

During your session, you'll be asked to complete a questionnaire and participate in a structured interview. The session will last about 1 to 2 hours and will focus on:

- How well units are trained on the major digital system capabilities.
- Factors that influence use and employment of digital systems.
- How well units use digital systems to share information and collaborate.
- Possible decision-making errors avoided or caused by digital systems.
- Good ideas you have for improving digital system capabilities and training.

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The information collected in the survey will be used solely for research purposes. Your responses will be held in strict confidence. No one outside the research team will have access to individual data.

If you have any questions about this data collection effort, contact Greg Goodwin of the Army Research Institute at: 706-545-2198 (DSN: 835-2198), or [gregory.goodwin1@us.army.mil](mailto:gregory.goodwin1@us.army.mil)

Please review the following pages, and be prepared to address the above topics in your survey-interview session.

## Unit Proficiency on Digital Systems

### BACKGROUND INFORMATION

- You will be asked to discuss the strengths and weaknesses of units you have observed at JRTC regarding their use of the system capabilities listed below.
- You will not be asked to discuss units by name, but only to talk in general terms about units you have observed.
- You will be asked questions concerning use of **only** the specific digital system(s) you have observed being employed. The systems are: FBCB2, ASAS, AFATDS, and MCS.
- Everyone will be asked about cross-system capabilities.
- Please take some time to look over these capabilities and begin thinking about ways in which units have been effective or ineffective in using digital systems prior to the questionnaire/interview session.

### Major FBCB2 Capabilities

1. Support navigation (knowing your position, map displays, and route selection aids to a selected destination).
2. Distribute C2I messages (alerts/warnings/messages/reports, i.e. calls for fire, SALT, etc).
3. Develop and distribute unit task organization/reorganization data.
4. Process and display status information (provided by weapon systems, sensors, and support platforms and units).
5. Prepare and distribute orders (Warning, Operations, and FRAGOs – text and overlays).
6. Receive, develop, and distribute a common battlefield picture (known locations of other friendly, enemy elements, control measures, and graphics).
7. Access prepared messages, reports, and requests for edit and/or transmission.
8. Conduct a circular and/or line of sight analysis for selected locations.
9. Support clearance of fires, maneuver decisions, and fratricide avoidance.

### Major ASAS capabilities

1. Integrate, process, and correlate enemy information (input information from different sources).
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.
3. Provide probable identification of enemy units (using analysis tools).
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.
9. Support rapid attack of high priority/critical targets as identified.

### **Major AFATDS Capabilities**

1. Facilitate fire support planning for current and future operations.
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.
3. Coordinate target damage assessment.
4. Integrate all fire support systems via a data distributed processing system.
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.
9. Facilitate adjustment and override of fire support coordination and control measures.

### **Major MCS Capabilities**

1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.
2. Conduct mobility analysis of the terrain.
3. Analyze different courses of action.
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).
5. Access up-to-date situational and decision support information from other ATCCS systems.
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).
7. Update friendly/enemy unit movement locations and battlefield geometry.

### **Cross-System Capabilities**

1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks).
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units).
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted).
4. Share appropriate information to conduct targeting planning and operations (i.e. FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information).
5. Use digital systems to track the flow of the battle and to maintain situational understanding (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up).

### ***Typical factors that impact a unit's ability to optimally use digital systems:***

Operator skills	Ability to cope with hardware problems
Staff employment skills	Ability to cope with software problems
Familiarity with unit SOP	

## Decision-Making Errors

### BACKGROUND INFORMATION

- Leaders must make decisions with imperfect information, often within a constrained timeframe and under stress; a certain level of decision-making error is to be expected.
- Six types of decision-making errors are listed below. We would like you to look over and think about these typical errors before the interview.
- In the interview, you will be asked to describe decision-making errors you have observed. You will also be asked how digital systems might have helped avoid some of these errors, or how the systems contributed to making errors.

- **ERROR A: Make a decision with critical piece of information missing, but it is not recognized that it is missing.**

Example 1: A vehicle burning on the side of the road is reported as the remains of a vehicle-borne IED (VBIED), yet witnesses who were in the area before the vehicle was reported did not report hearing an explosion.

Example 2: An electronic report, order, or message is presumed to have been read by the recipient even though no message confirming receipt of the electronic report, order, or message was sent back.

- **ERROR B: Make a decision based on personal, salient, emotional or recent event ignoring information suggesting that trends have changed.**

Example 1: A commander believes that he will find weapons caches in and around population centers because that is where they were always found in his prior area of operation. As a result, he concentrates patrols to search for caches in population centers even though trends show that caches have been found in rural locations and in population centers about equally.

Example 2: A company commander is driving through a town when several heavy rocks strike his HMMWV and one cracks the windshield. Although his platoon leaders have consistently reported that the population is friendly towards them, the captain reports to BN that the local population is hostile towards Americans.

- **ERROR C: Make decision based on information that has been discredited.**

Example 1: Enemy forces have increased attacks in a formerly quiet province. Additionally, HUMINT suggest the enemy has decided to allocate more of its resources to the fight in this same province. Friendly commanders, however, are slow to allocate more resources to this province believing the increase in violence is an exception in a still peaceful region.

Example 2: Enemy units are posted to a map but their locations are not actively updated when they move. When the commander orders an artillery strike against these units, the shells fall into an empty field.

- **ERROR D: Make a decision based on the consistency of multiple secondary sources not realizing that all those sources are consistent because they originate from the same primary source.**

Example 1: Several TV and newspaper reports indicate that a recent attack on American forces was carried out by one insurgent group, but these are all based on the claims placed on the group's website. Because every TV and newspaper is carrying the story, physical evidence linking the attack to another group is ignored.

Example 2: Multiple FBCB2 SPOT reports from vehicles indicate that an enemy squad sized element is located in a village but what is not conveyed is that the reports are all based on secondhand information ultimately derived from a single source. The commander plans an assault without seeking further confirmation of the enemy's location.

- **ERROR E: Make a decision assuming that simultaneous, similar events are causally related, when there is no evidence to support this conclusion.**

Example 1: Over a two-day period, three UASs are lost while flying over a particular village. Commanders believe the enemy has developed an anti-UAS device and order subordinate units to search for such a device. Time is wasted searching for a non-existent device as the crashes were unrelated.

Example 2: On the anniversary of a significant defeat for the enemy, explosions destroy a friendly fuel depot. It is assumed that the fuel depot was targeted by the enemy and security is tightened at other fuel depots. The added security unnecessarily slows down delivery of fuel since the explosion was not the result of enemy action.

- **ERROR F: Make a decision based on input from a small sample of individuals when input from a larger group is available.**

Example 1: A company commander wants to know if his efforts have won the confidence of civilians in his AO. He talks to two or three residents who have benefited from projects the commander has funded and hears that there is widespread satisfaction with his efforts. By relying on this biased sample, the commander mistakenly assumes he has more support than actually exists.

Example 2: A BN commander surveys his unit to assess unit morale during the unit's deployment. The survey suggests that morale is declining each month. To confirm the survey results, the BN commander asks his four company commanders if they think morale is dropping. None of them believe morale has gone down so the BN commander disregards the survey results.



## Appendix D

### Survey Responses to Questions about Factors Contributing to Mission Success and Failure

Table D1

*Factors that Contribute to Mission Success for all FBCB2 Capabilities*

Major FBCB2 Capabilities	Number of units in which capability contributed to mission success	Proportion of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Familiar with SOP	Cope with hardware problems	Cope with software problems
1. Support navigation	6.21	.72	.78	.42	.21	.14
2. Distribute messages, warnings, reports	3.89	.63	.64	.41	.12	.15
3. Develop and distribute unit task organization-reorganization data.	.84	.35	.30	.21	.16	.21
4. Process and display platform status information.	1.26	.55	.47	.40	.22	.16
5. Prepare and distribute orders	1.84	.70	.59	.39	.21	.16
6. Receive, develop, and distribute a common battlefield picture	2.32	.71	.58	.39	.21	.24
7. Access prepared messages, reports, and requests	2.89	.56	.48	.30	.20	.15
8. Conduct a circular and/or line of sight analysis.	1.21	.53	.47	.39	.12	.11
9. Support clearance of fires, maneuver decisions, avoid fratricide	2.89	.78	.69	.49	.25	.23

Table D2

*Factors that Contribute to Mission Failure for all FBCB2 Capabilities*

Major FBCB2 Capabilities	Number of units in which capability contributed to mission failure	Proportion of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	Un-familiar with SOP	Can't cope with hardware problems	Can't cope with software problems
1. Support navigation	.68	.19	.25	.26	.11	.11
2. Distribute messages, warnings, reports	1.47	.38	.40	.46	.26	.26
3. Develop and distribute unit task organization-reorganization data.	1.84	.23	.18	.33	.21	.21
4. Process and display platform status information.	1.37	.21	.19	.26	.16	.16
5. Prepare and distribute orders	1.47	.32	.33	.36	.14	.16
6. Receive, develop, and distribute a common battlefield picture	2.68	.41	.54	.61	.26	.21
7. Access prepared messages, reports, and requests	1.32	.14	.09	.20	.21	.21
8. Conduct a circular and/or line of sight analysis.	1.79	.22	.18	.22	.16	.16
9. Support clearance of fires, maneuver decisions, avoid fratricide	2.21	.37	.47	.47	.21	.21

Table D3

*Factors that Contribute to Mission Success for all MCS Capabilities*

Major MCS Capabilities	Number of units in which use of this capability contributed to mission success	Proportion of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.	3.09	0.7	0.47	0.34	0.2	0.29
2. Conduct mobility analysis of the terrain.	1.82	0.34	0.25	0.18	0.02	0.02
3. Analyze different courses of action.	0.64	0.02	0.11	0	0.02	0.02
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).	0.73	0.36	0.27	0.2	0	0
5. Access up-to-date situational and decision support information from other ATCCS systems.	1.09	0.2	0.2	0.11	0.13	0.13
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).	1.09	0.55	0.41	0.23	0.27	0.27
7. Update friendly/enemy unit movement locations and battlefield geometry.	3.36	0.73	0.55	0.2	0.22	0.22

Table D4

*Factors that Contribute to Mission Failure for all MCS Capabilities*

Major MCS Capabilities	Number of units in which failure to use this capability contributed to mission failure	Proportion of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Use graphics decision support tools (digital maps, aerial photos, 3D flyover) to support planning and execution.	0.73	0.18	0.23	0.3	0.09	0.09
2. Conduct mobility analysis of the terrain.	2.09	0.26	0.26	0.34	0.18	0.18
3. Analyze different courses of action.	2.18	0.25	0.2	0.25	0.18	0.18
4. Conduct other tactical planning activities (decision support template, execution matrix, CCIR, etc.).	2.18	0.27	0.27	0.25	0.18	0.18
5. Access up-to-date situational and decision support information from other ATCCS systems.	2.45	0.27	0.36	0.52	0.36	0.27
6. Prepare and send orders (Warning/Operations/FRAGOs and overlays).	2.18	0.35	0.44	0.39	0.18	0.18
7. Update friendly/enemy unit movement locations and battlefield geometry.	0.91	0.27	0.41	0.3	0.09	0.09

Table D5

*Factors that Contribute to Mission Success for all ASAS Capabilities*

Major ASAS Capabilities	Number of units in which use of this capability contributed to mission success	Proportion of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Integrate, process, and correlate enemy information (input information from different sources).	5.25	0.47	0.53	0.31	0	0.13
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.	3.25	0.54	0.63	0.33	0	0.17
3. Provide probable identification of enemy units (using analysis tools).	0.25	0	0	0.25	0	0.25
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.	2	0.75	0.5	0.38	0	0.25
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.	0.5	0	0	0	0	0.25
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).	0	0	0	0	0	0
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.	2.25	0.31	0.31	0.25	0.06	0.25
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.	2.5	0.16	0.16	0	0	0.25
9. Support rapid attack of high priority/critical targets as identified.	2	0.06	0.06	0	0	0

Table D6

*Factors that Contribute to Mission Failure for all ASAS Capabilities*

Major ASAS Capabilities	Number of units in which failure to use this capability contributed to mission failure	Proportion of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Integrate, process, and correlate enemy information (input information from different sources).	1	0.25	0.25	0.25	0	0.13
2. Provide rapid access to enemy dispositions and activities (graphics and text) to support assessments and estimates.	2.5	0.5	0.5	0.25	0	0.17
3. Provide probable identification of enemy units (using analysis tools).	4.5	0.69	0.44	0.5	0.5	0.25
4. Filter, focus, and fuse reports and data to place enemy entities on maps/displays.	4.5	0.75	0.75	0.75	0.13	0.46
5. Sort incoming information and provide alarms when specified information is identified (location, units, weapons, activities). Support to decision making and execution of the operation.	5.75	0.67	0.5	0.46	0.29	0.38
6. Support IEW planning and monitor the execution of collection, surveillance, and EW plans. (IEW asset status and reports).	6.5	0.56	0.5	0.5	0.25	0.25
7. Access and retrieve/receive products and reports from higher HQ, adjacent/cooperating units and collection sources/agencies/platforms.	4.25	0.5	0.07	0.14	0	0.21
8. Support the creation, maintenance, and dissemination of a threat/enemy COP and database.	4	0.5	0.17	0.17	0	0.21
9. Support rapid attack of high priority/critical targets as identified.	3.75	0.5	0.25	0.25	0	0.15

Table D7

*Factors that Contribute to Mission Success for all AFATDS Capabilities*

Major AFATDS Capabilities	Number of units in which use of this capability contributed to mission success	Proportion of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Facilitate fire support planning for current and future operations.	2.25	0.44	0.41	0.5	0.25	0.25
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.	2.25	0.41	0.41	0.5	0.25	0.25
3. Coordinate target damage assessment.	2.25	0.44	0.44	0.5	0.25	0.25
4. Integrate all fire support systems via a data distributed processing system.	2.75	0.38	0.63	0.5	0.25	0.25
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.	2.25	0.41	0.44	0.5	0.25	0.25
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.	2.25	0.41	0.41	0.5	0.25	0.25
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.	0.5	0.5	0.5	0.25	0.25	0.25
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.	3.25	0.69	0.69	0.5	0.25	0.25
9. Facilitate adjustment and override of fire support coordination and control measures.	4.5	0.63	0.63	0.5	0.25	0.25

Table D8

*Factors that Contribute to Mission Failure for all AFATDS Capabilities*

<b>Major AFATDS Capabilities</b>	Number of units in which failure to use this capability contributed to mission failure	Proportion of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Facilitate fire support planning for current and future operations.	2.25	0.25	0.25	0.25	0	0
2. Provide up-to-date battlefield information, target analysis, and status for fire support elements.	2.25	0.25	0.25	0.25	0	0
3. Coordinate target damage assessment.	2.5	0.5	0.5	0.5	0.25	0.25
4. Integrate all fire support systems via a data distributed processing system.	2.5	0.25	0.25	0.5	0.25	0
5. Match targets to target attack criteria to provide the most effective, available weapon systems/firing units.	2.5	0.5	0.5	0.5	0.25	0
6. Manage critical resources, ammunition, support allocation/reallocation of assets, collect and forward intelligence and target information, and control supply/maintenance/other logistical functions.	2.75	0.25	0.5	0.5	0	0
7. Process and facilitate execution of fires coordinated with maneuver and the commander's guidance and intent.	4.25	0.25	0.5	0.5	0.5	0.5
8. Facilitate coordination of sensor cueing in support of target development and counterfire operations.	1.5	0.25	0.25	0.25	0.25	0.25
9. Facilitate adjustment and override of fire support coordination and control measures.	0	0	0	0	0	0

Table D9

*Factors that Contribute to Mission Success for all Cross-System Capabilities*

Cross-System Capabilities	Number of units in which use of this capability contributed to mission success	Proportion of units for whom these factors contributed to mission success				
		Good operator skills	Good employment skills	Personnel were familiar with SOP	Able to cope with hardware problems	Able to cope with software problems
1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks.)	3.8	0.61	0.48	0.29	0.25	0.21
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units)	4.6	0.72	0.56	0.3	0.21	0.25
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted)	2.4	0.47	0.43	0.23	0.14	0.15
4. Share appropriate information to conduct targeting planning and operations. (i.e FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information)	2.1	0.38	0.34	0.18	0.1	0.05
5. Use digital systems to track the flow of the battle and to maintain situational understanding. (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up)	3.85	0.76	0.71	0.33	0.21	0.2

Table D10

*Factors that Contribute to Mission Failure for all Cross-System Capabilities*

Cross-System Capabilities	Number of units in which failure to use this capability contributed to mission failure	Proportion of units for whom these factors contributed to mission failure				
		Poor operator skills	Poor employment skills	No SOP or unfamiliar with SOP	Unable to cope with hardware problems	Unable to cope with software problems
1. Properly network systems together (i.e. ensure systems are properly connected to the network, correct sharing configuration is set-up, conducted connectivity/commo checks.)	1.4	0.2	0.15	0.25	0.23	0.27
2. Maintain an accurate and complete "FRIENDLY force" common operating picture (COP) (i.e. ensure all units are being tracked, stale information is checked for accuracy, higher level units share info with lower level units)	1.35	0.28	0.32	0.47	0.07	0.06
3. Maintain an accurate and complete "ENEMY force" common operating picture (COP) (i.e. ensure all intel reports are entered into system, duplicate reports are eliminated, outdated information is either updated or deleted)	2.8	0.29	0.5	0.45	0.06	0.06
4. Share appropriate information to conduct targeting planning and operations. (i.e FBCB2/MCS sharing operational plan // ASAS sharing enemy information // AFATDS sharing indirect fire information)	1.7	0.15	0.24	0.38	0.18	0.18
5. Use digital systems to track the flow of the battle and to maintain situational understanding. (i.e. monitor unit movements, check accomplished/reported actions against the planned actions, alerts and warnings are set-up)	1.55	0.33	0.44	0.46	0.06	0.06