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EVALUATION OF A COMPUTER-ASSISTED BATTLE SIMULATION: CAMMS VERSUS A CPX

Ira T. Kaplan and Herbert F. Barber

ARI FIELD UNIT AT FORT LEAVENWORTH, KANSAS

U. S. Army
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The Computer-Assisted Map Maneuver System (CAMMS) creates a simulated battle to train battalion and brigade command groups in the exercise of command and control. In contrast to a conventional manual command post exercise (CPX) which is driven by prefabricated messages, CAMMS calculates weapons effects, movement rates, and logistical support in real time to provide the command group with realistic feedback about the consequences

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of its actions. The purpose of this investigation was to evaluate the cost and training effectiveness of CAMMS in comparison to a CPX.

The players' attitudes toward the alternative training systems were assessed by means of questionnaires administered to 50 battalion command groups and 12 brigade command groups after they participated in CAMMS exercises. Estimates of the preparation time and the number of controllers required for each type of exercise were obtained from 14 CAMMS exercise directors and, for a CPX only, from 5 division and brigade commanders.

Analysis of the data showed that the players judged CAMMS to be significantly and consistently more realistic and more interesting than a CPX. The functional areas in which CAMMS enjoyed the greatest advantage were related to preparing and organizing the battlefield, controlling and coordinating combat operations, and concentrating combat power as rated by the S3; and in the exercise of command and control rated by the commander, especially exposure to the capabilities of enemy weapons systems, facing a thinking enemy, and making decisions under real-time constraints.

The principal weaknesses of CAMMS were that it did not produce much stress, and it did not exercise the players in security procedures, such as electromagnetic and communications security, nor did it require them to react to special situations like enemy jamming, chemical, biological, or nuclear warfare. The CPX also received low ratings in these areas.

A CAMMS exercise cost 25-30% less than a CPX, primarily because CAMMS required much less preparation time.

Overall, CAMMS produced a distinctly superior exercise at a moderate saving in cost over a conventional CPX.

This report is written for the researcher in command-control investigations, although military personnel will be interested in implications of the results.

Technical Paper 355

EVALUATION OF A COMPUTER-ASSISTED BATTLE SIMULATION: CAMMS VERSUS A CPX

Ira T. Kaplan and Herbert F. Barber

Submitted by:
Robert S. Andrews, Chief
ARI FIELD UNIT AT FORT LEAVENWORTH, KANSAS

Approved By:

A. H. Birnbaum, Acting Director
ORGANIZATIONS AND SYSTEMS
RESEARCH LABORATORY

Joseph Zeidner
TECHNICAL DIRECTOR

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333

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FOREWORD

The Fort Leavenworth Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) conducts a research program in support of the Combined Arms Center (CAC). The CAC includes the Combined Arms Training Developments Activity (CATRADA), the Combined Arms Combat Developments Activity (CACDA), and the Command and General Staff College (CGSC).

The CATRADA-related efforts encompass the identification of critical command group performance requirements at battalion, brigade, and division levels; the development of procedures for measuring command group performance; the analysis of organizational and cognitive processes involved in command and control; the development of procedures for measuring the training effectiveness of battle simulations; and the development of specifications for more effective command and control training systems through experimentation with current simulations.

Part of that program addressed the specific requirement to provide a preliminary assessment of the cost and training effectiveness of the Computer-Assisted Map Maneuver System (CAMMS). CAMMS was developed to provide battalion and brigade command groups with a more realistic and responsive training experience than a conventional manual command post exercise (CPX) provides.

This report describes a survey of player attitudes that identified areas in which CAMMS was judged superior to a CPX and areas in need of improvement. A survey of trainees and exercise directors was used to investigate the capabilities and limitations of both training systems (CAMMS and a CPX). The investigation, begun in the summer of 1977, was responsive to both the special requirements of CATRADA and to those of Army Project 2Q763743A773 concerned with the improvement of command and control training methods and systems.

Joseph Zeidner

JOSEPH ZEIDNER
Technical Director

EVALUATION OF A COMPUTER-ASSISTED BATTLE SIMULATION: CAMMS VERSUS A CPX

BRIEF

Requirement:

The Combined Arms Center, Fort Leavenworth, Kans., is the proponent for all Training and Doctrine Command (TRADOC) command and staff simulations. Determination of the effectiveness and efficiency of simulations in relation to alternatives is a recurring requirement for guiding the continued development and use of simulations to the most favorable cost-benefit relationship. To satisfy part of this requirement, a preliminary comparative evaluation of the Computer-Assisted Map Maneuver System (CAMMS) and a conventional command post exercise (CPX) in terms of cost and training effectiveness was made.

Procedure:

Questionnaires were administered to 50 battalion command groups and 12 brigade command groups after they participated in CAMMS exercises. The questionnaires asked players to rate CAMMS and a CPX on several measures of training effectiveness, including realism, motivation, and the degree to which the player was required to perform subtasks of the Battalion or Brigade Command Group Army Training and Evaluation Program (ARTEP).

Estimates of man-hours required to prepare CAMMS and a CPX and of the number of controllers needed came from 14 CAMMS exercise directors and, for a CPX only, from 5 division and brigade commanders.

Findings:

1. CAMMS was judged significantly and consistently more realistic and more interesting than a CPX. Two functional areas in which CAMMS enjoyed the greatest advantage were related to (a) preparing and organizing the battlefield and (b) controlling and coordinating combat operations and concentrating combat power as rated by the S3. CAMMS showed up well in the exercise of command and control rated by the commander, especially in exposure to the capabilities of enemy weapons systems in facing a thinking enemy, and in making decisions under real-time constraints.

2. Principal weaknesses of CAMMS were that it did not produce much stress and did not exercise the players in security procedures, such as electromagnetic and communications security. Nor did CAMMS require players to react to special situations, such as enemy jamming or chemical, biological, or nuclear warfare. The CPX also received low ratings in these areas.

3. A CAMMS exercise cost 25% to 30% less than a CPX, primarily because CAMMS required much less preparation time.

4. Overall, CAMMS produced a distinctly superior exercise at a moderate savings in cost over a conventional CPX.

Utilization of Findings:

Findings from this research will contribute to developing strategies to increase capabilities of current battle simulations and to forming specifications for future command and control training simulations. Results of this investigation will provide the Army Training Support Center (ATSC) of TRADOC and potential users in the field an initial perspective of the training effectiveness of CAMMS. Results will help users decide when and for which training objectives to use CAMMS in its current form. In addition, CATRADA will identify weak areas to help guide the continued development of the CAMMS system.

EVALUATION OF A COMPUTER-ASSISTED BATTLE SIMULATION:
CAMMS VERSUS A CPX

CONTENTS

CONTENTS (Continued)

LIST OF TABLES

CONTENTS (Continued)

CONTENTS (Continued)

Page

LIST OF FIGURES

EVALUATION OF A COMPUTER-ASSISTED BATTLE SIMULATION: CAMMS VERSUS A CPX

INTRODUCTION

Background

The Computer-Assisted Map Maneuver System (CAMMS) was designed to provide a more realistic exercise than the conventional command post exercise (CPX) for battalion and brigade command groups. The CPX has been criticized for insufficient sensitivity to the players' actions. The CPX is driven by "canned" message inputs written before the exercise begins; thus it follows a relatively predetermined course. In addition, the assessments of weapons effects, movement rates, and logistics support are somewhat arbitrary. As a result, the CPX does not provide the command group with realistic feedback about the consequences of its actions. CAMMS is intended to remedy these deficiencies by providing free-play exercises that are responsive to the command group's actions and that provide realistic battlefield outcomes as feedback to the players.

CAMMS can accommodate an exercise consisting of armor, mechanized infantry, infantry, and cavalry maneuver brigades and battalions with normal combat support and combat service support elements in a nonnuclear environment against an appropriate enemy force. The computer data bank includes an opposing force segment capable of fielding two motorized rifle divisions and a tank division with all their normal support units. Any unit, from platoon to section level up to a full maneuver brigade, can be played in any combination. Artillery, air, mortars, helicopters, admin/log, and intelligence functions are handled as in actual combat. The computer calculates weapons effects, movement rates, and logistics support subject to the influence of weather and terrain. CAMMS can be used anywhere through a civilian time-shared computer system. Terminals are linked to the computer mainframe by telephone so that units can participate at remote field sites or at central administrative locations. Compared to a CPX, CAMMS should require less preparation time, provide faster and more accurate results, and insure greater objectivity. The system also provides historical data for analysis and critique.

To obtain insight as to how well CAMMS objectives are working out, the Training Devices and Simulations Directorate of the U.S. Army Combined Arms Training Developments Activity (CATRADA) at Fort Leavenworth, Kans., requested that the colocated ARI field unit investigate the cost and training effectiveness of CAMMS in comparison to a CPX. This investigation was part of the field unit's research support to CATRADA programs concerned with training systems for battalion and brigade command groups.

Purpose

The purpose of this investigation was to assess the comparative effectiveness and cost of two alternative systems, CAMMS and a conventional CPX, for training battalion and brigade command groups in combined arms operations. In the terminology of the Cost and Training Effectiveness Analysis (CTEA) Handbook (TRADOC Pamphlet 71-10), this is a training development study (TDS). The study compares alternative training approaches designed to achieve the same trainee performance objectives. CAMMS was developed to produce a more realistic exercise than a CPX, to motivate the players more intensely, and to exercise them more thoroughly in the subtasks of the Battalion and Brigade Command Group ARTEPs, as described in chapter 10 of ARTEP 71-2.

Evaluating the comparative effectiveness of the two systems contributed to two general objectives of the field unit's research program:

1. To develop procedures for measuring the training effectiveness of battle simulations, and

2. To assist in developing specifications for more effective command and control training systems through experimentation with current simulations.

With respect to measuring training effectiveness, the specific aims of this investigation were to gather data on

- Similarity of exercise tasks to actual job requirements,
- Improvement in performance,
- Realism,
- Stress, involvement, and interest produced by each exercise,
- Amount of required ARTEP subtask performance related to player positions (S1, S2, S3, S4, and fire support officer), and
- How well each system exercised certain characteristics of command and control, as seen by the battalion and brigade commanders.

To help develop specifications for more effective training systems, these data were analyzed to identify areas in which each system was weak and areas in which one system was distinctly superior to the other. Finally, to evaluate the cost-effectiveness of each system, data were gathered on the resources required to prepare and conduct each type of exercise.

METHOD

Attitude Questionnaires

Ideally, the alternative systems would be evaluated by experimentally measuring the changes in command group performance produced by training with each system. However, limited time and resources precluded such experimentation. Therefore, as an interim phase, training effectiveness was assessed by means of questionnaires designed to measure attitudes of players toward alternative training systems.

Questionnaires were administered to 50 battalion command groups and 21 brigade command groups after they participated in CAMMS exercises. The questionnaires, reproduced in Appendix A, have two parts. Part I was the same for everyone. Comprised of 11 items, it is concerned with four measures of training effectiveness:

1. Similarity of tasks performed in each exercise (CAMMS and a CPX) to actual job requirements,

2. Perceived improvement in individual and group performance produced by participation in each exercise,

3. Perceived realism of several aspects of each exercise, and

4. Motivation; i.e., stress, involvement, and interest produced by each exercise.

Part II differed for each player position. The forms for the S1, S2, S3, S4, and fire support officer (FSO) asked each player to rate the degree to which CAMMS and a CPX exercised the performance of specific ARTEP subtasks appropriate to the player's position. The battalion and brigade commanders rated the alternative systems on 14 characteristics associated with the exercise of command and control.

Each item in both parts of the questionnaire asked the respondent to rate on a 5-point scale how well a particular aspect of the exercise was represented by CAMMS and, based on previous experience, by a CPX:

1. Not at all
2. Slightly
3. Moderately
4. Considerably
5. Greatly.

Data Analysis

The data analysis includes only responses by respondents who rated both CAMMS and a CPX. Means and standard deviation were computed for each item on the questionnaire, and an analysis of variance (ANOVA) was performed for each of the measures in Part I (similarity, improvement, realism, and motivation) and for each set of subtasks associated with a given player position in Part II. The ANOVAs were performed by Biomedical Computer Program[1] "BMDP2V" following Winer's[2] method of multifactor experiments with repeated measures on the same elements.

The effects tested for significance were system (CAMMS versus CPX), level (battalion versus brigade), position (S1, S2, etc.), item, and the interactions among these variables. When there was a significant interaction between system and another variable, planned orthogonal comparisons (t tests) were performed to determine the significance of the difference between CAMMS and a CPX at each level of the other variable. As a rule, whenever there is a significant interaction it is necessary to examine the simple main effects involved. Kirk's procedure was used to make comparisons between means for simple main effects.[3] It is similar to Winer's treatment of individual comparisons (1971, pp. 384, 385).

After it was determined which effects were statistically significant, their size and pattern were examined for practical significance in relation to these questions:

1. In which areas is the CAMMS exercise most in need of improvement?

2. In which areas does the difference between CAMMS and a CPX indicate the choice of one system over the other?

Personnel Requirements Questionnaire

Questionnaires designed to ascertain the preparation time and the number of controllers required for CAMMS and for a CPX were administered to the exercise directors who were responsible for planning and

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[1]Dixon, W. J. (Ed.). Biomedical Computer Programs. Berkeley: University of California Press, 1977.

[2]Winer, B. J. Statistical Principles in Experimental Design (2nd ed.). New York: McGraw-Hill, 1971.

[3]Kirk, R. E. Experimental Design: Procedures for the Behavioral Sciences. Belmont, Calif.: Brooks/Cole, 1968, pp. 73, 74.

supervising the CAMMS exercises. Because only 8 of the 14 exercise directors who answered the questions for CAMMS provided data for a CPX, similar questionnaires were sent to eight division and brigade commanders to increase the sample size for a CPX. Both questionnaires are reproduced in Appendix B.

RESULTS

Attitude Questionnaires

About 60% of the respondents rated both CAMMS and a CPX. The means and standard deviations (SD) of their ratings for each item, as well as the numbers (n) of players who rated each item, are tabulated in Appendix C. The players were fairly consistent in their ratings, as shown by the SDs, which averaged 1.0 and did not exceed 1.8. Each table of data is followed by a summary of the ANOVA performed on those data. When the ANOVA indicated that the effect of a particular variable was not statistically significant, the data were averaged over the levels of that variable to summarize the significant effects more concisely. For example, when there was no significant difference between battalion and brigade ratings, those data were combined, and the mean ratings for the combined data were included in the description of the results.

Perceived Similarity

Table C-1 shows that the perceived similarity of the tasks performed in the exercise to the rater's actual job requirements varied from 3.0 (moderately similar) to 4.6 (greatly similar). The ANOVA, summarized in Table C-2, indicates that the only significant effects were position and the interaction between system and position. Since the main effect and interactions of level were not significant, the battalion and brigade ratings were combined in Table 1 to show more clearly the two significant effects. For CAMMS, the greatest similarity was reported by the S3, S2, and commander, followed by the S4 and FSO. The least similarity was seen by the S1. For a CPX, the S2 and S3 reported the greatest similarity; the commander, FSO, S1, and S4, in descending order, reported somewhat lower ratings.

CAMMS was rated higher than a CPX for three positions (S3, S4, and commander) and lower for the other three. Averaged over all six positions, there was virtually no difference between CAMMS and a CPX in perceived similarity to actual job requirements. The planned t tests showed that only the superiority of CAMMS reported by the commanders was statistically significant ($p < .05$).

Table 1

Mean Ratings of Perceived Similarity of Tasks
to Actual Job Requirements

Position	CAMMS	CPX
S1	3.3	3.5
S2	4.0	4.1
S3	4.3	4.1
S4	3.6	3.4
FSO	3.6	3.6
Commander	4.0	3.7

Perceived Improvement

Two items on the questionnaire concerned the perceived improvement in performance produced by CAMMS and a CPX. One item asked the player how much each exercise improved his individual ability to perform his position. The other asked how much the player felt the exercise improved the command group's ability to perform its tactical mission. Table C-3 summarizes responses to both questions. According to the ANOVA in Table C-4, the only variable that had a significant effect was the type of training system. On the average, CAMMS was rated better than a CPX. For individual improvement, the mean CAMMS rating was 3.7; for a CPX, 3.5. For group improvement, the means were 3.7 and 3.4 for CAMMS and a CPX, respectively.

Perceived Realism

Each player was asked to rate CAMMS and a CPX on the apparent realism of five aspects of the exercise:

1. Combat activities,
2. Combat support activities,
3. Outcomes of battlefield engagements,
4. Enemy tactics and weapons capabilities, and
5. Speed of events on the battlefield.

The ratings, presented in Table C-5, were overwhelmingly in favor of CAMMS. Analysis of variance (Table C-6) showed that the advantage of CAMMS over a CPX was significant beyond the .001 level. The differences among the five measures of realism were also statistically significant, as was the interaction between type of system and measure of realism.

Since the level of exercise and position of rater and other interactions were not significant, data were pooled over level and position to show the significant effects more clearly.

The mean ratings in Table 2 show the statistically significant effects. The most realistic aspect of both CAMMS and a CPX was enemy tactics and weapons capabilities. Combat activities also were judged relatively realistic; speed of events and combat support activities were rated least realistic for both systems. The greatest difference was in the realism of battlefield outcomes, which was rated relatively low for a CPX, but relatively high for CAMMS.

Table 2

Mean Ratings of Perceived Realism

Measure	CAMMS	CPX
Combat activities	3.7	3.1
Combat support activities	3.3	2.9
Outcomes of battlefield engagements	3.7	2.9
Enemy tactics and weapons capabilities	3.9	3.3
Speed of events on the battlefield	3.4	2.9

Since the effect of system (CAMMS versus CPX) interacted with the measure of realism, the difference between CAMMS and a CPX was tested for significance by performing a t test on each measure. The superiority of CAMMS varied from .4 for support to .8 for outcomes, but was statistically significant ($p < .001$) for all five measures of realism.

Motivation

Three items on the questionnaire were related to motivation:

1. How much did you experience stress during the exercise?
2. How involved did you become in this exercise?
3. How interesting was this exercise?

Analysis of the ratings summarized in Table C-7 shows significant variation as a function of position, measure, and system. According to the ANOVA in Table C-8, the level of the exercise had no significant effect on the ratings, and the only significant interaction was between measure and system.

Since position did not interact with the other variables, it can be considered separately. Computing mean ratings for each position indicated that the S3 generally reported the highest rating (3.7), followed closely by the commander (3.5), S2 (3.5), FSO (3.5), and S4 (3.4). The S1 reported a somewhat lower rating (3.1).

Table 3 shows the effects of measure and system and of the interaction between them. Neither system produced much stress, but CAMMS especially stimulated considerable involvement and interest. CAMMS generated somewhat more stress and involvement than a CPX, and CAMMS was rated much more interesting. When evaluated by t tests, the difference in stress did not quite reach significance at the .05 level, but the differences in involvement ($p < .05$) and interest ($p < .001$) were statistically significant.

Table 3

Mean Ratings for Motivation

Measure	CAMMS	CPX
Stress	2.8	2.6
Involvement	4.1	3.8
Interest	4.1	3.4

S1 Subtasks

Part II of the questionnaire asked the S1 to indicate the extent to which CAMMS and a CPX required him to perform certain ARTEP subtasks. Although CAMMS usually was rated better than a CPX, especially at battalion level (Table C-9), the difference was not statistically significant (Table C-10). The only variables that did have a significant effect were level, subtask, and the interaction between level and subtask. These three effects are clearly evident in the mean S1 ratings (averaged over system) in Table 4, which shows the following trends:

1. Consistently higher ratings for battalion level exercises than for brigade;

2. Higher ratings for subtasks 3J, 6D, 9C, and 9D than for 3K, 9A, and 9B;

3. Extremely low ratings, which probably contributed to the significant interaction between subtask and level, for subtasks 9A and 9B at the brigade level.

Table 4

Mean Ratings for S1 Subtasks

Subtask	Battalion	Brigade
Task 3. Prepare and organize the battlefield		
3J. Provide supplies	3.1	2.8
3K. Maintain equipment	2.9	2.3
Task 6. Control and coordinate combat operations		
6D. Maintain the battlefield	3.4	2.9
Task 9. Manage combat service support assets		
9A. Arm and fuel the systems	3.0	1.4
9B. Fix the system	2.8	1.2
9C. Support the troops	3.2	2.9
9D. Integrate CSS into scheme of maneuver	3.1	2.6

S2 Subtasks

The S2 rated CAMMS and a CPX on how often they required performance of 19 ARTEP subtasks related to intelligence, communication, security, and certain special actions. Table C-11 lists the subtasks and ratings. In Table C-12, analysis of variance indicates three statistically significant effects: subtask, system x level interaction, and subtask x system interaction.

Examination of Table C-11 reveals a distinct pattern that divides the subtasks into three categories and appears to account for the three significant effects. Table 5 summarizes the subtasks and the mean ratings for each category. Subtasks directly related to intelligence were rated higher than subtasks related to security and special actions. This difference seems to be the primary source of the

significant variation among subtasks. The ratings for Subtask 3F, Develop a Communication Plan, were somewhat lower than the average ratings for intelligence.

Table 5

Mean Ratings for S2 Subtasks

Subtasks	Battalion		Brigade	
	CAMMS	CPX	CAMMS	CPX
Intelligence (1B, 2A, 2B, 2C, 2D, 3A, 5A, 5B, 5C, 5D)	3.5	3.5	4.3	3.4
Develop a communication plan (3F)	3.0	3.2	3.4	3.4
Security and special actions (3I, 10A, 10B, 10C, 12A, 12B, 12C)	1.8	2.4	2.1	2.1

A secondary aspect of the pattern is that although the brigade CAMMS exercise was rated better than a CPX on the intelligence subtasks, the battalion CAMMS exercise was rated worse than a CPX on the security and special actions subtasks. This disparity probably contributed to the two significant interactions in the ANOVA:

1. System x level (CAMMS better at brigade level, worse at battalion);

2. Subtask x system (CAMMS better for intelligence, worse for security and special actions).

The t tests that compared CAMMS with a CPX for every subtask at both levels failed to find any significant differences.

S3 Subtasks

The S3 rated CAMMS and a CPX on 31 ARTEP subtasks. Table C-13 lists these subtasks and their ratings. CAMMS was rated better than a CPX on almost every subtask at both battalion and brigade levels. According to the ANOVA summarized in Table C-14, the superiority of CAMMS was significant at the .001 level, although none of the individual t tests was significant. It is not unusual that the advantage of CAMMS was statistically significant over all subtasks combined,

but not for individual subtasks, because the individual t tests were based on fewer scores than the overall F test, and the size of the error estimate is inversely related to the number of scores in the sample. Differences among the subtasks and the interaction between system and subtask were also significant at $p < .001$.

The significant effects are apparent in Table 6, where the subtask ratings have been grouped and averaged by task. Since the effect of level was not statistically significant, battalion and brigade ratings were combined. Inspection of the data in Table 6 shows the following relationships:

1. System: CAMMS was consistently preferred to a CPX.

2. Subtask: The subtasks related to planning, organizing, and combat (Tasks 1, 3, 6, 7, and 8) were rated higher than those related to troop leading, security, and special actions (Tasks 4, 10, 11, and 12).

3. System x subtask interaction: The advantage of CAMMS over a CPX was greatest for Tasks 6-11. In the command group ARTEP, Tasks 1-4 are performed before the battle, and Tasks 5-12 are performed during the battle. Since CAMMS is essentially a battle simulation system, it is quite reasonable that the advantage of CAMMS should be greater for the S3 subtasks directly related to the simulated battle (Tasks 6, 7, 8, 10, and 11) than for those that precede the battle (Tasks 1, 3, and 4) or are incidental to it (Subtask 12D).

S4 Subtasks

Table C-15 shows that the S4 rated the same subtasks as the S1 with somewhat different results. Since the ANOVA in Table C-16 indicated significant variation among subtasks, but no significant interaction between subtask and the other variables, the ratings for each subtask were averaged over system and level and summarized in Table 7.

There were two main similarities and several differences between the S1 and S4 data. First, the subtask effect was statistically significant in both cases ($p < .001$). The subtasks concerned with maintenance (3K and 9B) were rated relatively low by both raters. In fact, most of the S4 ratings in Table 7 are similar to the S1 ratings in Table 4. Two exceptions involve the subtasks concerned with supply (3J and 9A), which were rated higher by the S4 than by the S1. These differences are plausible, however, because supply is primarily an S4 function.

Table 6

Mean Ratings for S3 Subtasks

Task	Subtasks	CAMMS	CPX
1. Develop plan based on mission	1S, 1C, 1D, 1E, 1G, 1H	4.3	3.9
3. Prepare and organize the battlefield	3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H	4.2	3.8
4. Troop lead (before battle)	4A, 4B, 4C	3.5	2.9
6. Control and coordinate combat operations	6A, 6B, 6C	4.2	3.3
7. Employ fires and other combat support assets	7C	4.3	3.3
8. Concentrate/shift combat power	8A, 8B, 8C, 8D	4.3	3.4
10. Secure and protect the task force	10E, 10F, 10G	3.6	2.9
11. Troop lead during battle	11A	3.9	2.7
12. React to situations requiring special actions	12D	3.1	2.7

Table 7

Mean Ratings for S4 Subtasks

Subtasks	Rating
Task 3. Prepare and organize the battlefield	
3J. Provide supplies	3.4
3K. Maintain equipment	2.7
Task 6. Control and coordinate combat operations	
6D. Maintain the battlefield	3.0
Task 9. Manage combat service support assets	
9A. Arm and fuel the systems	3.3
9B. Fix the system	2.7
9C. Support the troops	3.1
9D. Integrate CSS into scheme of maneuver	3.1

The second similarity is that at battalion level, CAMMS was preferred to a CPX on every subtask by the S1 (Table C-9) and by the S4 (Table C-15). This relationship contributed to the significant effect of level in Table C-10 and to the significant interaction between system and level in Table C-16.

A final difference is that Subtasks 9A and 9B were rated very low by the brigade S1, but not by the brigade S4. These low ratings contributed to the significant interaction between subtask and system for the S1 that was absent for the S4.

FSO Subtasks

The FSO rated CAMMS and a CPX on how well they exercised five ARTEP subtasks concerned with fire support. The brigade ratings were higher than the battalion ratings for both training systems (Table C-17), but the difference was not statistically significant. There was no significant difference between CAMMS and a CPX, nor were any of the other effects evaluated in Table C-18 significant.

Characteristics of Command and Control

The battalion and brigade commanders rated 14 characteristics associated with the exercise of command and control with respect to (a) how important it is to provide the characteristic in an exercise, (b) the extent to which it was provided by CAMMS, and (c) the extent to which it was provided in a CPX. All 14 characteristics were judged highly important: The mean importance rating was 4.8 on a 5-point scale. The characteristic judged least important was "working with incomplete information," which was rated 4.5 at battalion and 4.3 at brigade; all other characteristics were rated between 4.6 and 5.0.

Table C-19 shows that CAMMS was rated better than a CPX on every characteristic except utilizing communications security procedures (COMSEC). The superiority of CAMMS was significant at the .001 level (Table C-20). The variation among characteristics was also statistically significant, as was the interaction between characteristic and system.

Since there was no significant effect or interaction due to level, the battalion and brigade ratings were combined in Table 8 to show the significant effects more clearly. Thus, regarding variation among characteristics, intrastaff coordination was exercised relatively well by both training systems, while admin/log requirements were among the characteristics least exercised by both systems. The relative superiority of CAMMS is also readily apparent.

Because of the significant interaction between characteristic and system, t tests were performed to compare CAMMS and a CPX for each characteristic. The four largest such differences in Table 8 were significant.

Exposure to the capabilities of enemy weapons systems was one of the highest rated characteristics of CAMMS, but one of the lowest rated for a CPX; the t ratio was significant at $p < .01$. The t tests for facing a thinking enemy, for making decisions under real-time constraints, and for admin/log requirements were significant at $p < .05$. The smallest differences between CAMMS and a CPX were for COMSEC and message handling in the tactical operations center (TOC).

Implications for Further Development of CAMMS

Two criteria were employed to identify features of CAMMS that might require further development:

1. The items whose mean scores were 3.0 or less were classified as "low rated." This cut-off score, which was the midpoint of the rating scale, identified items that were defined by the scale as no more than moderately exercised.

Table 8

Mean Ratings for Characteristics of Command and Control

Characteristic	CAMMS	CPX
Facing a thinking enemy	4.1	3.2
Working with incomplete information	3.9	3.3
Making decisions under real-time constraints	4.1	3.3
Maintaining flexibility to cope with unanticipated events	4.1	3.4
Exposure to the capabilities (range, speed, lethality) of modern enemy weapons systems	4.3	3.0
Exposure to enemy tactics	4.1	3.5
Utilizing all available assets (Field Artillery, Air Defense Artillery, Engineers, Air Force, etc.) to counter the enemy's weapons and tactics	4.1	3.6
Concentrating/shifting combat power at the critical place and time	4.2	3.6
Gathering and analyzing information about the enemy	4.0	3.6
Planning and disseminating orders under battle-field conditions	4.0	3.4
Utilizing communications security procedures	3.4	3.6
Receiving, recording, and disseminating radio and telephone messages within the TOC	3.9	3.7
Coordination among staff members	4.3	3.8
Admin/log requirements	3.9	3.1

2. The distribution of these items was analyzed to identify consistent patterns of low-rated items, according to type of item, position of rater, level of exercise, and type of training system.

Figure 1 illustrates the pattern of low-rated items for Part I of the questionnaire. The only low-rated measures of effectiveness for the battalion CAMMS exercise were in the area of stress experienced by the players. For the brigade CAMMS exercise, in addition to the low ratings for stress, there were also low ratings for the perceived realism of combat activities, combat support activities, and speed of events on the battlefield.

However, CAMMS received far fewer low ratings than a CPX. Compared to the 4 low-rated items for the battalion CAMMS exercise and the 14 low ratings for CAMMS brigade, there were 20 and 35 low-rated items for battalion and brigade CPXs, respectively.

Figure 2 shows the percentage of subtasks and characteristics of command and control that were low rated for a given player position. Two main groups of subtasks received low ratings in the CAMMS exercises. First, the subtasks concerned with security and special actions (3I, 10A, 10B, 10C, 10D, 12A, 12B, and 12C) were given low ratings by the S2 for both levels of CAMMS, as well as for both levels of a CPX. These subtasks involve camouflage; electromagnetic and communications security; electronic warfare; and chemical, biological, and nuclear attack. The second large group of low-rated items for CAMMS, the admin/log subtasks (3J, 3K, 6D, 9A, 9B, 9C, and 9D), was rated by the brigade S1 and S4. The admin/log subtasks also received low ratings at both levels of a CPX. In addition, the S3's ratings indicated that rehearsals (4C) and enemy air assets (10G) were neglected at both levels of CAMMS and a CPX.

Relative Advantages of CAMMS and a CPX

CAMMS was rated better than a CPX on measures of perceived improvement, realism, motivation, S3 subtask ratings, and characteristics of command and control rated by the commander. In addition, there were significant interactions between system and position or level that indicated a selective advantage of CAMMS over a CPX for specific measures of similarity and subtasks rated by the S2 and S4. Only the S1 and FSO subtask ratings showed no statistically significant effects.

Statistical significance does not necessarily imply practical significance. A difference may be statistically significant, but small or isolated. Therefore, the criteria of size and consistency were used to identify patterns of large differences between CAMMS and a CPX. Figure 3 shows the distribution of measures from Part I of the questionnaire on which one system was rated at least .5 point

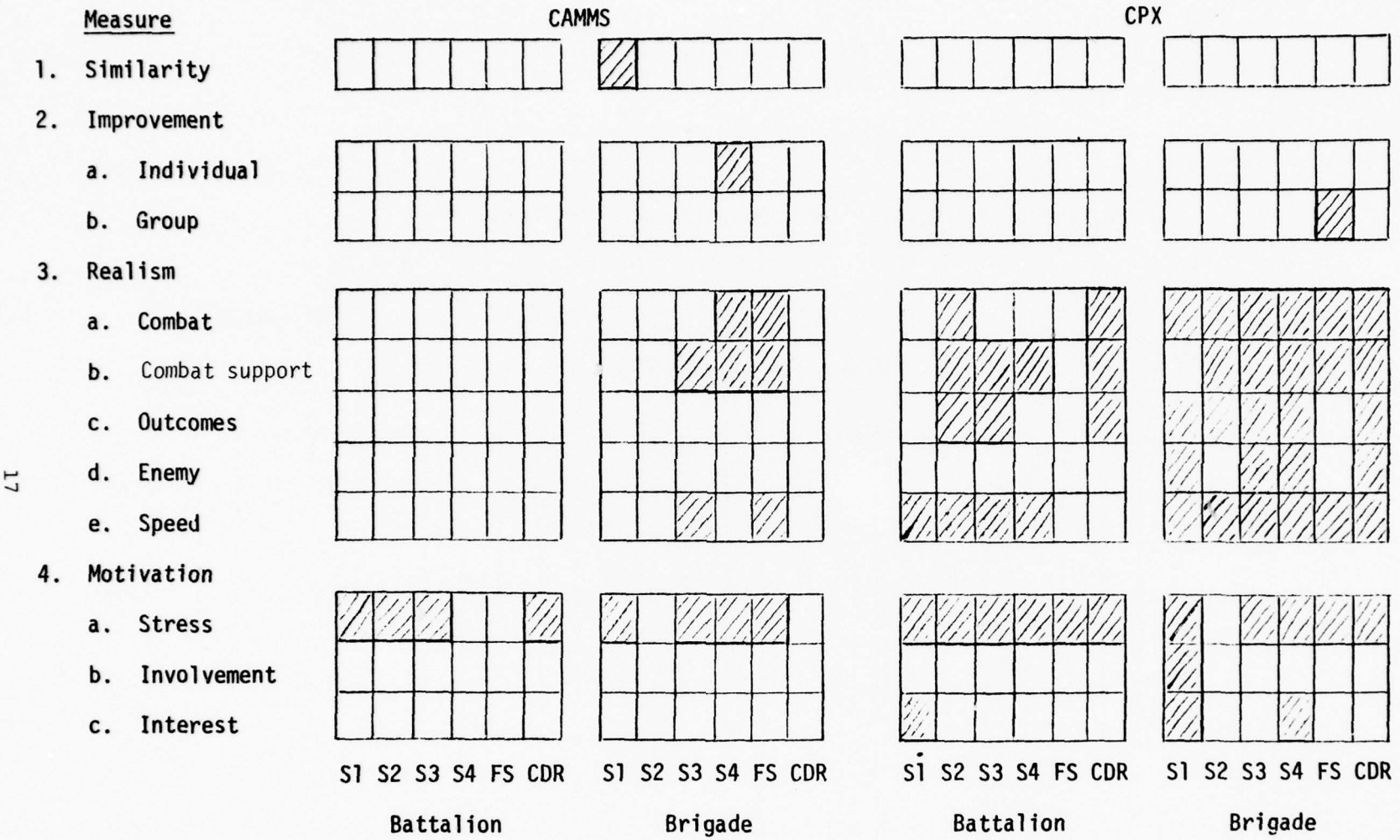

Figure 1. Low-rated measures of training effectiveness. The filled cells designate items whose mean ratings were less than or equal to 3.0.

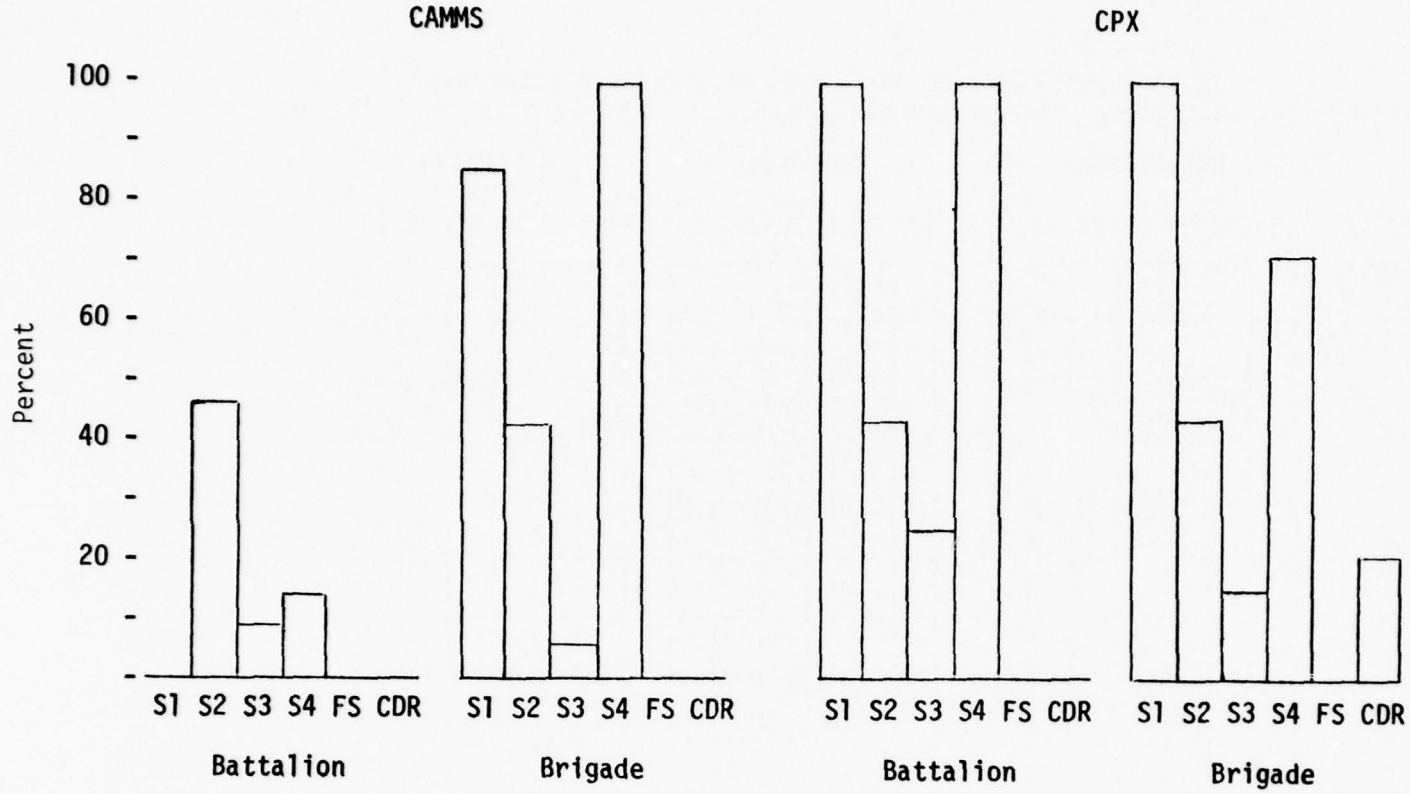

Figure 2. Low-rated subtasks and characteristics of command and control. The bars indicate the percentage of items for a given position whose mean ratings were less than or equal to 3.0.

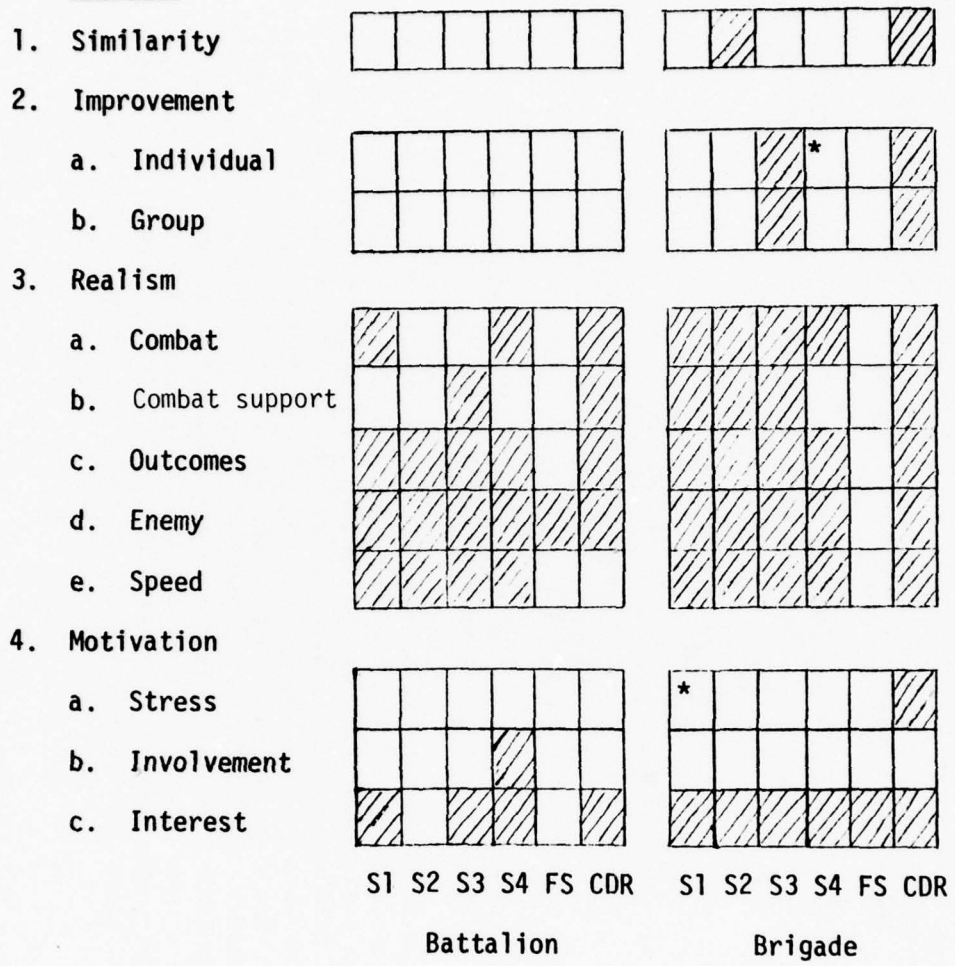

Figure 3. Measures of training effectiveness rated better for one system than for the other. The filled cells designate items whose mean ratings were at least .5 point higher for CAMMS than for a CPX. The asterisks indicate items rated at least .5 point higher for a CPX than for CAMMS.

higher than the other. It is apparent that CAMMS was rated consistently better than a CPX on most measures of realism and interest for both battalion and brigade level exercises. The brigade commander particularly preferred CAMMS to a CPX. There were only two isolated measures on which a CPX was rated as much as .5 point higher than CAMMS.

Figure 4 shows the percentage of subtasks and characteristics of command and control that were rated at least .5 point higher for one system than for the other. Several differences between CAMMS and a CPX were limited to one level of the exercise:

1. At battalion level, the S2 rated a CPX better than CAMMS on several subtasks concerned with security and special actions (3I, 10A, 10B, 12A, 12B, and 12C).

2. The battalion S4 preferred CAMMS to a CPX for most of the admin/log subtasks (3J, 6D, 9A, 9B, and 9D).

3. The brigade S2 rated CAMMS better than a CPX on all the subtasks directly related to intelligence (1B, 2A, 2B, 2C, 2D, 3A, 5A, 5B, 5C, and 5D).

4. Also at brigade, the S4 rated a CPX better than CAMMS on three logistics subtasks (3J, 9A, and 9B).

The trends common to both levels of the exercise were the strong preferences of the S3 and the commander for CAMMS. Their most consistent preferences were on the items most directly related to the battlefield events simulated by CAMMS. For the S3, these were the subtasks concerned with preparing and organizing the battlefield (3A, 3C, 3E, and 3G), controlling and coordinating combat operations (6A, 6B, and 6C), and concentrating combat power (8A, 8B, 8C, and 8D). For the commander, the greatest consistent advantages of CAMMS included facing a thinking enemy, working with incomplete information, making decisions under real-time constraints, maintaining flexibility, exposure to enemy tactics and weapons systems, and concentrating combat power.

Personnel Requirements

Exercise directors provided information on man-hours required to prepare a CAMMS exercise and the number of controllers needed to run it. Eight of the 14 directors also provided data on resources required for a CPX, as did five brigade and division commanders.

The estimates of preparation time were extremely variable, as indicated by the fact that many of the standard deviations in Table 9 are as large or larger than the means. This variability probably reflects differences in the procedures and criteria used to estimate

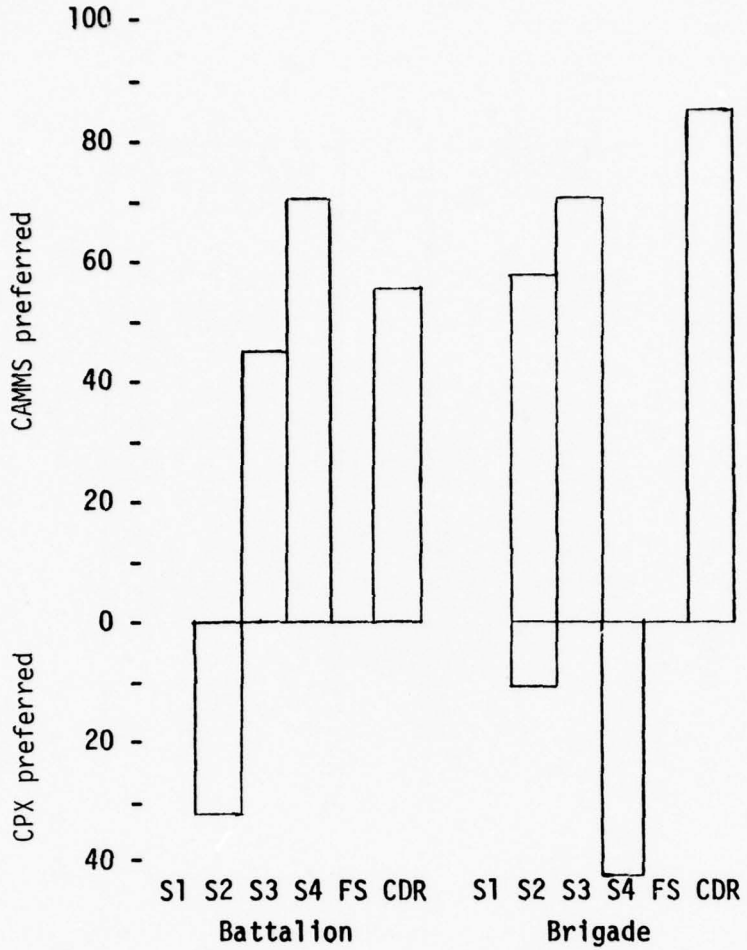

Figure 4. Subtasks and characteristics of command and control rated better for one system than for the other. The bars above the origin indicate the percentage of items for a given position whose mean ratings were at least .5 point higher for CAMMS than for a CPX. The bars below the origin indicate the percentage of items at least .5 point higher for a CPX than for CAMMS.

preparation time, as well as differences in the actual number of man-hours required to prepare an exercise.

Table 9

Man-Hours of Preparation

Item	Battalion[a]		Brigade[b]	
	Mean	*SD*	*Mean*	*SD*
CAMMS				
Learn procedures	30.0	22.0	34.0	39.6
Develop scenario	4.8	3.9	55.1	100.5
Train controllers	46.5	95.1	38.6	65.3
Set up equipment	13.7	6.5	21.0	22.2
Other	2.3	4.1	5.4	13.5
Total	97.3	103.4	154.1	141.8
CPX				
Develop scenario	114.1	233.7	175.7	325.5
Write messages	75.6	154.4	52.6	129.0
Train controllers	56.4	101.6	316.1	482.6
Set up equipment	76.9	117.1	72.7[c]	85.1[c]
Other	3.8	8.3	14.6	37.5
Total	326.8	344.2	658.2[c]	649.3[c]

[a] n = 6 for CAMMS, 9 for a CPX.

[b] n = 7 for CAMMS, 10 for a CPX.

[c] n = 9.

In spite of this large variability, the ANOVA summarized in Table 10 showed that CAMMS took significantly less time to prepare than a CPX. In fact, the total preparation time for a CPX was three to four times that for CAMMS. This was due primarily to the additional time required to plan a detailed scenario and to write prefabricated messages.

Table 10

ANOVA Summary for Total Person-Hours of Preparation

Source	df	Mean square	F
Level	1	318055.917	1.910
System	1	1003303.931	6.027*
L x S	1	186720.204	1.121
Error	27	166466.122	

*p < .05.

There was less variability in the number of controllers required to run an exercise (Table 11). The battalion CAMMS exercise needed fewer controllers than the other exercises, but the difference was not statistically significant (Table 12).

Table 11

Number of Controllers

	Battalion				Brigade			
	CAMMS[a]		CPX[b]		CAMMS[c]		CPX[d]	
Rank	Mean	SD	Mean	SD	Mean	SD	Mean	SD
COL	.8	1.3	.4	.7	.3	.5	.6	.5
LTC	2.0	1.7	1.8	3.1	1.6	1.8	1.3	.9
MAJ	4.5	1.0	3.2	4.6	2.1	1.8	5.1	6.2
CPT	3.3	1.2	6.1	3.2	9.7	6.3	10.4	6.8
1LT	1.5	2.7	3.2	4.9	6.6	4.2	3.1	2.7
2LT	1.0	1.3	.6	1.1	1.6	3.1	.2	.4
E8 or E9	2.5	2.3	2.4	2.8	.9	1.4	1.6	1.7
E7	1.5	1.0	2.8	2.4	.9	1.0	2.6	1.5
E6	.5	.5	2.9	3.2	1.1	1.6	1.8	2.0
E5	.8	1.6	4.0	5.4	2.5	2.6	.9	1.2
E4	.7	1.0	3.4	3.9	2.7	2.5	2.1	2.3
E2 or E3	0	0	.8	1.6	2.3	2.5	1.1	2.0
Total	19.2	1.7	31.7	19.4	32.4	9.6	30.8	14.4

[a] $n = 6$ [b] $n = 9$ [c] $n = 8$ [d] $n = 10$

Table 12

ANOVA Summary for Total Number of Controllers

Source	df	Mean square	F
Level	1	191.136	.997
System	1	162.954	.850
L x S	1	410.570	2.142
Error	29	191.665	

Four commanders derived their CPX data from previous similar exercises, the fifth gave a best estimate, but none of the commanders could provide total dollar or man-hour costs for a CPX.

The CAMMS exercise directors were asked whether they would prefer to run CAMMS or a CPX. All five directors at battalion exercises and five of the six at brigade who answered this question preferred CAMMS.

COSTS

Preparation

The personnel cost of an exercise can be estimated by multiplying the number of man-hours worked by the standard hourly rates for costing military personnel services, listed in Table D-1. Personnel cost is a function of rank; however, only four commanders reported preparation time by rank for a CPX. These data are summarized in Table D-2, which shows the mean number of man-hours by rank for each category of preparation, for a battalion CPX and a brigade CPX--each consisting of two 8-hour sessions. The dollar cost of preparation was obtained by multiplying the number of man-hours by the standard hourly rate for each rank.

Since preparation time was not reported by rank for CAMMS, the costs of preparing both CAMMS and a CPX were estimated from the data for a CPX. Accordingly, the cost per man-hour for each category of exercise preparation was calculated by dividing the total cost for the category by the total number of man-hours. For example, dividing the total cost of training controllers for a battalion CPX ($781.91 in Table D-2) by the total number of man-hours (87.5) yields a cost per man-hour of $8.94. The man-hour estimates in Table D-2 differ from those in Table 9, because they are based on a different size of sample, but do provide a cost estimate based on rank. Thus, it costs

more to develop a scenario than to set up equipment, because the scenario is developed primarily by officers, whereas the equipment is set up mainly by enlisted personnel. The estimated cost per man-hour for each category of preparation, based on the data in Table D-2, is given in Table D-3.

Estimated preparation costs for each type of exercise, shown in Table 13, were calculated by multiplying the man-hours of preparation in Table 9 by the cost per man-hour in Table D-3. The cost factors obtained for a CPX were also used for the corresponding categories of CAMMS. Learning procedures in CAMMS are assumed to involve the same personnel as training controllers. Thus, the latter costs per man-hour ($8.94 at battalion, $9.02 at brigade) were used for both categories. Since the cost per man-hour of "other" preparation was available only for a brigade CPX, that factor was used for all four types of exercise. The cost of other preparation was a negligible part of the total in any event. Table 13 shows that CAMMS' advantage in preparation time is reflected in a corresponding saving in dollars.

Table 13

Preparation Costs for a 16-Hour Exercise

Item	Battalion	Brigade
CAMMS		
Learn procedures	$ 268.20	$ 306.68
Develop scenario	53.18	685.99
Train controllers	415.71	348.17
Set up equipment	85.08	137.97
Other	25.00	58.70
Total	$ 847.17	$1,537.51
CPX		
Develop scenario	$1,264.23	$2,187.47
Write messages	750.71	500.75
Train controllers	504.22	2,851.22
Set up equipment	477.55	477.64
Other	41.31	158.70
Total	$3,038.02	$6,175.78

Controllers

The cost of controllers for a 16-hour exercise was calculated by multiplying the mean numbers of controllers in Table 11 by 16 hours and by the hourly rates in Table D-1. The hourly rates used for the combined categories of E8 or E9 and E2 or E3 were the averages of the rates for the two ranks in each category. The resultant costs, summarized in Table 14, indicate a marked saving (more than $1,000) in controller cost for a battalion CAMMS exercise compared to the nearly equal controller costs of the other exercises.

Table 14

Controller Costs for a 16-Hour Exercise

Rank	Battalion		Brigade	
	CAMMS	CPX	CAMMS	CPX
COL	$ 267.87	$ 133.94	$ 100.45	$ 200.90
LTC	545.82	491.24	436.65	354.78
MAJ	1,012.52	720.02	472.51	1,147.52
CPT	611.29	1,129.95	1,796.81	1,926.48
1LT	216.58	462.04	952.97	447.61
2LT	105.90	63.54	169.43	21.18
E8 or E9	418.16	401.43	150.54	267.62
E7	197.30	368.29	118.38	341.99
E6	54.82	317.95	120.60	197.35
E5	73.93	369.63	231.02	83.17
E4	54.29	263.70	209.41	162.87
E2 or E3	0.00	54.54	156.81	74.99
Total	$3,558.48	$4,776.27	$4,915.58	$5,226.46

Computer Time

Based on experience using the General Electric Mark III System,[4] the average cost per clock hour of CAMMS exercise time is $80 during prime time (0800 to 2000 hours EST, Monday through Friday) and $60 during nonprime time. This cost, which includes installation of telephones and computer time, is charged to the user.

[4] U.S. Army (CATRADA) CAMMS TSP Benchmark Evaluation Report. Prepared by GSA, ADTS Region 6, 30 September 1977.

Thus, a 16-hour CAMMS exercise costs $1,280 during prime time and $960 at other times. The actual charge for computer time varies somewhat with the amount of central processing time required. A brigade exercise costs slightly more than a battalion exercise, but it is more cost effective because three battalions are trained in one brigade exercise.

Terminal Support

The computer terminals required for a CAMMS exercise are presently leased by TRADOC (CATRADA) and furnished to the user without charge. The current annual cost is $60,000 for the lease of 50 terminals. These terminals will be purchased in FY 1979/1980 for $100,000. The current lease agreement with an option to buy allows $24,000 credit toward the purchase price, so the actual cost will be $76,000. Thereafter, annual maintenance will cost $10,500. Amortizing the purchase cost over 5 years, the annual cost to the Army for terminal support will be $25,700 (i.e., $76,000 ÷ 5 + $10,500).

Assuming that 446 exercises will be conducted during a year (the assumption for calculating cost of computer time), terminal support will cost $57.62 per exercise ($25,700 ÷ 446). A brigade exercise uses the same number of terminals as a battalion exercise uses, so the cost is the same.

Total Costs

Table 15 summarizes the total cost of preparation and controllers for a CPX, and the cost of computer time and terminal support for CAMMS. The highest total for CAMMS (for an exercise in prime time, including the cost of terminal support) is $377.62 more than the lowest CAMMS total (for the same level exercise in nonprime time, not including the cost of terminal support). Even the highest CAMMS figure is much less than the cost of a CPX. A CAMMS exercise saves more than $1,000 of the cost of a CPX at battalion level and more than $3,500 at brigade. This saving results primarily from the reduction in preparation time, another advantage of CAMMS over a CPX.

CONCLUSIONS

CAMMS was judged significantly and consistently more realistic and more interesting than a CPX. The functional areas in which CAMMS enjoyed the greatest advantage were related to preparing and organizing the battlefield; controlling and coordinating combat operations and concentrating combat power as rated by the S3; and the exercise of command and control rated by the commander, especially exposure to the capabilities of enemy weapons systems, facing a thinking enemy, and making decisions under real-time constraints.

Table 15

Total Exercise Costs

Item	Battalion	Brigade
CAMMS		
Preparation	$ 847.17	$1,537.51
Controllers	3,558.48	4,915.58
Computer time		
Prime	1,280.00	1,280.00
Nonprime	960.00	960.00
Total cost to user		
Prime time	5,685.65	7,733.09
Nonprime time	5,365.65	7,413.09
Terminal support	57.62	57.62
Total cost to Army		
Prime time	5,743.27	7,790.71
Nonprime time	5,423.27	7,470.71
CPX		
Preparation	3,038.02	6,175.78
Controllers	4,776.27	5,226.46
Total	$7,814.29	$11,402.24

The principal weaknesses of CAMMS were that (a) it did not produce much stress; (b) it did not exercise the players in security procedures, such as electromagnetic and communications security; and (c) nor did CAMMS require the players to react to special situations, such as enemy jamming, and chemical, biological, or nuclear warfare. The CPX also received low ratings in these areas.

A CAMMS exercise cost 25% to 30% less than a CPX, primarily because CAMMS required less preparation time.

Overall, CAMMS produced a distinctly superior exercise at a moderate savings in cost over a conventional CPX.

APPENDIX A

Attitude Questionnaires

This appendix contains copies of the questionnaires on which the players compared CAMMS and a CPX. Questionnaires were given to the S1, S2, S3, S4, FSO and commander of battalion and brigade command groups after they participated in a CAMMS exercise. To avoid reproducing several similar forms, one example of each type is presented, and the differences between other forms of the same type are described below:

1. Part I was the same for every position.

2. Part II was different for each position. This appendix contains copies of Part II for the battalion S1, S2, S3, FSO, and commander.

3. Part II for the battalion S4 was the same as for the battalion S1, except that the instructions referred to the S4 instead of the S1.

4. Part II for the brigade S1, S2, S3, S4 and FSO was the same as the corresponding battalion form, with the following exceptions:

a. The instructions referred to the brigade instead of the battalion.

b. Several items for the brigade S2 were worded slightly differently from those for the battalion S2, to correspond to the wording of the Brigade Command Group ARTEP, as follows:

1B. Identify critical intelligence
2A. Identify critical intelligence
2B. Gather critical intelligence
2D. Disseminate critical intelligence
5A. Identify critical intelligence
5B. Gather critical intelligence
5D. Disseminate critical intelligence

c. Several items for the brigade S3 were worded slightly differently from those for the battalion S3, to correspond to the wording of the Brigade Command Group ARTEP, as follows:

1F. Select routes/zones of approach to objective
1G. Assign areas and sectors of defense/battle positions
1H. Select delay positions, covering force positions and routes of withdrawal
4B & 11A. Supervise compliance with brigade order
10F. Detect/impede threats to brigade security

5. Part II on the characteristics associated with the exercise of command and control was the same for the battalion and the brigade commanders.

CAMMS
COMPUTER ASSISTED MAP MANEUVER SYSTEM
FIELD EVALUATION QUESTIONNAIRE

For the Battalion S1

1. The purpose of this questionnaire is to provide data for use in refining this simulation and to determine how it will be used by units in the field.

2. Part I asks your opinion of the realism and training value of CAMMS.

3. Part II asks you to evaluate the extent to which CAMMS provides an opportunity to accomplish the subtasks that make up the Battalion Command Group ARTEP.

4. Please record your answers in the space provided on the questionnaire and return the completed form to the CAMMS personnel from Fort Leavenworth.

5. Any additional comments you wish to include will be appreciated.

6. Thank you for your cooperation.

UNIT _____

PART I

Circle the number that best represents your answer to each of the following questions with respect to CAMMS and to a CPX.

		Not at All	Slightly	Moderately	Considerably	Greatly
1. How similar were the tasks you performed to your actual job requirements?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
2. How much do you feel the experience you received improved your ability to perform the position you played in the exercise?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3. How much do you feel the exercise improved your command group's ability to perform its tactical mission?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
4. How realistically were combat activities represented?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
5. How realistically were combat support activities represented?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
6. How realistic were the outcomes of the battlefield engagements?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
7. How realistic were the enemy tactics and weapons capabilities?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
8. How realistic was the speed of events on the battlefield?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
9. How much did you experience stress during the exercise?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10. How involved did you become in this exercise?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
11. How interesting was the exercise?	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

12. How many CPX's did your unit run in the past year? _____

13. If you could run either CAMMS or a CPX, how many of each would you run in one year?

CAMMS _____ CPX _____

14. a. Were you able to identify necessary modifications in your tactical SOP as a result of lessons learned in CAMMS? _____

b. If "Yes", list primary areas where SOP needs modification.

15. a. Have you had an ARTEP recently? (Check one) ____ Yes ____ No

b. If "Yes", how much do you feel CAMMS would have helped you prepare for the ARTEP?

Not at All	Slightly	Moderately	Considerably	Greatly
1	2	3	4	5

16. Comments:

PART II

Listed below are the subtasks of the Battalion Command Group ARTEP that are related to S1 functions. Beside each subtask are two sets of response alternatives. In the upper set, circle the response that indicates how much this CAMMS exercise required you to perform the subtask. In the lower set, indicate how much a CPX requires you to perform the subtask. If you have not played your present role in a CPX, check here ☐ and rate the CPX on the basis of your previous experience.

Circle the number that best represents your opinion.

Task 3		Not at All	Slightly	Moderately	Considerably	Greatly
Prepare and organize the battlefield.						
3J. Provide supplies	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3K. Maintain equipment	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 6						
Control and coordinate combat operations.						
6D. Maintain the battlefield	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 9						
Manage combat service support assets.						
9A. Arm and fuel the systems	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
9B. Fix the system	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
9C. Support the troops	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
9D. Integrate CSS into scheme of maneuver	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

PART II

Listed below are the subtasks of the Battalion Command Group ARTEP that are related to S2 functions. Beside each subtask are two sets of response alternatives. In the upper set, circle the response that indicates how much this CAMMS exercise required you to perform the subtask. In the lower set, indicate how much a CPX requires you to perform the subtask. If you have not played your present role in a CPX, check here ___ and rate the CPX on the basis of your previous experience.

Circle the number that best represents your opinion.

Task 1		Not at All	Slightly	Moderately	Considerably	Greatly
Develop plan based on mission						
1B. Identify critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 2						
Initiate intelligence preparation of the battlefield (IPB)						
2A. Identify critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
2B. Gather critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
2C. Analyze enemy	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
2D. Disseminate critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 3						
Prepare and organize the battlefield.						
3A. Determine critical place	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3F. Develop a communication plan	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

		Not at All	Slightly	Moderately	Considerably	Greatly
3I. Plan/employ active/passive security measures (e.g., camouflage, ELSEC, COMSEC, dummy positions of equipment, inoperative equipment realistically positioned and camouflaged)	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 5						
See the battlefield during the battle.						
5A. Identify critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
5B. Gather critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
5C. Analyze enemy	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
5D. Disseminate critical combat information and intelligence	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 10						
10A. Defeat or suppress enemy's electromagnetic intelligence effort	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10B. Defeat or suppress enemy's imagery intelligence effort	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10C. Defeat or suppress enemy's human intelligence effort	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10D. Deceive the enemy	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

Task 12		Not at All	Slightly	Moderately	Considerably	Greatly
React to situations requiring special actions.						
12A. React to enemy electronic warfare	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
12B. React to chemical or biological attack	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
12C. React to nuclear attack	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

PART II

Listed below are the subtasks of the Battalion Command Group ARTEP that are related to S3 functions. Beside each subtask are two sets of response alternatives. In the upper set, circle the response that indicates how much this CAMMS exercise required you to perform the subtask. In the lower set, indicate how much a CPX requires you to perform the subtask. If you have not played your present role in a CPX, check here ☐ and rate the CPX on the basis of your previous experience.

Circle the number that best represents your opinion.

Task 1		Not at All	Slightly	Moderately	Considerably	Greatly
Develop plan based on mission						
1A. Analyze mission	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1C. Identify critical friendly information	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1D. Analyze friendly capabilities	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1E. Select/control key terrain	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1F. Select routes/zones to objective	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1G. Select battle positions	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1H. Select delay and covering force positions	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 3						
Prepare and organize the battlefield						
3A. Determine critical place	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3B. Select a course of action	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

		Not at All	Slightly	Moder-ately	Consid-erably	Greatly
3C. Organize for combat	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3D. Select control measures	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3E. Plan organic, attached and non-organic supporting fires and determine priority	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3F. Develop a communication plan	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3G. Communicate/coordinate plans and orders	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
3H. Reinforce terrain	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 4						
Troop lead.						
4A. Supervise preparations	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
4B. Supervise compliance with TF order	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
4C. Conduct rehearsals	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 6						
Control and coordinate combat operations.						
6A. Modify scheme of maneuver	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
6B. Coordinate/communicate changes	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
6C. Supervise execution	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

Task 7		Not at All	Slightly	Moderately	Considerably	Greatly
Employ fires and other combat support assets.						
7C. Employ other combat support assets	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 8						
Concentrate/Shift Combat Power						
8A. Determine critical place and time	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
8B. Concentrate/shift combat power in the attack	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
8C. Concentrate/shift combat power in the defense or retrograde	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
8D. Protect thinly held areas	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 10						
Secure and protect the Task Force.						
10E. Reduce vulnerability to enemy mass destruction weapons systems	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10F. Detect/impede threats to TF security	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
10G. Detect/defeat enemy air assets	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 11						
Troop lead during battle.						
11A. Supervise compliance with TF order	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 12						
React to situations requiring special actions.						
12D. React to loss of key member of command group	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

PART II

Listed below are the subtasks of the Battalion Command Group ARTEP that are related to Fire Support. Beside each subtask are two sets of response alternatives. In the upper set, circle the response that indicates how much this CAMMS exercise required you to perform the subtask. In the lower set, indicate how much a CPX requires you to perform the subtask. If you have not played your present role in a CPX, check here ___ and rate the CPX on the basis of your previous experience.

Circle the number that best represents your opinion.

Task 1		Not at All	Slightly	Moderately	Considerably	Greatly
Develop plan based on mission.						
1I. Plan use of organic/attached and non-organic fires	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1J. Determine priority of fires	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
1L. Conduct initial fire support coordination.	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
Task 7						
Employ fires and other combat support assets.						
7A. Modify fire support plan	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5
7B. Employ fires (to include organic/attached weapons systems and supporting artillery, air defense, TAC Air and Attack Helicopters)	CAMMS	1	2	3	4	5
	CPX	1	2	3	4	5

PART II

Listed below are some characteristics associated with the exercise of command and control. For each item, indicate (a) how important it is to provide the characteristic in an exercise, (b) the extent to which it was provided in this CAMMS exercise, and (c) the extent to which the same characteristic is provided in a CPX. If you have not played your present role in a CPX, check here ☐ and rate the CPX on the basis of your previous experience.

Circle the number that best represents your opinion.

1. Facing a thinking enemy					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
2. Working with incomplete information					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
3. Making decisions under real-time constraints					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
4. Maintaining flexibility to cope with unanticipated events					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5

	None	Slight	Moderate	Considerable	Great
5. Exposure to the capabilities (range, speed, lethality) of modern enemy weapons systems					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
6. Exposure to enemy tactics					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
7. Utilizing all available assets (FA, ADA, Engineers, Air Force, etc.) to counter the enemy's weapons and tactics					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
8. Concentrating/shifting combat power at the critical place and time					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
9. Gathering and analyzing information about the enemy					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5

	None	Slight	Moderate	Considerable	Great
10. Planning and disseminating orders under battlefield conditions					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
11. Utilizing communications security procedures					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
12. Receiving, recording, and disseminating radio and telephone messages within the TOC					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
13. Coordination among staff members					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5
14. Admin/log requirements					
a. Importance	1	2	3	4	5
b. CAMMS	1	2	3	4	5
c. CPX	1	2	3	4	5

APPENDIX B
PERSONNEL REQUIREMENTS QUESTIONNAIRES

The first questionnaire in this appendix was completed by the exercise director at battalion and brigade level CAMMS exercises. The general instructions and the next two questionnaires were sent to brigade and division commanders to obtain additional data on the resources required for battalion and brigade CPXs.

CAMMS
COMPUTER ASSISTED MAP MANEUVER SYSTEM
FIELD EVALUATION QUESTIONNAIRE

For the Exercise Director

1. The purpose of this questionnaire is to provide data for use in refining this simulation and to determine how it will be used by units in the field.

2. Please record your answers in the space provided on the questionnaire and return the completed form to the CAMMS personnel from Fort Leavenworth.

3. Any additional comments you wish to include will be appreciated.

4. Thank you for your cooperation.

NAME _____ RANK _____

DUTY ASSIGNMENT _____ BRANCH OF SVC _____

UNIT ORGANIZATION _____

1. How many man-hour or man-days (specify which) did you and your staff require to prepare for each aspect of this exercise?

	Time Required
a. Learning the procedures	_____
b. Developing the scenario	_____
c. Training controllers and terminal operators	_____
d. Setting up equipment, commo, etc.	_____
e. Other (Please specify).	_____

2. How many hours does this exercise run? _____

3. a. How many controllers are employed to run this exercise? Fill in the number of each rank.

___ COL ___ LTC ___ MAJ ___ CPT ___ 1LT ___ 2LT

___ E8 or E9 ___ E7 ___ E6 ___ E5 ___ E4 ___ E2 or E3

b. Are the controllers from the same unit as the command group that is being exercised? (Check one) ___ Yes, all ___ No, None ___ Some (How many? _____)

4. Have you ever prepared a brigade and battalion CPX/MAPX similar to this exercise? (Check one) ___ Yes ___ No

If your answer is yes, please answer questions 5-8, otherwise, continue with Item 9.

5. Please indicate how many man-hours or man-days (specify which) were required to prepare the CPX/MAPX.

	Time Required
a. Developing the scenario	_____
b. Writing messages	_____
c. Training controllers	_____

Time Required

d. Setting up equipment, commo, etc. _____

e. Other (Please specify). _____

6. a. How many controllers did you need to run the CPX/MAPX? Fill in the number of each rank.

___ COL ___ LTC ___ MAJ ___ CPT ___ 1LT ___ 2LT

___ E8 or E9 ___ E7 ___ E6 ___ E5 ___ E4 ___ E2 or E3

b. Were the controllers from the same unit as the command group that was exercised? (Check one) ___ Yes, all ___ No, None ___ Some (How many? _____)

7. What were the major differences between setting up this CAMMS exercise and setting up the CPX/MAPX?

8. Given a choice, which exercise would you prefer to run? (Check one)
____ CAMMS ____ CPX/MAPX

Why?

9. Comments:

GENERAL INSTRUCTIONS

1. The United States Army Combined Arms Training Development Activity (CATRADA), Fort Leavenworth, KS, is currently developing manual and computer-assisted simulations to aid in the training of command and control functions at company commander level and above. One such simulation is the Computer-Assisted Map Maneuver System (CAMMS). CAMMS is currently undergoing field testing to ascertain its cost and training effectiveness. The information derived from this test will contribute to the further development and implementation of CAMMS within the Army Training System. A portion of this test consists of a comparison of the relative costs of CAMMS versus a CPX/MAPX. In order to assess these relative costs, it is necessary to gather cost and resource data concerning manually-driven CPX's currently being run in the field.

2. CAMMS is designed to train battalion and brigade command groups in simulated combat. Therefore, we are seeking information about brigade and battalion CPX's for comparison purposes.

3. There are, of course, several different types of CPX's. Therefore, in answering the questions concerning a battalion level exercise consider a battalion CPX/MAPX to have the following characteristics:

a. Provides training for a battalion command group consisting of battalion commander, S1, S2, S3, S4, S3 air, assistant S3, S1 NCO, S4 NCO, fire support officer, fire support NCO, operations sergeant, intel sergeant, and air liaison officer.

b. Has company commanders as player-controllers. That is, the exercise is partially driven by inputs from the company commanders concerning battlefield events.

c. Has controllers playing brigade commander and staff.

d. Has a pre-written scenario with messages or incidents lists.

e. Runs for two eight-hour training sessions.

4. Similarly, when answering questions concerning brigade level exercises consider a brigade CPX/MAPX to have the following characteristics:

a. Provides training for the brigade command group including the brigade commander, S1, S2, S3, S4, S3 air, assistant S3, S1 NCO, S4 NCO, fire support officer, fire support NCO, operations sergeant, intel sergeant, and air liaison officer.

b. Consists of three battalion command groups and company commanders as described in 3a and 3b above.

c. Has controllers playing division commander and staff.

d. Has a scenario with pre-written messages or incidents.

e. Runs for two eight-hour training sessions.

5. If you have run a CPX similar to the one described above, please answer the following questions using that data. If you have not run a CPX similar to the one above, assume that you have been tasked to develop such a CPX and estimate your requirements. Provide data for both a battalion level exercise and a brigade level exercise. Please indicate whether your responses to the following questions are based on previous CPX data or are estimates.

6. CATRADA POC is LTC J. R. Parker, AV 552-4669/3892.

CPX FOR BATTALION COMMAND GROUP

(with company commanders as player-controllers)

1. Source of data.

   ____Previous similar exercises

   ____Best estimate

2. How many man-hours per controller did it take to prepare for each aspect of this exercise?

Task	Personnel (by rank)	Time Spent
a. Develop scenario		
b. Write messages		
c. Train other controllers		
d. Set up equipment, commo, etc.		
e. Other (please specify)		

3. How many controllers were required to actually run this exercise? Fill in number of each rank (include company commanders).

   ____COL ____LTC ____MAJ ____CPT ____1LT ____2LT

   ____E8 or E9 ____E7 ____E6 ____E5 ____E4 ____E2 or E3

4. If available, what was the total cost of this CPX/MAPX (man-hours and dollars)?

CPX FOR BRIGADE AND SUBORDINATE BATTALION COMMAND GROUPS

1. Source of data.

   ____Previous similar exercises
   ____Best estimate

2. How many man-hours per controller did it take to prepare for each aspect of this exercise?

Task	Personnel (by rank)	Time Spent
a. Develop scenario		
b. Write messages		
c. Train other controllers		
d. Set up equipment, commo, etc.		
e. Other (please specify)		

3. How many controllers were required to actually run this exercise? Fill in number of each rank (include company commanders).

   ____COL ____LTC ____MAJ ____CPT ____1LT ____2LT

   ____E8 or E9 ____E7 ____E6 ____E5 ____E4 ____E2 or E3

4. If available, what was the total cost of this CPX/MAPX (man-hours and dollars)?

APPENDIX C
SUMMARY OF RESPONSES TO THE ATTITUDE QUESTIONNAIRES

TABLE C-1
Perceived Similarity of Tasks to Actual Job Requirements

	Battalion					Brigade				
		CAMMS		CPX			CAMMS		CPX	
Position	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
S1	27	3.4	1.0	3.5	.9	6	3.0	.6	3.7	1.0
S2	22	3.9	.9	4.0	.7	6	4.5	.5	4.0	.6
S3	30	4.2	.7	4.0	.6	6	4.5	.8	4.3	.8
S4	24	3.6	1.2	3.5	1.1	5	3.4	1.5	3.4	1.1
FSO	16	3.6	.8	3.7	1.0	7	3.6	.8	3.4	1.0
Commander	22	3.9	1.0	3.7	1.1	5	4.6	0.5	3.6	1.1

TABLE C-2
ANOVA Summary for Perceived Similarity

Source	df	Mean Square	F
Level	1	.379	.288
Position	5	4.989	3.797**
L X P	5	.514	.391
Error	164	1.314	
System	1	.711	1.747
S X L	1	.324	.797
S X P	5	.942	2.315*
S X L X P	5	.579	1.421
Error	164	.407	

*$p < .05$
**$p < .01$

TABLE C-3
Perceived Improvement in Performance

		Battalion					Brigade				
			CAMMS		CPX			CAMMS		CPX	
Measure	Position	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
Individual	S1	25	3.6	1.0	3.4	1.0	6	3.5	1.2	3.8	1.0
	S2	22	3.6	1.2	3.7	1.1	5	4.0	1.0	4.0	.7
	S3	28	4.0	.8	3.6	.8	6	4.2	1.2	3.7	1.2
	S4	23	3.4	1.2	3.1	.9	5	2.6	.9	3.2	.8
	FSO	15	3.5	1.1	3.7	1.1	7	3.3	1.3	3.6	1.1
	Commander	22	3.9	1.0	3.6	1.0	5	4.6	.5	3.4	.5
Group	S1	25	3.5	.9	3.2	1.0	6	3.8	.8	3.7	.8
	S2	22	3.4	.8	3.6	.9	5	3.6	1.1	3.6	1.1
	S3	28	3.8	1.0	3.4	.8	6	4.2	1.6	3.5	1.8
	S4	23	3.4	1.0	3.3	1.0	5	3.4	.9	3.4	.5
	FSO	15	3.5	1.2	3.5	1.1	7	3.3	1.1	3.0	1.2
	Commander	22	4.0	1.1	3.6	.8	5	4.6	.5	3.6	.9

TABLE C-4
ANOVA Summary for Perceived Improvement

Source	df	Mean Square	F
Level	1	.820	.340
Position	5	4.474	1.852
L X P	5	.919	.380
Error	157	2.416	
Measure	1	.223	.417
M X L	1	.106	.197
M X P	5	.715	1.335
M X L X P	5	.290	.542
Error	157	.536	
System	1	3.986	4.510*
S X L	1	.057	.065
S X P	5	1.812	2.050
S X L X P	5	.935	1.058
Error	157	.884	
M X S	1	.629	3.428
M X S X L	1	.379	2.065
M X S X P	5	.169	.920
M X S X L X P	5	.114	.620
Error	157	.183	

*$p < .05$

TABLE C-5
Perceived Realism

		Battalion					Brigade				
			CAMMS		CPX			CAMMS		CPX	
Measure	Position	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
Combat activities	S1	23	3.8	.7	3.3	1.0	5	3.8	1.3	3.0	1.4
	S2	19	3.4	.8	3.9	1.0	6	4.0	.9	2.8	.8
	S3	27	3.7	.9	3.3	.8	6	3.5	1.5	2.7	1.4
	S4	21	3.7	.9	3.2	1.2	4	3.0	1.2	2.5	.6
	FSO	15	3.6	1.1	3.2	.9	6	3.0	1.3	3.0	1.1
	Commander	22	3.6	.9	3.0	1.1	5	4.6	.5	2.4	.9
Combat Support activities	S1	23	3.4	1.0	3.1	1.0	5	3.8	.8	3.2	1.3
	S2	19	3.3	1.2	2.9	.9	6	3.3	1.2	2.3	1.0
	S3	27	3.5	1.1	2.9	1.1	6	2.7	1.0	2.2	1.2
	S4	21	3.3	1.2	2.9	.9	4	2.3	.5	2.5	.6
	FSO	15	3.1	.9	3.1	1.0	6	2.8	1.2	2.8	1.2
	Commander	22	3.5	1.1	2.9	1.1	5	3.8	.8	2.6	1.1
Outcomes of battlefield engagements	S1	23	3.9	.8	3.3	.9	5	3.2	1.3	2.6	.5
	S2	19	3.4	1.0	2.6	.8	6	3.8	1.0	2.3	.8
	S3	27	3.5	1.0	2.6	.8	6	3.3	1.2	2.7	1.4
	S4	21	3.7	.9	3.1	.7	4	3.5	1.0	2.5	.6
	FSO	15	3.5	1.1	3.2	.8	6	3.5	1.4	3.2	1.2
	Commander	22	3.9	1.2	3.0	1.1	5	4.4	.5	2.4	.9

TABLE C-5 (Continued)
Perceived Realism

		Battalion					Brigade				
			CAMMS		CPX			CAMMS		CPX	
Measure	Position	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
Enemy tactics and weapons capabilities	S1	23	4.0	1.0	3.5	1.0	5	4.0	1.0	3.0	.7
	S2	19	3.9	.6	3.3	.9	6	4.2	.4	3.3	.5
	S3	27	3.8	1.2	3.2	1.0	6	3.7	1.4	3.0	1.1
	S4	21	4.0	.7	3.4	.8	4	3.7	1.3	3.0	.8
	FSO	15	4.0	.9	3.3	.7	6	3.7	1.0	3.3	1.0
	Commander	22	3.9	1.1	3.3	1.3	5	4.8	.4	2.8	.4
Speed of events on the battlefield	S1	23	3.5	.8	3.0	.9	5	3.4	1.5	2.6	.9
	S2	19	3.5	1.3	2.9	.8	6	3.7	.8	2.7	.8
	S3	27	3.3	1.3	2.7	.9	6	3.0	1.4	2.5	1.2
	S4	21	3.4	1.4	2.6	1.4	4	3.5	1.0	2.0	.8
	FSO	15	3.4	1.1	3.3	1.1	6	2.8	1.5	3.0	1.3
	Commander	22	3.5	1.1	3.2	1.0	5	4.4	.5	2.6	.9

TABLE C-6
ANOVA Summary for Perceived Realism

Source	df	Mean Square	F
Level	1	9.043	2.368
Position	5	3.137	.821
L X P	5	1.994	.522
Error	147		
Measure	4	10.088	12.682***
M X L	4	.240	.302
M X P	20	.468	.588
M X L X P	20	.493	.620
Error	588	.795	
System	1	121.172	55.536***
S X L	1	6.281	2.879
S X P	5	4.724	2.165
S X L X P	5	2.652	1.215
Error	147	2.182	
M X S	4	1.088	3.738**
M X S X L	4	.229	.787
M X S X P	20	.296	1.018
M X S X L X P	20	.186	.640
Error	588	.291	

**$p < .01$
***$p < .001$

TABLE C-7
Motivation

		Battalion					Brigade				
			CAMMS		CPX			CAMMS		CPX	
Measure	Position	n	Mean	SD	Mean	SD	n	Mean	SD	Mean	SD
Streee	S1	24	2.5	1.2	2.5	1.1	6	1.8	.8	2.3	1.0
	S2	22	2.5	1.2	2.6	1.1	6	3.3	.8	3.2	1.3
	S3	29	3.0	1.1	2.7	1.0	6	2.8	1.2	2.7	1.0
	S4	23	3.3	1.6	2.9	1.4	4	2.0	1.4	1.7	1.0
	FSO	15	3.1	1.0	2.8	.8	7	2.0	1.4	1.7	1.0
	Commander	20	2.7	1.1	2.5	1.3	5	3.6	.9	2.2	1.3
Involvement	S1	24	3.7	1.2	3.6	1.1	6	3.3	1.2	3.0	1.3
	S2	22	4.0	1.1	4.0	.9	6	4.2	.8	4.2	.8
	S3	29	4.3	.8	4.0	.9	6	4.8	.4	4.7	.5
	S4	23	4.2	1.0	3.4	1.2	4	3.5	1.0	3.3	1.0
	FSO	15	3.9	1.1	4.0	.8	7	4.0	.6	3.6	1.0
	Commander	20	4.1	1.0	3.9	1.3	5	4.4	.9	4.0	1.2
Interest	S1	24	3.8	1.0	3.0	1.3	6	3.3	1.5	2.8	1.2
	S2	22	4.0	1.2	3.6	1.1	6	4.0	.9	3.5	.8
	S3	29	4.3	.8	3.6	.8	6	4.5	.8	3.5	1.2
	S4	23	4.1	1.1	3.1	1.3	4	4.0	1.4	3.0	1.4
	FSO	15	3.9	1.0	3.7	.8	7	4.0	.8	3.1	1.2
	Commander	20	4.3	1.1	3.5	1.3	5	5.0	.0	3.2	.8

TABLE C-8
ANOVA Summary for Motivation

Source	df	Mean Square	F
Level	1	1.162	.380
Position	5	8.672	2.888*
L X P	5	3.550	1.162
Error	155	3,056	
Measure	2	92.620	103.148***
M X L	2	.358	.398
M X P	10	.651	.725
M X L X P	10	.921	1.026
Error	310	.898	
System	1	27.739	17.272***
S X L	1	.498	.310
S X P	5	1.599	.995
S X L X P	5	.910	.567
Error	155	1.606	
M X S	2	5.795	18.744***
M X S X L	2	.270	.873
M X S X P	10	.239	.772
M X S X L X P	10	.365	.182
Error	310	.309	

*$p < .05$
***$p < .001$

TABLE C-9
ARTEP Subtasks Rated by S1

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TASK 3. Prepare and organize the battlefield								
3J. Provide supplies	3.4	.9	2.8	.8	2.8	1.3	2.8	1.1
3K. Maintain equipment	3.1	.8	2.7	.9	2.2	1.3	2.4	1.1
Task 6. Control and coordinate combat operations								
6D. Maintain the battlefield	3.7	.9	3.0	.9	3.0	1.4	2.8	1.3
Task 9. Manage combat service support assets								
9A. Arm and fuel the systems	3.3	1.2	2.7	1.2	1.4	.9	1.4	.9
9B. Fix the system	3.1	1.2	2.6	1.2	1.2	.4	1.2	.4
9C. Support the troops	3.5	1.1	2.9	1.2	3.2	1.3	2.6	1.1
9D. Integrate CSS into scheme of maneuver	3.5	1.0	2.7	1.1	2.8	1.5	2.4	1.3

[a] $n = 29$
[b] $n = 5$

TABLE C-10
ANOVA Summary for S1 Subtasks

Source	df	Mean Square	F
Level	1	35.986	5.699*
Error	32	6.314	
Subtask	6	6.443	7.936***
Sub x L	6	2.933	3.613**
Error	192	.812	
System	1	8.369	3.245
Sys x L	1	3.201	1.241
Error	32	2.579	
Sub x Sys	6	.238	.853
Sub x Sys x L	6	.148	.531
Error	192	.279	

*p < .05
**p < .01
***p < .001

TABLE C-11
ARTEP Subtasks Rated by S2

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 1. Develop plan based on mission								
1B. Identify critical intelligence	3.5	.9	3.6	.9	4.5	.8	3.5	1.1
Task 2. Initiate intelligence preparation of the battlefield								
2A. Identify critical intelligence	3.4	1.1	3.4	.9	4.4	.7	3.5	.9
2B. Gather critical intelligence	3.4	1.2	3.3	1.1	4.3	.7	3.1	.8
2C. Analyze enemy	3.5	1.2	3.5	1.0	4.4	.5	3.3	1.0
2D. Disseminate critical intelligence	3.7	1.2	3.6	1.0	4.4	.7	3.4	1.2
Task 3. Prepare and organize the battlefield								
3A. Determine critical place	3.7	1.1	3.6	1.1	4.1	1.0	3.5	.9
3F. Develop a communication plan	3.0	1.2	3.2	1.1	3.4	.9	3.4	.9
3I. Employ security measures	2.2	1.1	2.8	1.3	2.5	1.3	2.6	.9
Task 5. See the battlefield during the battle								
5A. Identify critical intelligence	3.5	1.0	3.3	.9	4.1	.8	3.4	.9
5B. Gather critical intelligence	3.5	1.0	3.4	.9	4.4	.5	3.3	1.0
5C. Analyze enemy	3.3	1.2	3.5	1.0	4.5	.5	3.3	1.0
5D. Disseminate critical intelligence	3.5	1.2	3.4	1.1	4.1	.8	3.4	.9

[a] $n = 26$
[b] $n = 8$

TABLE C-11 (continued)
ARTEP Subtasks Rated by S2

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 10. Secure and protect the Task Force								
10A. Defeat electromagnetic intelligence	1.8	1.0	2.3	1.3	2.5	1.4	2.1	.6
10B. Defeat imagery intelligence	1.6	.9	2.1	1.1	1.5	.5	1.7	.7
10C. Defeat human intelligence	1.7	.9	2.1	1.2	1.6	.7	1.7	.7
10D. Deceive the enemy	1.8	1.0	2.2	1.1	1.7	1.0	1.7	.7
Task 12. React to situations requiring special actions								
12A. React to electronic warfare	1.8	1.1	2.6	1.3	3.0	1.4	2.4	1.3
12B. React to chemical or biological attack	1.9	1.2	2.4	1.3	2.0	1.3	2.6	1.4
12C. React to nuclear attack	1.7	1.1	2.6	1.2	1.7	1.2	2.3	1.3

[a] $n = 26$
[b] $n = 8$

TABLE C-12
ANOVA Summary for S2 Subtasks

Source	df	Mean Square	F
Level	1	9.669	.605
Error	32	15.992	
Subtask	18	31.129	34.073***
Sub x L	18	.763	.835
Error	576	.914	
System	1	3.260	.859
Sys x L	1	29.341	7.732**
Error	32	3.795	
Sub x Sys	18	2.229	5.287***
Sub x Sys x L	18	.649	1.540
Error	576	.422	

**p < .01
***p < .001

TABLE C-13
ARTEP Subtasks Rated by S3

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 1. Develop plan based on mission								
1A. Analyze mission	4.0	.9	3.9	1.0	4.7	.5	4.3	.8
1C. Identify friendly information	3.9	1.0	3.5	1.0	4.5	.5	4.3	.5
1D. Analyze friendly capabilities	4.0	.9	3.6	1.0	4.5	.5	4.3	.8
1E. Select/control key terrain	4.1	.9	3.7	.8	4.5	.5	4.3	.5
1F. Select routes to objective	4.0	.7	3.8	.7	4.3	.8	4.2	.8
1G. Select battle positions	4.2	.8	3.8	.8	4.5	.5	4.0	.9
1H. Select delay positions	4.0	1.0	3.7	.9	4.5	.5	3.8	1.2
Task 3. Prepare and organize the battlefield								
3A. Determine critical place	4.2	.8	3.7	.8	4.5	.5	4.2	.8
3B. Select a course of action	4.2	.8	3.8	.9	4.7	.5	4.5	.5
3C. Organize for combat	4.0	1.0	3.5	1.0	4.8	.4	4.3	.8
3D. Select control measures	3.8	.8	3.6	.9	4.7	.5	4.2	.8
3E. Plan fires	4.0	1.1	3.3	1.1	4.7	.5	4.0	1.1
3F. Develop a communication plan	3.6	1.1	3.4	1.0	3.7	.8	3.7	.8
3G. Communicate plans and orders	4.0	1.0	3.5	.9	4.5	.5	4.2	.8
3H. Reinforce terrain	3.9	1.0	3.4	1.0	4.5	.8	3.2	1.2

[a] $n = 30$
[b] $n = 6$

Table C-13 (Continued)
ARTEP Subtasks Rated by S3

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 4. Troop lead								
4A. Supervise preparations	3.1	1.4	2.9	1.3	4.5	.5	3.3	1.2
4B. Supervise compliance with order	3.4	1.3	3.0	1.3	4.5	.5	3.7	1.0
4C. Conduct rehearsals	2.5	1.4	2.3	1.3	2.8	1.7	2.3	1.8
Task 6. Control and coordinate combat operations								
6A. Modify scheme of maneuver	3.8	1.2	3.2	1.0	4.7	.5	3.3	1.4
6B. Coordinate/communicate changes	3.9	.9	3.4	.9	4.7	.5	3.7	1.0
6C. Supervise execution	3.6	1.3	3.0	1.2	4.5	.5	3.5	1.0
Task 7. Employ fires and other combat support assets								
7C. Employ other combat support assets	3.8	1.1	3.4	.8	4.7	.5	3.2	1.2
Task 8. Concentrate/shift combat power								
8A. Determine critical place and time	4.0	1.1	3.2	.9	4.7	.5	3.5	1.2
8B. Concentrate combat power in attack	3.8	1.1	3.2	.9	4.8	.4	3.7	1.0
8C. Concentrate in defense or retrograde	4.0	.9	3.3	.9	4.8	.4	3.7	1.0
8D. Protect thinly held areas	3.9	.9	3.2	.9	4.8	.4	3.5	1.0

[a] $n = 30$
[b] $n = 6$

Table C-13 (Continued)
ARTEP Subtasks Rated by S3

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 10. Secure and protect the Task Force								
10E. Reduce vulnerability to mass destruction weapons systems	3.8	.9	3.1	.9	4.3	1.2	3.0	1.1
10F. Detect/impede threats to security	3.5	1.3	3.0	1.0	4.0	1.1	3.2	1.2
10G. Detect/defeat enemy air assets	2.9	1.4	2.6	1.1	3.0	1.7	2.2	1.5
Task 11. Troop lead during battle								
11A. Supervise compliance with order	3.2	1.4	2.6	1.2	4.7	.8	2.7	1.2
Task 12. React to situations requiring special actions								
12D. React to loss of key member of command group	2.9	1.5	2.6	1.2	3.2	1.8	2.7	1.6

[a] $n = 30$
[b] $n = 6$

TABLE C-14
ANOVA Summary for S3 Subtasks

Source	df	Mean Square	F
Level	1	80.529	3.619
Error	34	22.252	
Subtask	30	7.739	8.195***
Sub x L	30	.754	.799
Error	1020	.944	
System	1	105.292	16.421***
Sys x L	1	6.826	1.065
Error	34		
Sub x Sys	30	.810	2.728***
Sub x Sys x L	30	.346	1.179
Error	1020	.294	

***$p < .001$

TABLE C-15
ARTEP Subtasks Rated by S4

Subtask	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 3. Prepare and organize the battlefield								
3J. Provide supplies	4.0	1.1	2.9	1.0	2.7	1.2	3.4	1.1
3K. Maintain equipment	2.8	1.2	2.6	1.1	2.3	1.0	2.7	1.5
Task 6. Control and coordinate combat operations								
6D. Maintain the battlefield	3.4	1.3	2.8	1.1	2.5	.9	2.7	.9
Task 9. Manage combat service support assets								
9A. Arm and fuel the systems	3.8	1.2	2.9	1.1	2.7	1.0	3.4	.9
9B. Fix the system	3.1	1.2	2.6	1.0	1.9	.8	2.4	1.4
9C. Support the troops	3.4	1.3	3.0	1.2	2.5	1.3	2.9	1.5
9D. Integrate CSS into scheme of maneuver	3.5	1.1	3.0	.9	2.6	1.1	2.7	.9

[a] $n = 31$
[b] $n = 8$

TABLE C-16
ANOVA Summary for S4 Subtasks

Source	df	Mean Square	F
Level	1	18.065	2.794
Error	37	6.465	
Subtask	6	4.082	4.763***
Sub x L	6	.432	.505
Error	222	.857	
System	1	.454	.104
Sys x L	1	22.256	5.074*
Syb x Sys	6	.212	.723
Sub x Sys x L	6	.570	1.942
Error	222	.294	

*p < ,05
***p < ,001

TABLE C-17
ARTEP Subtasks Rated by FSO

Subtask	Battalion[a]				Battalion[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Task 1. Develop plan based on mission								
1I. Plan use of organic/attached and non-organic fires	3.5	1.1	3.6	1.1	3.7	1.1	3.8	.9
1J. Determine priority of fires	3.3	1.4	3.3	1.3	3.7	1.2	3.7	1.1
1L. Conduct initial fire support coordination	3.3	1.0	3.5	1.1	3.9	1.3	3.7	1.2
Task 7. Employ fires and other combat support assets								
7A. Modify fire support plan	3.2	1.5	3.1	1.1	3.7	.9	3.4	.7
7B. Employ fires	3.6	1.3	3.2	1.1	3.9	.9	3.7	1.1

[a] n = 26
[b] n = 10

TABLE C-18
ANOVA Summary for FSO Subtasks

Source	df	Mean Square	F
Level	1	9.480	1.626
Error	34	5.829	
Subtask	4	.882	1.342
Sub x L	4	.121	.184
Error	136	.657	
System	1	.453	.120
Sys x L	1	.120	.032
Sub x Sys	4	.352	1.190
Sub x Sys x L	4	.185	.626
Error	136	.296	

Table C-19. Characteristics of Command and Control Rated by Commander

Characteristic	Battalion[a]				Brigade[b]			
	CAMMS		CPX		CAMMS		CPX	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Facing a thinking enemy	4.0	.8	3.3	.9	4.6	.8	3.0	1.2
Working with incomplete information	3.9	.7	3.3	.8	3.9	1.3	3.0	1.3
Making decisions under real-time constraints	4.0	1.0	3.4	1.0	4.6	.5	3.1	1.2
Maintaining flexibility to cope with unanticipated events	4.0	.8	3.4	.9	4.6	.5	3.6	1.0
Exposure to the capabilities (range, speed, lethality) of modern enemy weapons systems	4.2	.9	3.1	1.2	4.7	.5	2.9	1.1
Exposure to enemy tactics	4.1	1.0	3.5	1.2	4.3	.8	3.4	1.0
Utilizing all available assets (FA, ADA, Engineers, Air Force, etc.) to counter the enemy's weapons and tactics	3.9	.9	3.6	.9	4.7	.5	3.7	.8
Concentrating/shifting combat power at the critical place and time	4.2	.8	3.6	.9	4.6	.5	3.7	.8
Gathering and analyzing information about the enemy	3.9	1.0	3.6	1.1	4.3	.8	3.6	1.0
Planning and disseminating orders under battlefield conditions	3.9	1.1	3.5	1.0	4.6	.5	3.1	1.1
Utilizing communications security procedures	3.3	1.2	3.5	1.1	3.7	1.0	3.7	.8
Receiving, recording, and disseminating radio and telephone messages within the TOC	3.8	1.0	3.7	1.1	4.3	.5	4.0	.8
Coordination among staff members	4.2	.8	3.8	.9	4.6	.5	3.9	.7
Admin/log requirements	3.8	1.2	3.1	1.1	4.0	1.0	3.4	1.1

[a] $n = 33$

[b] $n = 7$

TABLE C-20
ANOVA Summary for Characteristics of Command and Control

Source	df	Mean Square	F
Level	1	7.139	.591
Error	38	12.077	
Characteristic	13	1.389	2.352**
C x L	13	.299	.506
Error	494	.591	
System	1	84.693	29.254***
S x L	1	7.479	2.583
Error	38	2.895	
C x S	13	1.761	6.673***
C x S x L	13	.285	1.081
Error	494	.264	

**p < .01
***p < .001

APPENDIX D

PERSONNEL COSTS

TABLE D-1
Composite Standard Rates for Costing
Military Personnel Services[1]

	Annual Rate	Hourly Rate
COL	$38,674	$20.9275
LTC	31,521	17.0568
MAJ	25,988	14.0628
CPT	21,395	11.5774
1LT	16,677	9.0243
2LT	12,231	6.6185
E9	21,415	11.5882
E8	17,777	9.6196
E7	15,192	8.2208
E6	12,663	6.8523
E5	10,673	5.7754
E4	8,958	4.8474
E3	8,192	4.4329
E2	7,557	4.0892

*Hourly rate based on 1848 hour military man year.

[1]From revised Army Training Study (ARTS) TEA 78 Management System Package, ATCG-ATS, Fort Belvoir, VA, 10 April 1978.

TABLE D-2
Preparation Costs for a 16-Hour CPX

	Battalion		Brigade	
	Man-hours	Cost	Man-hours	Cost
Develop scenario[a]				
LTC	2.0	34.11	-	-
MAJ	10.7	150.47	20.0	281.26
CPT	12.7	147.03	37.3	431.84
E8	1.5	14.43	-	-
E7	.7	5.75	-	-
E6	.7	4.80	-	-
E4	5.3	25.69	-	-
E3	1.5	6.65	-	-
Total	35.1	$388.93	57.3	$713.10
Write messages[a]				
MAJ	2.0	28.13	16.0	225.00
CPT	49.3	570.77	49.3	570.77
1LT	75.3	679.53	64.0	577.56
E8	-	-	8.0	76.96
E7	1.7	13.98	32.0	263.07
E6	-	-	32.0	219.27
E4	3.5	16.97	3.3	16.00
Total	131.8	$1,309.38	204.6	$1,948.63
Train controllers[a]				
LTC	-	-	10.0	170.57
MAJ	5.0	70.31	14.7	206.72
CPT	17.6	203.76	37.3	431.84
1LT	9.1	82.12	9.3	83.93
2LT	6.0	39.71	-	-
E8	14.0	134.67	14.7	141.41
E7	23.8	195.66	14.7	120.85
E4	6.0	29.08	38.7	187.59
E3	6.0	26.60	18.7	82.90
Total	87.5	$781.91	158.1	$1,425.81

[a]n = 4 for battalion, 3 for brigade.

Table D-2 (Continued)

	Battalion		Brigade	
	Man-hours	Cost	Man-hours	Cost
Set up equipment[b]				
MAJ	4.0	56.25	2.0	28.13
CPT	4.0	46.31	7.0	81.04
1LT	-	-	3.0	27.03
E8	-	-	16.0	153.91
E7	18.0	147.97	19.0	156.20
E6	8.4	57.56	3.0	20.56
E5	25.0	144.39	-	-
E4	61.7	299.08	80.0	387.79
Total	121.1	$751.56	130.0	$854.70
Other[c]				
MAJ	-	-	2.0	28.13
CPT	-	-	2.0	23.15
E8	-	-	2.0	19.24
E7	-	-	2.0	16.44
Total	-	-	8.0	$86.96

[a] n = 4 for battalion, 3 for brigade
[b] n = 2
[c] n = 1 for brigade

TABLE D-3
Cost Per Man-Hour of Exercise Preparation

	Battalion	Brigade
Develop scenario	$11.08	$12.45
Write messages	9.93	9.52
Train controllers	8.94	9.02
Set up equipment	6.21	6.57
Other	-	10.87

ARI Distribution List

4 OASD (M&RA)
2 HQDA (DAMI-CSZ)
1 HQDA (DAPE-PBR
1 HQDA (DAMA-AR)
1 HQDA (DAPE-HRE-PO)
1 HQDA (SGRD-ID)
1 HQDA (DAMI-DOT-C)
1 HQDA (DAPC-PMZ-A)
1 HQDA (DACH-PPZ-A)
1 HQDA (DAPE-HRE)
1 HQDA (DAPE-MPO-C)
1 HQDA (DAPE-DW)
1 HQDA (DAPE-HRL)
1 HQDA (DAPE-CPS)
1 HQDA (DAFD-MFA)
1 HQDA (DARD-ARS-P)
1 HQDA (DAPC-PAS-A)
1 HQDA (DUSA-OR)
1 HQDA (DAMO-RQR)
1 HQDA (DASG)
1 HQDA (DA10-PI)
1 Chief, Consult Div (DA-OTSG), Adelphi, MD
1 Mil Asst. Hum Res, ODDR&E, OAD (E&LS)
1 HQ USARAL, APO Seattle, ATTN: ARAGP-R
1 HQ First Army, ATTN: AFKA-OI-TI
2 HQ Fifth Army, Ft Sam Houston
1 Dir, Army Stf Studies Ofc, ATTN: OAVCSA (DSP)
1 Ofc Chief of Stf, Studies Ofc
1 DCSPER, ATTN: CPS/OCP
1 The Army Lib, Pentagon, ATTN: RSB Chief
1 The Army Lib, Pentagon, ATTN: ANRAL
1 Ofc, Asst Sec of the Army (R&D)
1 Tech Support Ofc, OJCS
1 USASA, Arlington, ATTN: IARD-T
1 USA Rsch Ofc, Durham, ATTN: Life Sciences Dir
2 USARIEM, Natick, ATTN: SGRD-UE-CA
1 USATTC, Ft Clayton, ATTN: STETC-MO-A
1 USAIMA, Ft Bragg, ATTN: ATSU-CTD-OM
1 USAIMA, Ft Bragg, ATTN: Marquat Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Lib
1 US WAC Ctr & Sch, Ft McClellan, ATTN: Tng Dir
1 USA Quartermaster Sch, Ft Lee, ATTN: ATSM-TE
1 Intelligence Material Dev Ofc, EWL, Ft Holabird
1 USA SE Signal Sch, Ft Gordon, ATTN: ATSO-EA
1 USA Chaplain Ctr & Sch, Ft Hamilton, ATTN: ATSC-TE-RD
1 USATSCH, Ft Eustis, ATTN: Educ Advisor
1 USA War College, Carlisle Barracks, ATTN: Lib
2 WRAIR, Neuropsychiatry Div
1 DLI, SDA, Monterey
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-MR
1 USA Concept Anal Agcy, Bethesda, ATTN: MOCA-JF
1 USA Arctic Test Ctr, APO Seattle, ATTN: STEAC-PL-MI
1 USA Arctic Test Ctr, APO Seattle, ATTN: AMSTE-PL-TS
1 USA Armament Cmd, Rostone Arsenal, ATTN: ATSK-TEM
1 USA Armament Cmd, Rock Island, ATTN: AMSAR-TDC
1 FAA-NAFEC, Atlantic City, ATTN: Library
1 FAA-NAFEC, Atlantic City, ATTN: Hum Engr Br
1 FAA Aeronautical Ctr, Oklahoma City, ATTN: AAC-44D
2 USA Fld Arty Sch, Ft Sill, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: Library
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DI-E
1 USA Armor Sch, Ft Knox, ATTN: ATSB-DT-TP
1 USA Armor Sch, Ft Knox, ATTN: ATSB-CD-AD
2 HQUSACDEC, Ft Ord, ATTN: Library
1 HQUSACDEC, Ft Ord, ATTN: ATEC-EX-E-Hum Factors
2 USAEEC, Ft Benjamin Harrison, ATTN: Library
1 USAPACDC, Ft Benjamin Harrison, ATTN: ATCP-HR
1 USA Comm-Elect Sch, Ft Monmouth, ATTN: ATSN-EA
1 USAEC, Ft Monmouth, ATTN: AMSEL-CT-HDP
1 USAEC, Ft Monmouth, ATTN: AMSEL-PA-P
1 USAEC, Ft Monmouth, ATTN: AMSEL-SI-CB
1 USAEC, Ft Monmouth, ATTN: C, Facl Dev Br
1 USA Materials Sys Anal Agcy, Aberdeen, ATTN: AMXSY-P
1 Edgewood Arsenal, Aberdeen, ATTN: SAREA-BL-H
1 USA Ord Ctr & Sch, Aberdeen, ATTN: ATSL-TEM-C
2 USA Hum Engr Lab, Aberdeen, ATTN: Library/Dir
1 USA Combat Arms Tng Bd, Ft Benning, ATTN: Ad Supervisor
1 USA Infantry Hum Rsch Unit, Ft Benning, ATTN: Chief
1 USA Infantry Bd, Ft Benning, ATTN: STEBC-TE-T
1 USASMA, Ft Bliss, ATTN: ATSS-LRC
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA-CTD-ME
1 USA Air Def Sch, Ft Bliss, ATTN: Tech Lib
1 USA Air Def Bd, Ft Bliss, ATTN: FILES
1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: ATSW-SE-L
1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: DepCdr
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: CCS
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCASA
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-I
1 USA Combined Arms Cmbt Dev Act, Ft Leavenworth, ATTN: ATCACC-C
1 USAECOM, Night Vision Lab, Ft Belvoir, ATTN: AMSEL-NV-SD
3 USA Computer Sys Cmd, Ft Belvoir, ATTN: Tech Library
1 USAMERDC, Ft Belvoir, ATTN: STSFB-DQ
1 USA Eng Sch, Ft Belvoir, ATTN: Library
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-TD-S
1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATS-CTD-MS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEX-GS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTS-OR
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-DT
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: DAS/SRD
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TEM
1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: Library
1 CDR, HQ Ft Huachuca, ATTN: Tech Ref Div
2 CDR, USA Electronic Prvg Grd, ATTN: STEEP-MT-S
1 HQ, TCATA, ATTN: Tech Library
1 HQ, TCATA, ATTN: AT CAT-OP-Q, Ft Hood
1 USA Recruiting Cmd, Ft Sheridan, ATTN: USARCPM-P
1 Senior Army Adv., USAFAGOD/TAC, Elgin AF Aux Fld No. 9
1 HQ USARPAC, DCSPER, APO SF 96558, ATTN: GPPE-SE
1 Stimson Lib, Academy of Health Sciences, Ft Sam Houston
1 Marine Corps Inst., ATTN: Dean-MCI
1 HQUSMC, Commandant, ATTN: Code MTMT
1 HQUSMC, Commandant, ATTN: Code MPI-20-28
2 USCG Academy, New London, ATTN: Admission
2 USCG Academy, New London, ATTN: Library
1 USCG Training Ctr, NY, ATTN: CO
1 USCG Training Ctr, NY, ATTN: Educ Svc Ofc
1 USCG, Psychol Res Br, DC, ATTN: GP 1/62
1 HQ Mid-Range Br, MC Det, Quantico, ATTN: P&S Div

1 US Marine Corps Liaision Ofc, AMC, Alexandria, ATTN: AMCGS–F
1 USATRADOC, Ft Monroe, ATTN: ATRO–ED
6 USATRADOC, Ft Monroe, ATTN: ATPR–AD
1 USATRADOC, Ft Monroe, ATTN: ATTS–EA
1 USA Forces Cmd, Ft McPherson, ATTN: Library
2 USA Aviation Test Bd, Ft Rucker, ATTN: STEBG–PO
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Library
1 USA Agcy for Aviation Safety, Ft Rucker, ATTN: Educ Advisor
1 USA Aviation Sch, Ft Rucker, ATTN: PO Drawer O
1 HQUSA Aviation Sys Cmd, St Louis, ATTN: AMSAV–ZDR
2 USA Aviation Sys Test Act., Edwards AFB, ATTN: SAVTE–T
1 USA Air Def Sch, Ft Bliss, ATTN: ATSA TEM
1 USA Air Mobility Rsch & Dev Lab, Moffett Fld, ATTN: SAVDL–AS
1 USA Aviation Sch, Res Tng Mgt, Ft Rucker, ATTN: ATST–T–RTM
1 USA Aviation Sch, CO, Ft Rucker, ATTN: ATST–D–A
1 HQ, DARCOM, Alexandria, ATTN: AMXCD–TL
1 HQ, DARCOM, Alexandria, ATTN: CDR
1 US Military Academy, West Point, ATTN: Serials Unit
1 US Military Academy, West Point, ATTN: Ofc of Milt Ldrshp
1 US Military Academy, West Point, ATTN: MAOR
1 USA Standardization Gp, UK, FPO NY, ATTN: MASE–GC
1 Ofc of Naval Rsch, Arlington, ATTN: Code 452
3 Ofc of Naval Rsch, Arlington, ATTN: Code 458
1 Ofc of Naval Rsch, Arlington, ATTN: Code 450
1 Ofc of Naval Rsch, Arlington, ATTN: Code 441
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Acous Sch Div
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L51
1 Naval Aerospc Med Res Lab, Pensacola, ATTN: Code L5
1 Chief of NavPers, ATTN: Pers-OR
1 NAVAIRSTA, Norfolk, ATTN: Safety Ctr
1 Nav Oceanographic, DC, ATTN: Code 6251, Charts & Tech
1 Center of Naval Anal, ATTN: Doc Ctr
1 NavAirSysCom, ATTN: AIR–5313C
1 Nav BuMed, ATTN: 713
1 NavHelicopterSubSqua 2, FPO SF 96601
1 AFHRL (FT) William AFB
1 AFHRL (TT) Lowry AFB
1 AFHRL (AS) WPAFB, OH
2 AFHRL (DOJZ) Brooks AFB
1 AFHRL (DOJN) Lackland AFB
1 HQUSAF (INYSD)
1 HQUSAF (DPXXA)
1 AFVTG (RD) Randolph AFB
3 AMRL (HE) WPAFB, OH
2 AF Inst of Tech, WPAFB, OH, ATTN: ENE/SL
1 ATC (XPTD) Randolph AFB
1 USAF AeroMed Lib, Brooks AFB (SUL–4), ATTN: DOC SEC
1 AFOSR (NL), Arlington
1 AF Log Cmd, McClellan AFB, ATTN: ALC/DPCRB
1 Air Force Academy, CO, ATTN: Dept of Bel Scn
5 NavPers & Dev Ctr, San Diego
2 Navy Med Neuropsychiatric Rsch Unit, San Diego
1 Nav Electronic Lab, San Diego, ATTN: Res Lab
1 Nav TrngCen, San Diego, ATTN: Code 9000–Lib
1 NavPostGraSch, Monterey, ATTN: Code 55Aa
1 NavPostGraSch, Monterey, ATTN: Code 2124
1 NavTrngEquipCtr, Orlando, ATTN: Tech Lib
1 US Dept of Labor, DC, ATTN: Manpower Admin
1 US Dept of Justice, DC, ATTN: Drug Enforce Admin
1 Nat Bur of Standards, DC, ATTN: Computer Info Section
1 Nat Clearing House for MH–Info, Rockville
1 Denver Federal Ctr, Lakewood, ATTN: BLM
12 Defense Documentation Center
4 Dir Psych, Army Hq, Russell Ofcs, Canberra
1 Scientific Advsr, Mil Bd, Army Hq, Russell Ofcs, Canberra
1 Mil and Air Attache, Austrian Embassy
1 Centre de Recherche Des Facteurs, Humaine de la Defense Nationale, Brussels
Canadian Joint Staff Washington
C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
3 Chief, Canadian Def Rsch Staff, ATTN: C/CRDS(W)
4 British Def Staff, British Embassy, Washington
1 Def & Civil Inst of Enviro Medicine, Canada
1 AIR CRESS, Kensington, ATTN: Info Sys Br
1 Militaerpsykologisk Tjeneste, Copehagen
1 Military Attache, French Embassy, ATTN: Doc Sec
1 Medecin Chef, C.E.R.P.A.–Arsenal, Toulon/Naval France
1 Prin Scientific Off, Appl Hum Engr Rsch Div, Ministry of Defense, New Delhi
1 Pers Rsch Ofc Library, AKA, Israel Defense Forces
1 Ministeris van Defensie, DOOP/KL Afd Sociaal Psychologische Zaken, The Hague, Netherlands