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ARMY AIRSPACE CONTROL PROGRAM OF EVALUATION REPORT

Daniel J. DeLany, et al

Modern Army Selected Systems Test Evaluation and Review
Fort Hood, Texas

April 1973

(1)

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ARMY AIRSPACE CONTROL PROGRAM OF EVALUATION REPORT

MASSTER TEST No 152

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APRIL 1973

HEADQUARTERS

MODERN ARMY SELECTED SYSTEMS TEST EVALUATION AND REVIEW

MASSTER

14 KEY WORDS (continued)	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Designated airspace						
Direct air support center (DASC)						
Division airspace control element (DACE)						
Effectiveness of airspace system						
Efficiency of airspace system						
Estimated probability of interference						
Field artillery and mortar delays						
Flight coordination center (FCC)						
Flight operations center						
Forward air control post (FACP)						
Integration						
Interference						
Joint airspace control center						
Joint force						
Level of airspace utilization						
Mid or high intensity air movement						
Minimum risk route						
Mission pair combinations						
Non-troop-support artillery						
Positive control						
Potential incidents of interference						
Ratio of potential incidents to mission combinations						
Monitoring service						
Regulation						
Restricted area						
Senior airspace control authority						
Simplified volume of airspace						
Simultaneous missions						
Tactical air control centers						
Tactical air control party						
Tactical air control system						

DEPARTMENT OF THE ARMY
HEADQUARTERS MODERN ARMY SELECTED SYSTEMS TEST EVALUATION AND REVIEW
(MASSTER)
FORT HOOD, TEXAS 76544

ATMAS-PA-PUB 17 April 1973

SUBJECT: Army Airspace Control Program of Evaluation Report, MASSTER Test Number 152

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1. References:

a. Letter, Office of The Adjutant General, ACDA (M) (19 Aug 71) FOR DC EXO, 2 September 1971, subject: Charter of the Commanding General, Modern Army Selected Systems Test, Evaluation, and Review (MASSTER).

b. STANO Program Plan, 16 January 1973.

c. Letter, DAFD-DCD, Office of the Assistant Chief of Staff for Force Development, 19 June 1972, subject: Program of Evaluation (POE) Army Airspace Control.

2. In accordance with instructions in references, paragraph 1, submitted herewith is the report by MASSTER.

3. The findings, conclusions, and recommendations contained in this document are those of the Commanding General and not necessarily those of the Department of the Army.

FOR THE COMMANDER:

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P. J. VOLK
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ARMY AIRSPACE CONTROL PROGRAM OF EVALUATION REPORT

ARMY AIRSPACE CONTROL PROGRAM OF EVALUATION REPORT

List of Figures

LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AADCP-----	Army air defense command post
AAE-------	Army aviation element
ACE-------	airspace control element
ACR-------	armored cavalry regiment
AD--------	air defense
ADA-------	air defense artillery
ADE-------	air defense element
AF--------	Air Force
ALO-------	air liaison officer
anal------	analyze, analysis, analyst
AO--------	area of operations
arty------	artillery
asst------	assistant
ATRC------	air traffic regulation center
avn-------	aviation
BACE------	brigade airspace control element
bde-------	brigade
carr------	carrier
cav sqn---	cavalry squadron
cbt-------	combat
CDC-------	Combat Developments Command
CENTO-----	Central Treaty Organization
cmd-------	command
comm------	communications
CP--------	command post
CPX-------	command post exercise
CRC-------	control and reporting center
CRP-------	control and reporting post
CTOC------	corps tactical operations center
DA--------	Department of the Army
DACE------	division airspace control element
DASC------	direct air support center
DEFCON----	defense readiness condition
DEFREP----	defense readiness posture
div-------	division
div arty--	division artillery
dvr-------	driver
DTOC------	division tactical operations center
EEI-------	essential elements of information
ele-------	element

EM-------- enlisted man
equip----- equipment
eval------ evaluation, evaluator
exp------- expiration
FA-------- field artillery
FAAUS----- Field Army Airspace Utilization Study
FAAR------ forward area alerting radar
FAC------- forward air controller
FACP------ forward air control post
FAM------- field artillery and mortar
FCC------- flight coordination center
FDC------- fire direction center
FEBA------ forward edge of the battle area
FM-------- field manual
FOC------- flight operations center
FSCC------ fire support coordination center
FSCOORD--- fire support coordinator
FSE------- fire support element
FSO------- fire support officer
FSWN------ fire support warning net
FU-------- fire unit
gnd------- ground
IFF------- identification of friend or foe
IFR------- instrument flight rules
IMC------- instrument meteorological conditions
Intel----- intelligence
In-------- liaison
LNO------- liaison officer
LOC------- line of communications
lt-------- light
MASSTER--- Modern Selected Systems Test, Evaluation, and Review
MOE------- measures of effectiveness
MRR------- minimum risk route
mvr------- maneuveer
NATO------ North Atlantic Treaty Organization
NCO------- noncommissioned officer
NCS------- net control station
off------- officer
OIR------- other intelligence requirements
op-------- operation
opns------ operations
OTW------- on the way
POE------- program of evaluation
rdo------ radio
RATELO---- radio telephone operator
RATT------ radio teletypewriter
reg------- regulation
rpmn------ repairman
rsn------- reason
sgt------- sergeant
SOP------- standard operating procedures

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13 ABSTRACT

The purpose of the Army Airspace Control Program of Evaluation was to evaluate Army doctrine, procedures, and organization for controlling airspace and to identify materiel needed to implement the system. The program of evaluation was conducted as four separate, but interrelated, activities which overlapped in time: A background and materiel review; a two-sided, computer assisted, time step war game; a one-sided, computer assisted, command post exercise; and a day-long conference of general officers representing the Combat Arms Centers, United States Army Combat Developments Command, and Headquarters, MASSTEP.

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Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
MASSTER						
Active aircraft						
Adequate						
Airborne operation						
Air controller						
Air corridors						
Air defense action area						
Air defense artillery misidentification rate						
Air defense battle zone						
Air defense liaison officer						
Air Force delay						
Airspace control						
Airspace control area						
Airspace control authority						
Airspace control center						
Airspace control element (ACE)						
Airspace control facility						
Airspace control line						
Airspace control objective						
Airspace control problem						
Airspace control sector						
Airspace control system						
Airspace coordination						
Airspace management						
Airspace reservation						
Airspace user						
Air traffic control						
Air traffic control line (ATCL)						
Air traffic control service						
Air traffic identification						
Air traffic regulation						
Air traffic regulation center						
Area airspace control authority						
Army air defense command post (AADCP)						
Army airspace control system						
Army aviation delays						
Army element						
Assistant division air defense officer (ADADO)						
Battalion area						
Block altitudes						
Brigade airspace control element (BACE)						
Brigade antiair package (BAP)						
Brigade area						
Brigade rear						
Combat area						
Component						
Component commander						
Control						
Control and reporting center (CRC)						
Control and reporting post (CRP)						
Controlled airspace						
Coordinating authority						
Coordination						
Crossover						

STANAG----	Standard NATO Agreement
sup-------	supply
TACAN-----	tactical air navigation
TACM------	tactical air command manual
TACSIT----	tactical situation
TASE------	tactical air support element
tech------	technical
TOC-------	tactical operations center
TOE-------	tables of organization and equipment
TRICO-----	Tricap concepts and organization
TT--------	training text
TTC-------	terminal traffic control
USAAVNS---	United States Army Aviation School
USACDC----	United States Army Combat Development Command
USAIS-----	United States Army Infantry School
veh-------	vehicle
VFR-------	visual flight rules
VMC-------	visual meteorological conditions

EXECUTIVE SUMMARY

1. Authority. Authority for the program of evaluation was letter, DAFD-DCD, DA, Office of the Assistant Chief of Staff for Force Development, 19 June 1972, subject: Program of Evaluation (POE) Army Airspace Control.

2. Purpose. The purpose of the Army airspace control program of evaluation was to evaluate Army doctrine, procedures, and organization for controlling airspace and to identify materiel needed to implement the system.

3. Program Objectives. The overall program objectives, as found in the approved POE, are listed below:

a. Objective 1. To examine available airspace control doctrine, organization, materiel, and procedures as a basis for developing a proposed Army airspace control system for experimentation.

b. Objective 2. To propose airspace control doctrine, organization, and procedures for experimentation and to identify supporting materiel.

c. Objective 3. To evaluate and refine the test doctrine, organization, and procedures for application in battalion, brigade, division, and, time permitting, corps.

d. Objective 4. To recommend an Army airspace control system for validation by Army field evaluation.

4. Program Description. The program of evaluation was conducted as four separate, but interrelated, activities which overlapped in time. The activities were conducted during the period 19 June 1972 through 2 February 1973.

a. A background and materiel review was conducted by researching manuals, documents, and test reports. This review determined past experimentation in the area, available equipment, and proposed equipment which could be used to operate an airspace control system.

b. A two-sided, partial knowledge, computer assisted, time-step war game was conducted. Experts from all of the combat arms service schools and the Air Force were used as players and evaluators. The war game defined the extent of airspace usage in a mid-intensity environment and evaluated existing and proposed Army doctrine.

The war game laid the groundwork for the more detailed testing which took place during the command post exercise.

(1) The measurement used to determine the intensity of the airspace control problem was the number of potential incidents of interference which occurred in the various designated areas.

(2) The computer was used to construct simplified volumes of airspace for all aircraft and firing unit projectiles; then it was used to screen these volumes for all possible combinations of intersections. Any such incident was recorded and, henceforth, labeled as a potential incident of interference.

c. A command post exercise (CPX) was used to experiment with, and modify, the airspace control systems which were designed as a result of the war game. The CPX examined the effectiveness of recommended airspace control systems by evaluating the timeliness of the combat support which was provided to the maneuver commander and by evaluating the efficiency of the systems in preventing incidents of interference.

(1) The experiment vehicle was a realtime, mid-intensity, division-level, command post exercise which used various tactical situations.

(2) Each system was evaluated for approximately 5 hours. Six different tactical situations were used during the CPX. The tactical situations were delay, day defense, night counterattack, day attack, exploitation, and airmobile operations. Eight different airspace control systems were evaluated.

(3) An airspace control system was determined to be effective if it minimized both delays in combat support and potential incidents of interference.

d. A day-long conference of general officers was conducted. The combat arms centers, United States Army Combat Developments Command, and Headquarters, Modern Army Selected Systems, Test, Evaluation, and Review (MASSTER) were represented. The conference provided a forum for the discussion of the basic issues involved in airspace control and alternative solutions to the problems.

5. Findings.

a. The Army airspace control procedures outlined in TT-44-10-1, Army Airspace Coordination Techniques, dated November 1971, effectively prevented 83 percent of the potential incidents of interference identified in the war game. The problem areas were interferences

involving Air Force aircraft with field artillery and mortars, Air Force aircraft with Army aircraft, Air Force aircraft with air defense artillery, and Army aircraft with air defense artillery.

b. The incidents involving air defense artillery occurred because friendly aircraft were mistakenly identified as hostile and were engaged by friendly air defense fire units.

c. During the CPX, aircraft were provided a recommended minimum risk route to reduce the probability of being involved in a potential incident of interference. There were 397 recommended minimum risk routes provided to Air Force aircraft. There were 128 potential incidents of interference between Air Force aircraft and field artillery and mortars. Of these incidents, only 11 occurred when the aircraft were travelling on recommended minimum risk routes. There were 39 Air Force and Army aviation potential incidents of interference during the eight runs of the CPX.

d. There was no direct correlation between the number of aircraft flights which travelled without the friendly air defense artillery units being alerted and the number of potential incidents with air defense units. The correlation did exist for the air defense units which were located inside brigade areas from which alerts were transmitted. The CPX uncovered the phenomenon of the air defense crossover for aircraft flights which passed near unit boundaries.

e. The airspace control sections in the brigade and division headquarters were unable to effect all of the required coordination and communication during six of the CPX runs. The problems were created by inadequate numbers of personnel and an insufficient amount of equipment.

f. There were communication problems encountered between the Air Force and the Army concerning recommended minimum risk routes until the Army adopted a plotting system similar to that used by the Air Force. The Army's use of a tactical air navigation-type system simplified the communications. Confusion dealing with terminology was reduced by conducting integrated training of Air Force and Army radio operators.

g. No potential incidents occurred above 10,000 feet.

h. During the CPX, the probability of incidents involving Air Force and Army aircraft was minimized by routine coordination between Air Force and Army personnel.

6. Conclusions.

a. There is no requirement for the army to prescribe headings and altitudes or other restrictions on Air Force aircraft flying over the battle area. In other words, there is no requirement for the Army to regulate Air Force air traffic.

b. An airspace control system is required for coordination of use of airspace over a division. This system is needed to reduce risks and hazards to Air Force and Army aircraft. Additional personnel and equipment are required to implement the system.

c. To educe confusion in coordination of airspace activities, Army and Air Force personnel require similar training in techniques and terminology. A common Air Force and Army plotting system is required.

d. Utilization of a minimum risk route reduces the hazard for Air Force aircraft transiting the division area.

e. Results of the CPX dealing with forward area air defense artillery weapons employment indicated a potential hazard to Army and Air Force aircraft because of misidentification and engagement by CHAPARRAL, Vulcan, and Redeye weapons crews. The hazard is alleviated when the likelihood of misidentification and engagement is reduced. Possible methods of achieving this are:

(1) Alerting air defense artillery units concerning flights of friendly aircraft. This would require radio nets between Army units and Air Force air traffic control facilities. Information from this net would be used as input to an Army air defense alert net.

(2) Placing more stringent controls and rules of engagement on forward area air defense artillery weapons. This would decrease the hazard to friendly aircraft and would cause some degradation in effectiveness against enemy aircraft. Currently, the normal weapons control status is weapons tight. Weapons hold is a more stringent weapons control status.

(3) A combination of the above; i.e., alert CHAPARRAL and Vulcan crews to Air Force aircraft and large Army aircraft flights, and, at the same time, place the Redeye on a weapons hold weapons control status.

f. Air Force aircraft flying through areas of intense field artillery and mortar firing encountered numerous potential incidents of interference with projectiles. The number of potential incidents was significantly reduced when the aircraft flew on a recommended minimum risk route. Minimum risk routes were planned through areas of little or

no field artillery and mortar activity. To permit proper determination of recommended routes, the artillery fire support officer at brigade headquarters requires information concerning all field artillery activities within and over the brigade area.

g. Friendly aircraft flying near unit boundaries are subjected to misidentification and engagement by friendly air defense artillery units located in an adjacent brigade or division area. A method of reducing these crossovers is to alert all air defense artillery firing units that are within range of a friendly aircraft's flight path, even if the firing units are located in an adjacent unit's area.

h. Routine coordination minimized the problem of interference between Air Force and Army aircraft. Less coordination is required when Army aircraft use nap-of-the-earth flying techniques.

i. Air Force aircraft flying at altitudes above 10,000 feet were able to transit division areas with only remote possibilities of incidents of interference from friendly weapons systems. This occurred because of infrequency of trajectories reaching that altitude from field artillery, mortar, and divisional air defense weapons.

j. Interferences between Army aircraft and field artillery and mortars will be minimized by aircraft flying nap-of-the-earth and not overflying artillery positions. The only danger zones from artillery for low flying aircraft are at the initial point (gun position) and the terminal point (target). Normal communications with ground commanders will minimize hazards from the terminal section of the artillery flight.

k. A communications link was needed between the brigade operations center and Army aircraft operating in the brigade's airspace.

7. Recommendations.

a. Validate the Army system for airspace control, as outlined in (1) through (6) below, in future Army field exercises.

(1) Establish a radio net to link an appropriate Air Force air traffic control facility with an Army division. This net will consist of one frequency with terminals at division and brigade headquarters as well as at the Air Force air traffic control facility. This net will require Air Force liaison parties to assist in airspace control functions at division level and at brigade level.

(2) Establish an Army air defense alert radio net from division and brigade headquarters to CHAPARRAL and Vulcan fire units. The net will be used to alert air defense units of flights of friendly aircraft. Net control stations will be located in the headquarters of each committed division and brigade. The divisions and brigades will alert the air defense units located inside their respective tactical zones. Personnel and radios to operate the system should be furnished by the CHAPARRAL-Vulcan battalion. Personnel would include liaison parties to assist in airspace control functions at division level and at brigade level and to operate the alert net control stations at these locations.

(3) Commanders use a weapons hold weapons control status for the Redeye as normal operating procedure.

(4) Establish a division airspace control radio net for the coordination of airspace control activities. Stations for the net should be located in each brigade headquarters, the division headquarters, and the flight coordination center. The station in the flight coordination center will provide timely information concerning Army aviation flights. This information will insure timely air defense alerts at each brigade and at the division headquarters. This net will always have activity in a division; consequently, the radios and personnel to operate the net should be added to the division TOE's.

(5) Establish an Army aviation air-to-ground radio net at each brigade when the level of aviation activity justifies the net. This net will be used for the coordination of Army aviation activities within a brigade. The net already exists in some units which have a high aircraft density. In other units, when the level of aircraft traffic within or through a brigade area is significantly high, the personnel and equipment to operate an air-to-ground net should be provided to the brigade. The personnel should include an Army aviation liaison officer provided by the supporting aviation unit or organization to assist in airspace control activities.

(6) Provide liaison parties from field artillery, Army aviation, Air Force, and air defense artillery to assist the G3 and S3 in the performance of airspace control functions. Current doctrine does not provide a liaison officer from the air defense artillery.

b. Revise Army Airspace Control Doctrine, FM 44-10.

c. Revise that portion of The Army Air-Ground Operations System, FM 100-26, pertaining to airspace control.

CHAPTER I

SUMMARY

SECTION I. INTRODUCTION

I-1. Authority. Authority for the program of evaluation was letter, DAFD-DCD, DA, Office of the Assistant Chief of Staff for Force Development, 19 June 1972, subject: Program of Evaluation (POE) Army Airspace Control (annex A).

I-2. Scope. The program of evaluation was conducted as four separate, but interrelated, activities which overlapped in time.

a. A background and material review was conducted by researching manuals, documents, test reports, etc.

b. A two-sided, partial knowledge, computer assisted, time-stepped war game was conducted. Experts from all of the combat arms service schools and the Air Force were used as players and evaluators.

c. A one-sided, computer assisted CPX experiment was conducted in realtime.

d. A day-long conference of general officers was conducted. The combat arms centers, USACDC, and Headquarters, MASSTER were represented.

e. The following terms which are used in this chapter are defined in annex B:

(1) Potential incident of interference.

(2) Battalion area.

(3) Brigade rear.

(4) Airspace control.

(5) Coordination.

(6) Integration.

(7) Regulation.

(8) Army airspace control system.

(9) Effectiveness.

(10) Efficiency.

(11) Airspace control problem.

(12) Minimum risk route.

(13) Weapons hold.

(14) Crossover.

1-3. Purpose. The purpose of the Army airspace control program of evaluation was to evaluate Army doctrine, procedures, and organization for controlling airspace and to identify materiel needed to implement the system.

a. The purpose of the background and materiel review was to determine, insofar as possible, what had been done in this area in the past and what existing and projected equipment could be used in airspace control.

b. The purpose of the war game was to provide environmental data for future analysis of the airspace control problem, to provide a documented system, and to develop a scenario for airspace control experiments.

c. The purpose of the command post exercise was to evaluate the airspace control system developed during the war game and to recommend changes to that system so that it could be utilized in subsequent airspace control experimentation.

d. The purpose of the general officer conference was to update the participants and to allow them to discuss the basic issues involved, with a view toward resolving these issues.

1-4. Program Objectives. Program objectives consist of the overall program objectives and the program objectives for each phase of the program.

a. The overall program objectives, as found in the approved POE, are listed below:

(1) Objective 1. To examine available airspace control doctrine, organization, materiel, and procedures as a basis for developing a proposed Army airspace control system for experimentation.

Para 1-4, Program Objectives (cont)

(2) Objective 2. To propose airspace control doctrine, organization, and procedures for experimentation and to identify supporting materiel.

(3) Objective 3. To evaluate and refine the test doctrine, organization, and procedures for application in battalion, brigade, division, and, time permitting, corps.

(4) Objective 4. To recommend an Army airspace control system for validation by Army field evaluation.

b. Background and materiel review: Subobjectives for POE objectives were defined for this phase of the program and are listed below:

(1) Subobjective 1. To determine what research, testing, and experimentation had been conducted in this area in the past.

(2) Subobjective 2. To determine what of the equipment which is currently available might be used to operate an airspace control system.

(3) Subobjective 3. To determine what of the equipment which is proposed for the future might be used to operate an airspace control system

c. War game subobjectives were as follows:

(1) Subobjective 1. To analyze existing and proposed Army doctrine, organization, materiel, and procedures for airspace control.

(2) Subobjective 2. To define the extent of airspace usage in a mid-intensity environment.

(3) Subobjective 3. To determine if existing and proposed doctrine and procedures satisfy the requirements of airspace control.

(4) Subobjective 4. To identify existing deficiencies or voids and to develop proposed solutions.

(5) In addition to the above major subobjectives, extensive documentation of the war game was conducted to provide detailed environmental data for future testing. These environmental data were instrumental in developing a definition of the Army airspace control problem.

d. The objective of the CPX was to determine the effectiveness of the recommended Army airspace control system.

Para 1-4. Program objectives (cont)

(1) Subobjective 1. To examine the efficiency of combat support which was provided to the maneuver commander.

(2) Subobjective 2. To examine the efficiency of the systems in preventing incidents of interference.

e. General officer conference objectives were as follows:

(1) Objective 1. To update the combat arms center team commanders on the progress of the program.

(2) Objective 2. To allow the center team commanders to make known their views on the basic issues involved in airspace control.

(3) Objective 3. To determine which, if any, of the airspace issues could be resolved.

1-5. Methodology. The methodology for the program involved several separate and distinct steps. The initial steps were designed to examine existing control procedures and materiel. Subsequent steps were designed to document and define the Army airspace control problem, to develop and improve control procedures, and, finally, to evaluate those control procedures (fig 1-1).

a. Background and materiel review. The methodology used to accomplish the objectives of the background and materiel review involved two concurrently executed activities.

(1) During the background review, literature on airspace control concepts, doctrine, procedures, and organizations was assembled and reviewed. The specific data requirements of the background review were as follows:

(a) To catalog literature by source and subject matter.

(b) To identify conflicting or similar concepts, doctrines, and procedures of the various airspace control activities.

(c) To identify required procedures to control those activities.

(d) To identify viable alternatives or additional concepts and procedures.

(2) During the materiel review, literature on the capabilities and limitations of all current and developmental materiel for use in airspace control was assembled and reviewed. The specific data requirements of the materiel review were as follows:

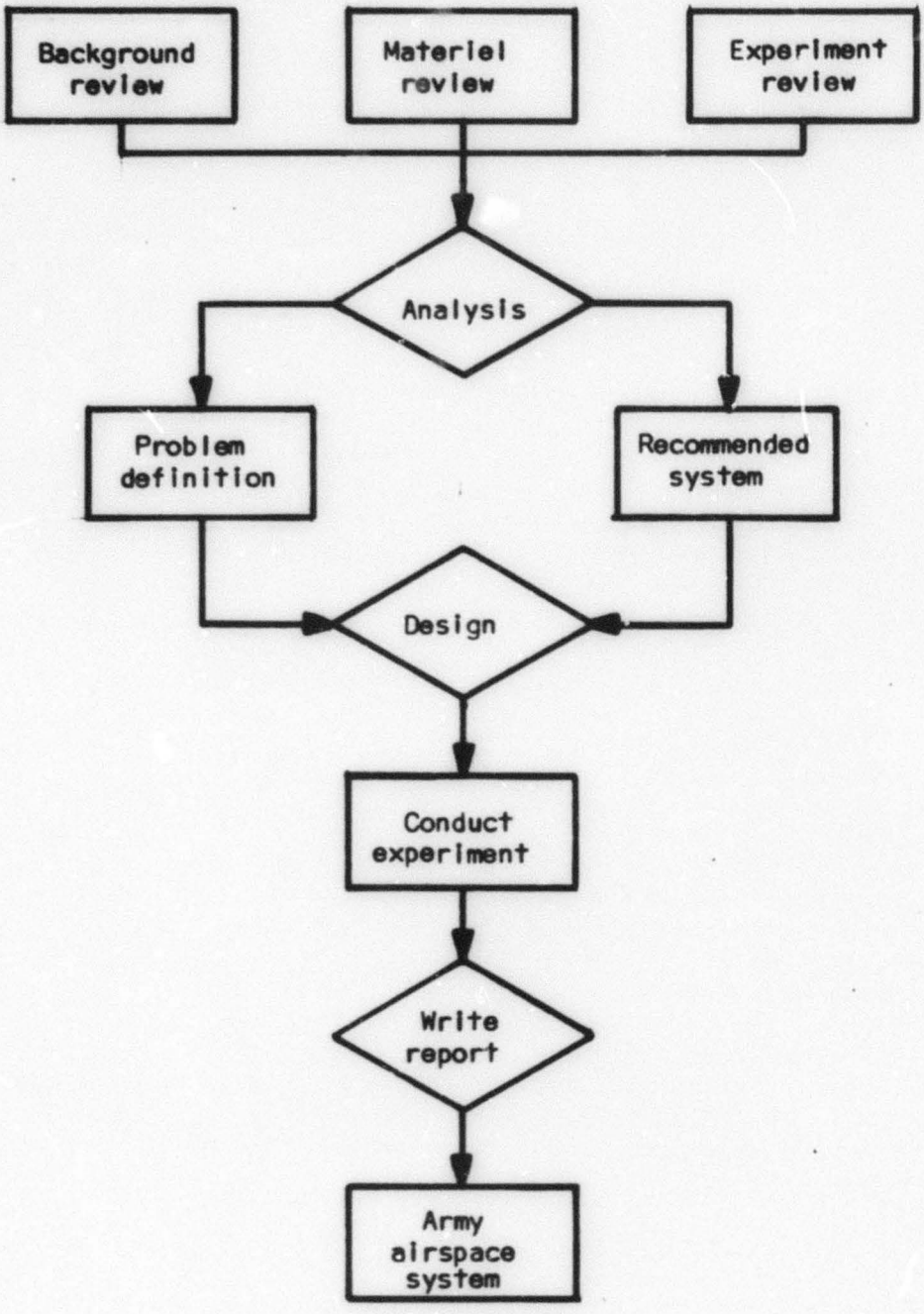


Figure 1-1. Program of Evaluation Flow Chart

Para 1-5, Methodology (cont)

(a) To catalog technical literature by status (current or developmental) and type of equipment.

(b) To identify equipment currently used in the control procedures of TT 44-10-1, Army Airspace Coordination Techniques, dated November 1971.

(c) To identify current or developmental equipment for use in supporting alternative or additional concepts and procedures.

b. War game. The main vehicle for studying the Army airspace control problem and for gathering environmental data was a two-sided, time-step, partial knowledge, computer assisted war game. The war game players were divided into two forces, red and blue. All players were experts in their fields. They included maneuver players from Fort Benning, Georgia, Fort Belvoir, Virginia, and Fort Knox, Kentucky; field artillery players from Fort Sill, Oklahoma, and Fort Huachuca, Arizona; air defense players from Fort Bliss, Texas, and US Army, Europe; aviation players from Fort Knox, Kentucky, and Fort Rucker, Alabama; and Air Force players from Bergstrom Air Force Base, Texas, and Langley Air Force Base, Virginia.

(1) The war game tactical situation, task organization, force deployment, aircraft sortie rate, ammunition supply rate, and similar data were selected from the midway point of games 5 (defense) and 9 (offense) of the TRICO study. At the time the data were selected, the forces were fully engaged. The games depict a mid-intensity European war environment. The basic forces were one friendly, H-series TOE armor division (blue) with attached attack helicopter troop and air cavalry troop, opposed by one enemy tank army (red) which was composed of three tank division and one mechanized division.

(2) The war game was played in 1-minute increments for 4 1/2 hours. Four different tactical situations were played. The friendly forces played 1 hour of daylight defense, 1/2 hour of daylight offense, 1/4 hour of daylight offense under IFR (weather conditions), and 1/2 hour of night offense.

(3) Players were provided with intelligence data and then required to allocate their resources in support of the maneuver commander's plan of action. The actions and current status of all aircraft and fire units were recorded on data forms, posted on overlays, placed in the computer data base, and passed to the data reducer-analyzers. No lateral coordination was permitted between players.

(4) Attrition of aircraft and personnel was played to add realism which, in turn, generated specific player actions.

Para 1-5, Methodology (cont)

(5) The measurement used to determine the intensity of the airspace control problem was the number of potential incidents of interference which occurred in the various designated areas.

(6) The computer was used to construct simplified volumes of airspace for all aircraft and firing unit projectiles, then it was used to screen these volumes for all possible combinations of intersections. Once the computer identified a possible intersection, experts representing Army aviation, air defense artillery, field artillery, and the Air Force manually refined the data and determined whether or not the intersection was close enough in time and space to be considered a hazard to manned flight. Any such incident was recorded and labeled as a potential incident of interference.

c. CPX experiment. A CPX was used to experiment with, and modify, the airspace control systems which were designed as a result of the war game. A flow chart depicting the methodology used is shown in figure 1-2.

(1) The experiment vehicle was a realtime, mid-intensity, division-level, command post exercise which used various tactical situations.

(2) The initial input to the validating experiments of the CPX was the airspace control systems developed in the war game.

(3) Each system was tested for approximately 5 hours. Six different tactical situations were used. The tactical situations were delay (pilot test), day defense, night counterattack, day attack, exploitation and airmobile operations.

(4) The CPX used two maneuver brigade headquarters and one mechanized division TOC as player elements. The third maneuver brigade headquarters, maneuver battalions, the corps TOC, and other essential division combat support elements were represented by controller personnel.

(5) An airspace control system was determined to be effecitve if it minimized both delays in combat support and potential incidents of interference.

(6) An analysis of the effectiveness of the airspace control system was made during and after the play of each tactical situation.

(a) If the analysis indicated the airspace control system being tested was not effective, the system was modified. If the modifications were minor, testing was continued. If major modifications were made, retesting under the same tactical situation was conducted.

Para 1-5, Methodology (cont)

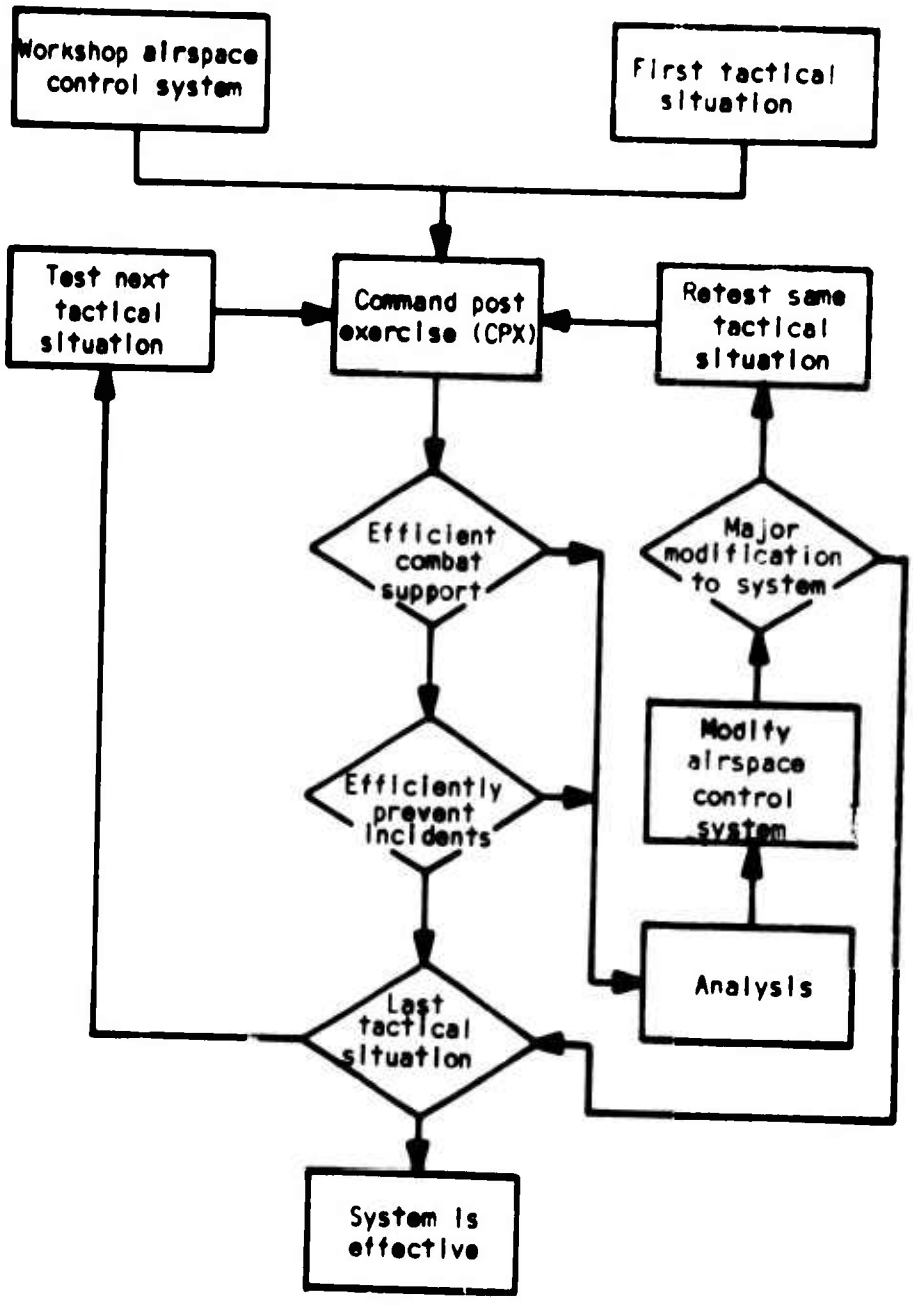


Figure 1-2. CPX Experiment Methodology

Para 1-5, Methodology (cont)

(b) If the analysis indicated the airspace control system being tested was effective, testing continued until the system had been tested under the complete scenario.

(c) An analysis of the combat support provided to the maneuver commander was accomplished by using the derivative process. The derivative process is the division of the experiment objective to progressively lower levels of analysis until field data form questions are provided which can be answered in one location by one collector-evaluator on a single data collection form.

d. General officer conference. A day-long conference of general officers who represented the combat arms centers, USACDC, and MASSTER was conducted on 2 February 1973. Participants were briefed on the major issues involved in airspace control. Each issue was fully discussed by the participants in an attempt to arrive at a common understanding of the issues and to reach a solution to these issues, where possible. A copy of the memorandum for record summarizing the conference is in annex C.

Section II. SUMMARY OF PROGRAM RESULTS

1-6. General. The results of the war game are addressed in chapter 3 and the results of the CPX experiment are addressed in chapter 5.

1-7. War Game.

a. Findings. Out of 407 potential incidents of interference identified in the war game, the 10 most frequent types are listed in figure 1-3. Starting with the most frequent type of potential incident of interference, each potential incident was analyzed as if it had been subjected to the control procedures as outlined in TT 44-10-1. The Army airspace control procedures outlined in TT 44-10-1 effectively prevented 337 of the 407 potential incidents of interference identified in the war game.

(1) Air defense artillery results.

(a) There was a total of 89 ADA and AF, and ADA and AVN potential incidents of interference during the war game. Control procedures outlined in TT 44-10-1 effectively resolved 77 of these incidents. All 12 unresolved incidents involved friendly aircraft which were mistakenly identified as hostile and were, therefore, engaged by friendly air defense fire units.

Type potential incident	Area	Number of incidents	Percentage of incidents	Critical altitude (ft)
FAM-AF	Battalions	160	39.3	0-3,000
FAM-AVN	Battalions	69	17.0	0- 500
ADA-AF	Battalions	47	11.5	0-3,000
FAM-AVN	Bde rear	25	6.1	0- 500
FAM-AF	Bde rear	22	5.4	0-2,000
ADA-AVN	Battalions	17	4.2	0- 500
ADA-AF	Bde rear	12	2.9	0-3,000
AVN-AVN	Battalions	10	2.4	0- 500
ADA-AVN	Bde rear	9	2.2	0- 500
AVN-AF	Battalions	6	1.5	0- 500
TOTAL		377	92.6	

Figure 1-3. Ten Most Frequent Types of Potential Incidents of Interference

(b) There were 196 Army aviation and 75 Air Force flights in the division area during the war game. There were 128 single aircraft Army flights. The remaining 68 were multiaircraft flights. Of the 128 single aircraft Army flights, 119 were rotary-wing flights and nine were fixed-wing flights.

(2) Field artillery and mortar results.

(a) There were 99 FAM-AVN and 185 FAM-AF potential incidents of interference during the war game.

(b) No potential incidents of interference occurred above 10,000 feet.

(c) Control procedures outlined in TT 44-10-1 effectively resolved all 99 FAM-AVN potential incidents of interference.

(d) Control procedures outlined in TT 44-10-1 effectively resolved 134 of the 185 FAM-AF potential incidents of interference.

(e) The 51 unresolved FAM-AF potential incidents of interference all involved the passage of transient Air Force aircraft through the division area.

Para 1-7, War Game (cont)

(3) Aircraft results.

(a) Of the 34 potential incidents of interference involving two aircraft, 25 occurred under day visual meteorological conditions; six occurred under day instrument meteorological conditions; and three occurred under night visual meteorological conditions.

(b) Current Air Force control procedures effectively resolved all seven AF-AF potential incidents of interference.

(c) Control procedures outlined in TT 44-10-1 effectively resolved all 18 AVN-AVN potential incidents of interference.

(d) There were nine Army AVN and AF potential incidents of interference during the war game. All occurred below 500 feet. Control procedures outlined in TT 44-10-1 effectively resolved two of these incidents. The seven unresolved incidents involved the passage of transient Air Force aircraft through the division area.

b. Conclusions.

(1) Air defense artillery.

(a) In order to prevent friendly aircraft from mistakenly being identified as hostile and being engaged by friendly air defense artillery fire units, division and brigade must have timely information on all Air Force aircraft transiting the division area. All ADA fire units must be alerted and/or informed of the passage of friendly aircraft through their areas.

(b) Alerting or informing ADA fire units of the passage of all friendly aircraft is impracticable because of the high density of Air Force and Army aircraft flights in the division area.

(c) A rule of engagement stating that ADA fire units will not engage rotary-wing single aircraft flights except in self-defense will eliminate the need to alert or inform ADA fire units of these flights.

(2) Field artillery and mortar. In order to minimize the hazard to Air Force aircraft, division and brigade must have timely information on all Air Force aircraft transiting the division area.

(3) Aircraft. In order to minimize the probability of a collision between Army aircraft and Air Force transient aircraft, division and brigade must have timely information on all Air Force aircraft transiting the division area.

Para 1-7, War Game (cont)

c. Recommendations. Based on the conclusions of the war game, two systems were recommended for evaluation during the CPX experiment. These systems, known as System A and System B, were alternate recommended solutions to the same problem. Action has been completed on all war game recommendations.

(1) System A.

(a) Established a two-way long-range, secure radio net from the Air Force CRP to each Army division served by the CRP. This net was called the Air Force routing net. It included equipment and personnel to permit all maneuver brigades to operate in their respective divisions and in the CRP radio net. The brigades used this net to inform the CRP of minimum risk flight paths in the brigade area. The DACE monitored transmissions between the brigades and the CRP and notified the CRP of the minimum risk flight paths over the division rear area. These minimum risk flight paths were furnished when the CRP indicated that an Air Force flight would be transiting the division area.

(b) Created a five-man augmentation at brigade headquarters to function as a BACE. This augmentation was organized as shown in figure 1-4.

Number of personnel	Position	Grade
1	Aviation officer	Captain
1	Air defense officer	Captain
1	Operations NCO	E6
2	RATELO	E4

Figure 1-4. Brigade Airspace Control Element Organization

(c) Established a two-way radio net from the BACE to the DACE. This net was called the division airspace control net. It was used for coordinating airspace activities within the division.

(d) Established one-way, long-range, secure radio, division and brigade air defense alert nets. These nets were used by brigade headquarters to alert ADA fire units of friendly aircraft flights which were crossing the brigade area. Division headquarters used its net to alert air defense fire units in the division rear of friendly aircraft flights which crossed that area.

Para 1-7, War Game (cont)

(e) Revised the use of the fire support warning net. This net was used by the general support artillery to notify the BACE and/or DACE of general support fire missions.

(f) Established a rule of engagement that air defense weapons would not engage single aircraft, rotary-wing flights.

(g) Revised TT 44-10-1 to incorporate airspace control procedures which eliminate the control problems disclosed during the war game.

(h) Major changes to current airspace control procedures recommended by System A are shown on figure 1-5.

(2) System B.

(a) Established a two-way, long-range, secure radio net from the Air Force CRP to each Army division served by the CRP. This net was called the Air Force routing net. It included equipment to permit all maneuver brigades to operate in their respective Air Force routing nets. The brigades only monitored this net. When the CRP notified the division that an Air Force flight was going to transit the division area, the brigades transmitted a minimum risk flight path for the brigade areas to the DACE. The DACE consolidated the brigade and division minimum risk flight paths and transmitted to the CRP one minimum risk flight path for the flight to transit the division area.

(b) Conducted brigade airspace control functions with personnel already assigned to the brigade headquarters. System B did not create an augmented BACE.

(c) Established a two-way radio net from the brigade headquarters to the DACE. This net was called the division airspace control net. It was used for coordinating airspace activities within the division.

(d) Established one-way, long-range, secure radio, division and brigade air defense alert nets. These nets were used by brigade headquarters to alert air defense fire units of friendly aircraft flights which crossed the brigade area. The DACE used its net to alert air defense fire units in the division rear area of friendly aircraft flights which crossed that area.

(e) Eliminated the fire support warning net.

(f) Established a rule of engagement that air defense fire units would not engage single aircraft, rotary-wing flights.

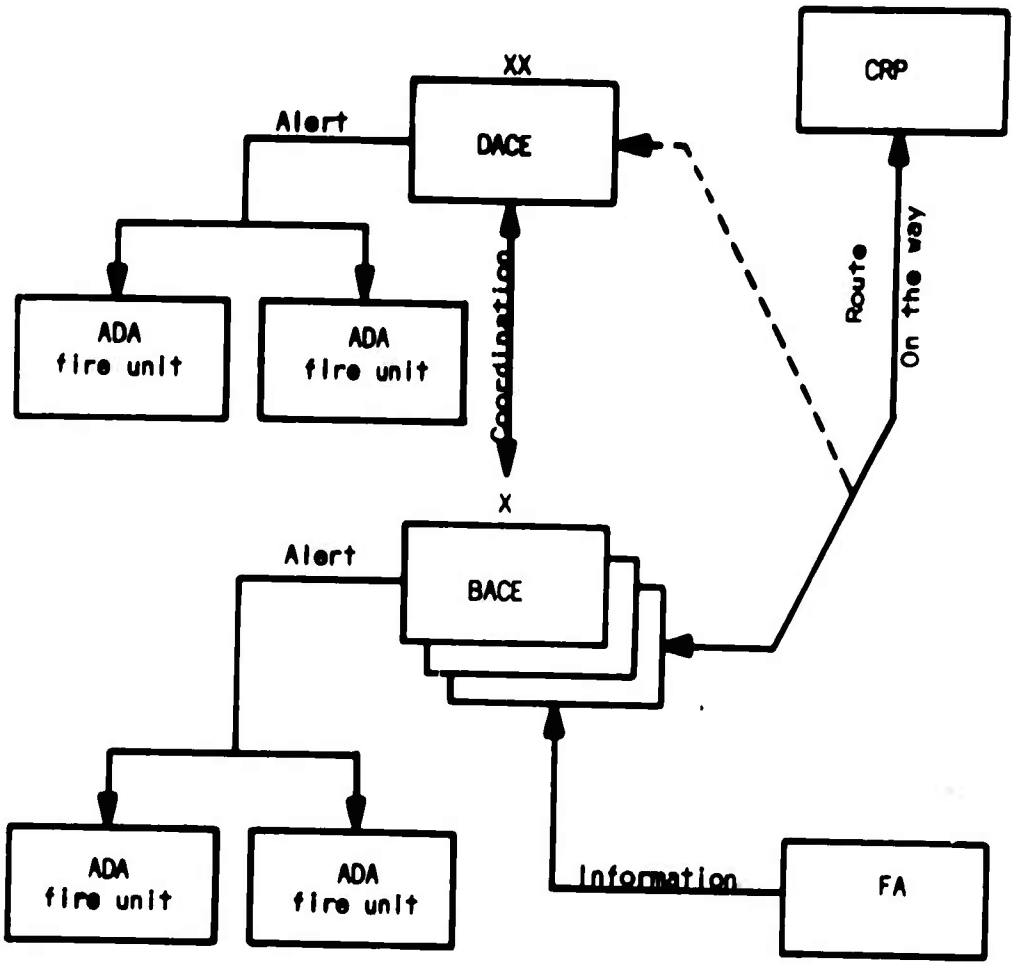


Figure 1-5. Recommended System A Major Changes

Para 1-7, War Game (cont)

(g) Revised TT 44-10-1 to incorporate airspace control procedures which eliminated the control problems disclosed during the war game. Modified the training text to eliminate the formation of the BACE.

(h) Major changes to current airspace control procedures recommended by System B are shown in figure 1-6.

1-8. CPX Experiment.

a. Findings. The first 13 findings are appropriate for all eight runs of the CPX. Other findings are grouped by the run during which they were produced.

(1) Successful transmission of air defense alerts concerning Air Force flights ranged from a low of 43 percent to a high of 94 percent. Alerts for Army flight ranged from a low of zero to a high of 68 percent. Figure F-14, CPX Air Defense Alerts Transmitted on Friendly Aircraft, gives details concerning each run.

(2) One AF-AVN potential incident of interference in run 4 involved an Army fixed-wing aircraft (OV-1) and occurred at 6,000 feet. All other AF-AVN incidents involved Army rotary-wing aircraft and occurred at altitudes of 500 feet and below. Figure 5-1 gives specific numbers of AF-AVN incidents.

(3) Brigades did not laterally coordinate close air support boxes. Some of the close air support missions extended over an adjacent brigade or division's lateral boundary.

(4) Air defense crossovers occurred during all runs of the CPX. Figure F-12, CPX Potential Incidents of Interference, includes specific numbers of crossovers for each run. The phenomenon of the air defense crossover for flights which passed near unit boundaries was uncovered during the CPX. The crossover caused aircraft which had alerted ADA units in one brigade to become involved in potential incidents with ADA units from an adjacent brigade. Play of the CPX only alerted ADA units located within the brigade area in which aircraft were traveling.

(5) No potential incidents of any type occurred above 10,000 feet.

(6) Enemy air force and ADA activities were not considered in assignment of an MRR.

(7) Players were adequately trained for valid evaluation of the airspace control procedures used during each run.

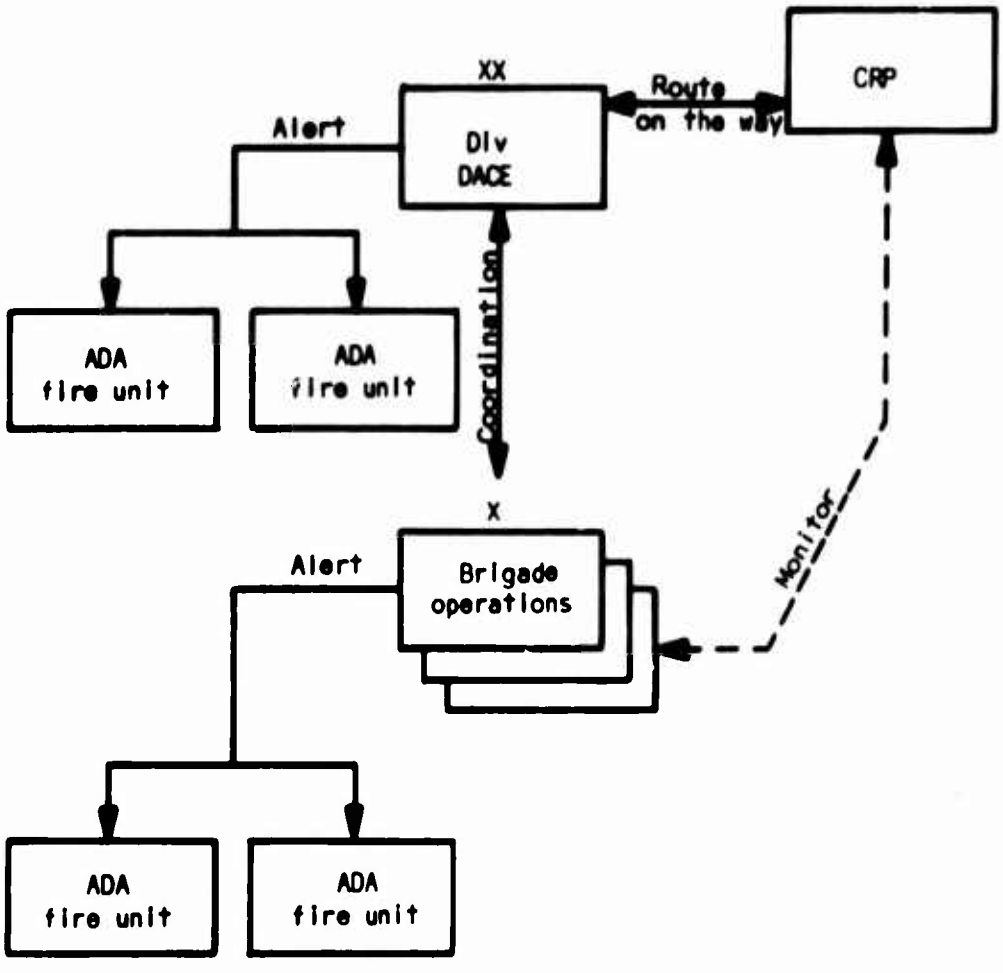


Figure 1-6. Recommended System B Major Changes

(8) During the CPX, there were 128 FAM-AF potential incidents of interference. Of these incidents, only 11 occurred when the aircraft were traveling on recommended minimum risk routes.

(9) There were 397 recommended minimum risk routes provided to Air Force aircraft.

(10) The airspace control sections in the brigade and division headquarters were unable to effect all of the required coordination and communication during six of the CPX runs. The problems were created by inadequate numbers of personnel and an insufficient amount of equipment.

(11) Communications between the Air Force and the Army concerning recommended minimum risk routes encountered problems until the Army adopted a plotting system similar to the Air Force system. The Army's use of a TACAN-type system simplified the communications. Confusion dealing with terminology was reduced by conducting integrated training of Air Force and Army radio operators.

(12) There were 39 AF-AVN potential incidents of interference during the eight runs of the CPX.

(13) There were 13 FAM-AVN potential incidents of interference.

b. Conclusions. The data listed below represent the conclusions of the entire program to date and include the results of the general officer conference.

(1) There is no requirement for the Army to prescribe headings and altitudes or other restrictions on Air Force aircraft flying over the battle area. In other words, there is no requirement for the Army to regulate Air Force air traffic.

(2) An airspace control system is required for coordination of use of airspace over a division. This system is needed to reduce risks and hazards to Air Force and Army aircraft. Additional personnel and equipment are required to implement the system.

(3) To reduce confusion in coordination of airspace activities, Army and Air Force personnel require similar training in techniques and terminology. A common Air Force and Army plotting system is required.

(4) Utilization of a minimum risk route reduces the hazard for Air Force aircraft transiting the division area.

Para 1-8, CPX Experiment (cont)

(5) Results of the CPX dealing with forward area air defense artillery weapons employment indicated a potential hazard to Army and Air Force aircraft because of misidentification and engagement by Chaparral, Vulcan, and Redeye weapons crews. The hazard is alleviated when the likelihood of misidentification and engagement is reduced. Possible methods of achieving this are:

(a) Alerting air defense artillery units concerning flights of friendly aircraft. This would require radio nets between Army units and Air Force air traffic control facilities. Information from this net would be used as input to an Army air defense alert net.

(b) Placing more stringent controls and rules of engagement on forward area air defense artillery weapons. This would decrease the hazard to friendly aircraft and would cause some degradation in effectiveness against enemy aircraft. Currently, the normal weapons control status is weapons tight. Weapons hold is a more stringent weapons control status.

(c) A combination of the above; i.e., alert Chaparral and Vulcan crews to Air Force aircraft and large Army aircraft flights, and, at the same time, place the Redeye on a weapons hold weapons control status.

(6) Air Force aircraft flying through areas of intense field artillery and mortar firing encountered numerous potential incidents of interference with projectiles. The number of potential incidents was significantly reduced when the aircraft flew on a recommended minimum risk route. Minimum risk routes were planned through areas of little or no field artillery and mortar activity. To permit proper determination of recommended routes, the artillery fire support officer at brigade headquarters requires information concerning all field artillery activities within and over the brigade area.

(7) Friendly aircraft flying near unit boundaries are subjected to misidentification and engagement by friendly air defense artillery units located in an adjacent brigade or division area. A method of reducing these crossovers is to alert all air defense artillery firing units that are within range of a friendly aircraft's flight path, even if the firing units are located in an adjacent unit's area.

(8) Routine coordination minimized the problem of interference between Air Force and Army aircraft. Less coordination is required when Army aircraft use nap-of-the-earth flying techniques.

Para 1-8, CPX Experiment (cont)

(9) Air Force aircraft flying at altitudes above 10,000 feet were able to transit division areas with only remote possibilities of incidents of interference from friendly weapons systems. This occurred because of infrequency of trajectories reaching that altitude from field artillery, mortar, and divisional air defense weapons.

(10) Interferences between Army aircraft and field artillery and mortars will be minimized by aircraft flying nap-of-the-earth and not overflying artillery positions. The only danger zones from artillery for low flying aircraft are at the initial point (gun position) and the terminal point (target). Normal communications with ground commanders will minimize hazards from the terminal section of the artillery flight.

(11) A communications link was needed between the brigade operations center and Army aircraft operating in the brigade's airspace.

c. Recommendation. It is recommended that the Army system for airspace control, as outlined below, be validated in future Army field exercises. This represents the recommendation of the entire program to date and includes the results of the general officer conference.

(1) Establish a radio net to link an appropriate Air Force air traffic control facility with an Army division. This net will consist of one frequency with terminals at division and brigade headquarters as well as at the Air Force air traffic control facility. This net will require Air Force liaison parties to assist in airspace control functions at division level and at brigade level.

(2) Establish an Army air defense alert radio net from division and brigade headquarters to Chaparral and Vulcan fire units. The net will be used to alert air defense units of flights of friendly aircraft. Net control stations will be located in the headquarters of each committed division and brigade. The divisions and brigades will alert the air defense units located inside their respective tactical zones. Personnel and radios to operate the system should be furnished by the Chaparral-Vulcan battalion. Personnel would include liaison parties to assist in airspace control functions at division level and at brigade level and to operate the alert net control stations at these locations.

(3) Commanders use a weapons hold weapons control status for the Redeye as normal operating procedure.

(4) Establish a division airspace control radio net for the coordination of airspace control activities. Stations for the net should be located in each brigade headquarters, the division headquarters,

and the flight coordination center. The station in the flight coordination center will provide timely information concerning Army aviation flights. This information will insure timely air defense alerts at each brigade and at the division headquarters. This net will always have activity in a division; consequently, the radios and personnel to operate the net should be added to the division TOE's.

(5) Establish an Army aviation air-to-ground radio net at each brigade when the level of aviation activity justifies the net. This net will be used for the coordination of Army aviation activities within a brigade. The net already exists in some units which have a high aircraft density. In other units, when the level of aircraft traffic within or through a brigade area is significantly high, the personnel and equipment to operate an air-to-ground net should be provided to the brigade. The personnel should include an Army aviation liaison officer provided by the supporting aviation unit or organization to assist in airspace control activities.

(6) Provide liaison parties from field artillery, Army aviation, Air Force, and air defense artillery to assist the G3 and S3 in the performance of airspace control functions. Current doctrine does not provide a liaison officer from the air defense artillery.

(7) Revise Army Airspace Control Doctrine, FM 44-10, as shown in annex G.

(8) Revise that portion of The Army Air-Ground Operations System, FM 100-26, as pertains to airspace control, as shown in annex H.

CHAPTER 2

DETAILED CONCEPT AND CONDUCT OF THE BACKGROUND AND MATERIEL REVIEW AND THE WAR GAME

Section I. GENERAL

2-1. General.

a. The airspace control war game was designed to define the airspace control problem and to recommend an Army airspace control system for experimentation.

b. The design eliminated the need to have aircraft fly and weapons fire. This need was eliminated by using a computer-assist technique which provided information on the volume of airspace the various users were occupying at a given minute during the war game.

c. Research was conducted to determine the major items of equipment which are required to support the airspace control system emerging from the airspace control program of evaluation.

d. Research was also conducted to establish a detailed reference library of publications which related to current and proposed systems of airspace control.

e. The following terms which are used in this chapter are defined in annex B.

(1) Mission pair combination.

(2) Simplified volume of airspace.

(3) Simultaneous missions.

(4) Estimated probability of interference.

(5) Airspace control system.

(6) Interference.

(7) Adequate.

(8) Non-troop-support artillery.

Section II. BACKGROUND AND MATERIEL REVIEW DESIGN

2-2. General. The background and materiel review was designed to determine what had been done in the past toward establishing an airspace control system for the combat zone, and what equipment, currently available and projected, could be used to operate an airspace control system. One hundred seventeen documents, manuals, articles, and reports were reviewed.

2-3. Materiel Review. Information and data were assembled on the capabilities of existing and proposed airspace control supporting equipment to insure that appropriate procedures for its employment were included in the program of evaluation. The methodology for the materiel review is shown in figure 2-1.

2-4. Background Review. Literature from the Joint Chiefs of Staff, Army, and other services documents was assembled in order that current and proposed doctrine, organization, and procedures for airspace control, could be reviewed, cataloged, and analyzed. The background review resulted in a cataloging of reference material and the identification of required and viable airspace control concepts. The methodology for the background review is shown in figure 2-2.

Section III. WAR GAME DESIGN

2-5. General. The war game was designed to study the airspace control problem and materiel in a mid-intensity environment. No airspace control system was imposed on the commander. The open ended scenarios were based on the TRICO study.

a. The war game was to be conducted for a period of 2 1/2 weeks and was to produce 4 hours of environmental data. An armored division was to be examined in a defensive situation during the first week and in an offensive situation during the second week. Activities were alternated between two stages. The first stage was the actual conduct of the war game to assist in problem definition and scenario development. The second stage was a periodic examination of TT 44-10-1, Army Airspace Control Techniques, to refine airspace control procedures. These two stages were sequential and iterative to the extent that the results were used for refinement of procedures. However, the refined procedures were not used in subsequent war gaming. In fact, formal procedures were not imposed on the players at any time during the war game.

b. A basic aim of the war game was to reveal incidents of airspace interference during a mid-intensity conflict. These incidents were subsequently checked against the procedures of TT 44-10-1 to resolve each case of interference. Corrections, additions, and improvements were

Para 2-5, General (cont)

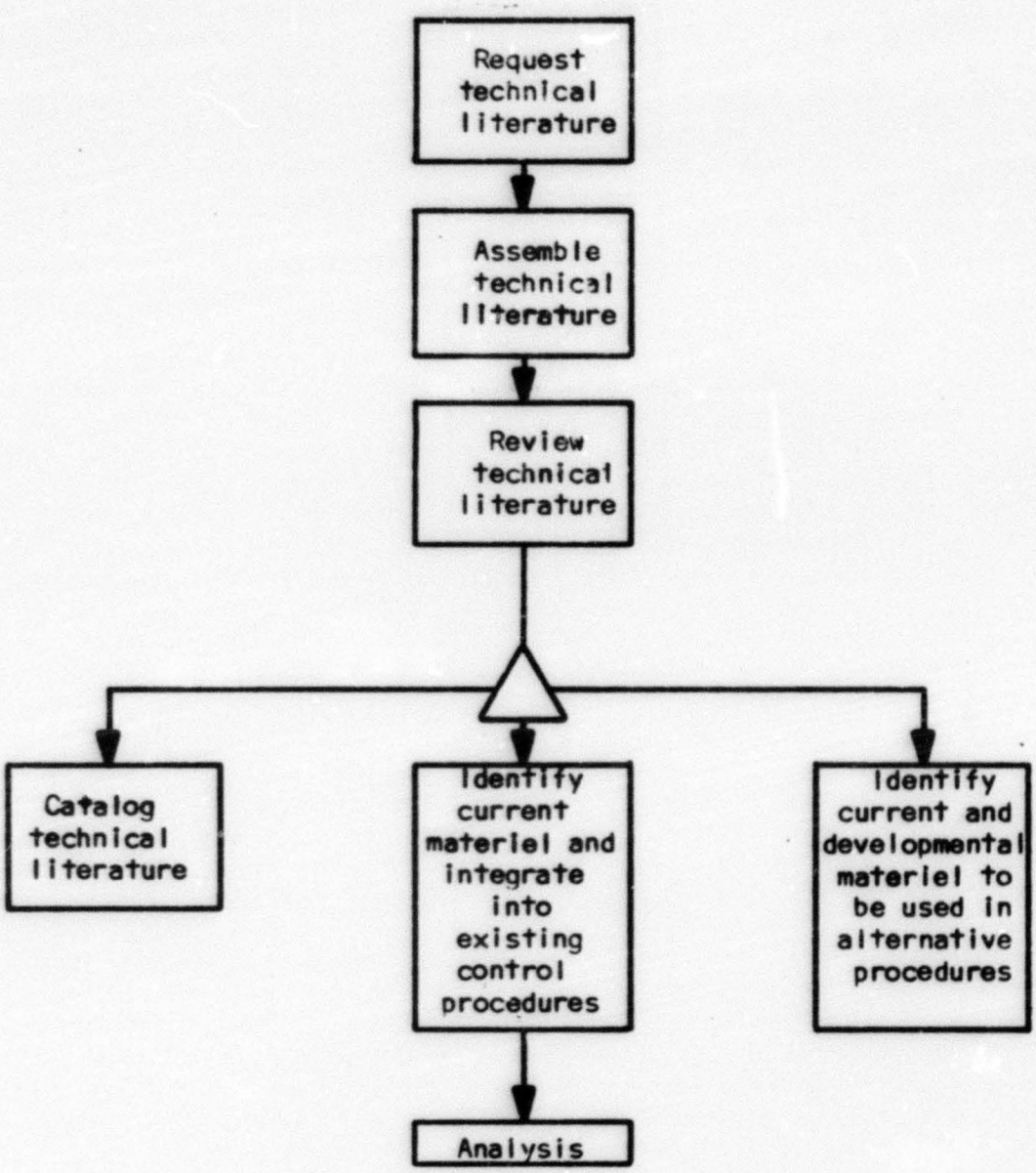


Figure 2-1. Methodology for Materiel Review

Para 2-5, General (cont)

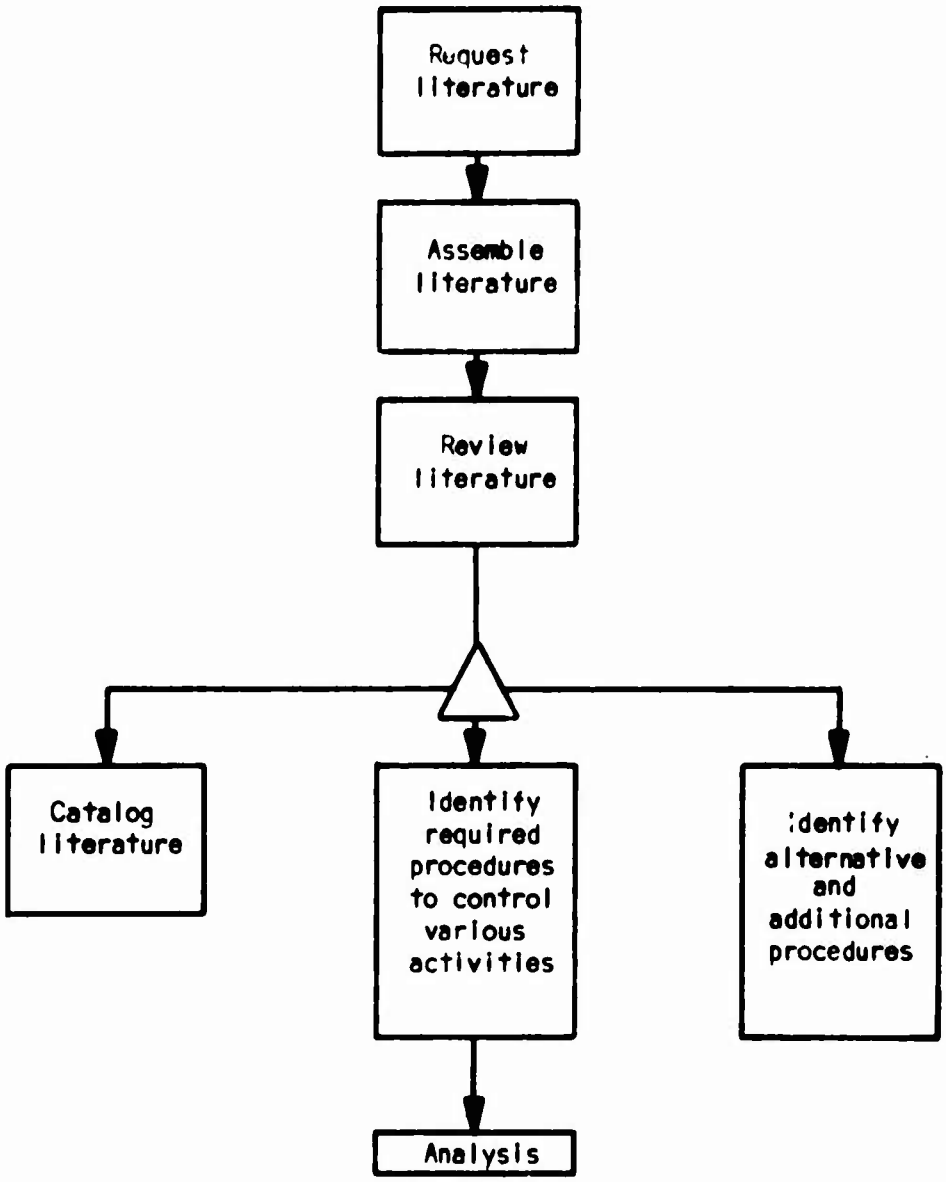


Figure 2-2. Methodology for Background Review

made to the procedures in TT 44-10-1 to resolve those incidents for which the system did not have adequate provisions.

c. The ground battle which gave rise to the airspace usage was played as realistically as possible; however, firepower scores and rates of movement were not calculated to determine the outcome of the relatively short (2 to 3 hour) ground battles. The general movement trends were predetermined by the outcome of the TRICO games which occurred over a longer period of time (15 to 30 hours). The progress of the opposing forces in the airspace war game was regulated by the controllers in order to stay within the framework of the TRICO results. The controllers, in turn, were guided by precomputed 15-minute progress lines which were based on interpolation of the TRICO results.

d. The war game was designed to be conducted with personnel who were organized as controllers, players, data recorders, and data reducers. They were to be under the supervision of the chief controller. Players were organized into two teams, a blue team and a red team. The physical layout of the war game is shown in figure 2-3. Players for both sides included experts from each of the supporting arms that used the airspace and from the Air Force. The players represented several echelons of command and functioned under the general supervision of players representing maneuver commanders.

e. The initial battlefield situations were taken from games 5 and 9 (baseline war games of an armored division's capabilities) of the SECRET document, subject: Evaluation of TRICAP Concept and Organizations (U) (Short Title: TRICO (U)), which was published by the Combat System Group, US Army Combat Developments Command. The battle segment which was used as the basis for the scenario occurred well after the initiation of the conflict. Initial maneuver unit positions were in accordance with those shown in the TRICO critical incident photographs.

f. According to design, when play began the battle was fully underway. Operational documents were prepared, and the computer was loaded with pregame information. The participants entered the ongoing situation much as a new duty shift begins duty at an operations center. Players were briefed on the existing and planned tactical situation, intelligence summary, preplanned fire support, rules of engagement for air defense weapons, and the status of combat forces and weapons systems. Emphasis was placed on the status of airspace users (artillery firing, close air support sorties, airmobile operations, etc.).

g. The war game was played in 1-minute increments. The clock that was used remained on the current war game minute while the actions described

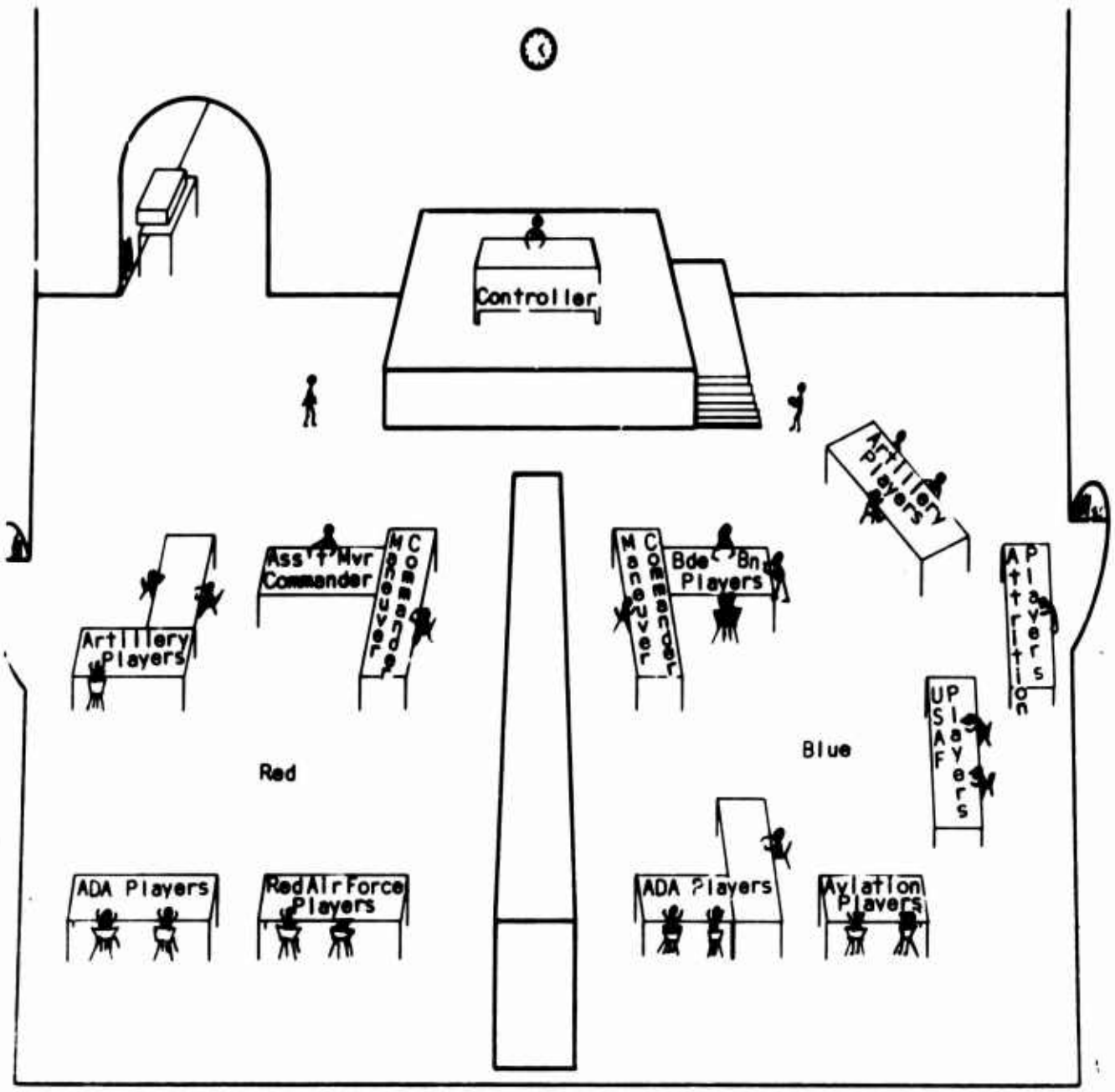


Figure 2-3. Airspace Workshop War Game Layout

below were conducted. In the war game players were not subjected to any formal system of airspace control; however, they coordinated requests for support with the senior maneuver players. The controllers presented each player with intelligence which stimulated maneuver action and requests for support which, in turn, resulted in use of the airspace. Data flow during the war game is shown in figure 2-4.

h. Early in the play of each minute, controllers selected that information from the maps of one side which represented the results of a reasonable intelligence collection effort by the opposing side. This intelligence was then recorded by the controller and given to players of the opposing side who took action in response to the intelligence input.

i. Players posted the intelligence input on their maps, evaluated the input, and initiated actions to engage worthy targets. These actions took the form of a maneuver initiated by the commander or calls for support by indirect fire, air defense, or air support. At a precomputed future minute of play, these actions by the players resulted in use of airspace (e.g., an artillery mission request began using airspace at T+3 minutes). Each player reacted unilaterally to intelligence provided by the controllers and coordinated his airspace usage actions as he felt the unit commander or unit SOP might require.

j. Each player then initiated the necessary actions to allocate his resources in support of the maneuver commander's plans. Changes to the current status of fire units and aircraft were recorded. Flight paths and weapon trajectories which depicted action that occurred for the current minute of play were posted on overlays. Players also recorded the actions taken on preprinted data forms.

k. Overlays were then taken to the attrition table where aircraft and force attrition was determined through the use of probabilities which were based on analysis of the overlays and a random number table. Player experts furnished the probabilities. Results of the attrition were recorded on preprinted attrition forms and given to the control personnel who then included this information with their next intelligence selection.

l. When all of the above actions listed in g through k had occurred, the war game clock was advanced to the next minute and the sequence of events was repeated.

2-6. Problem Identification. The Army airspace problem was defined with respect to doctrine, materiel, and the environment. Of primary importance was the fact that data from the workshop specified the level

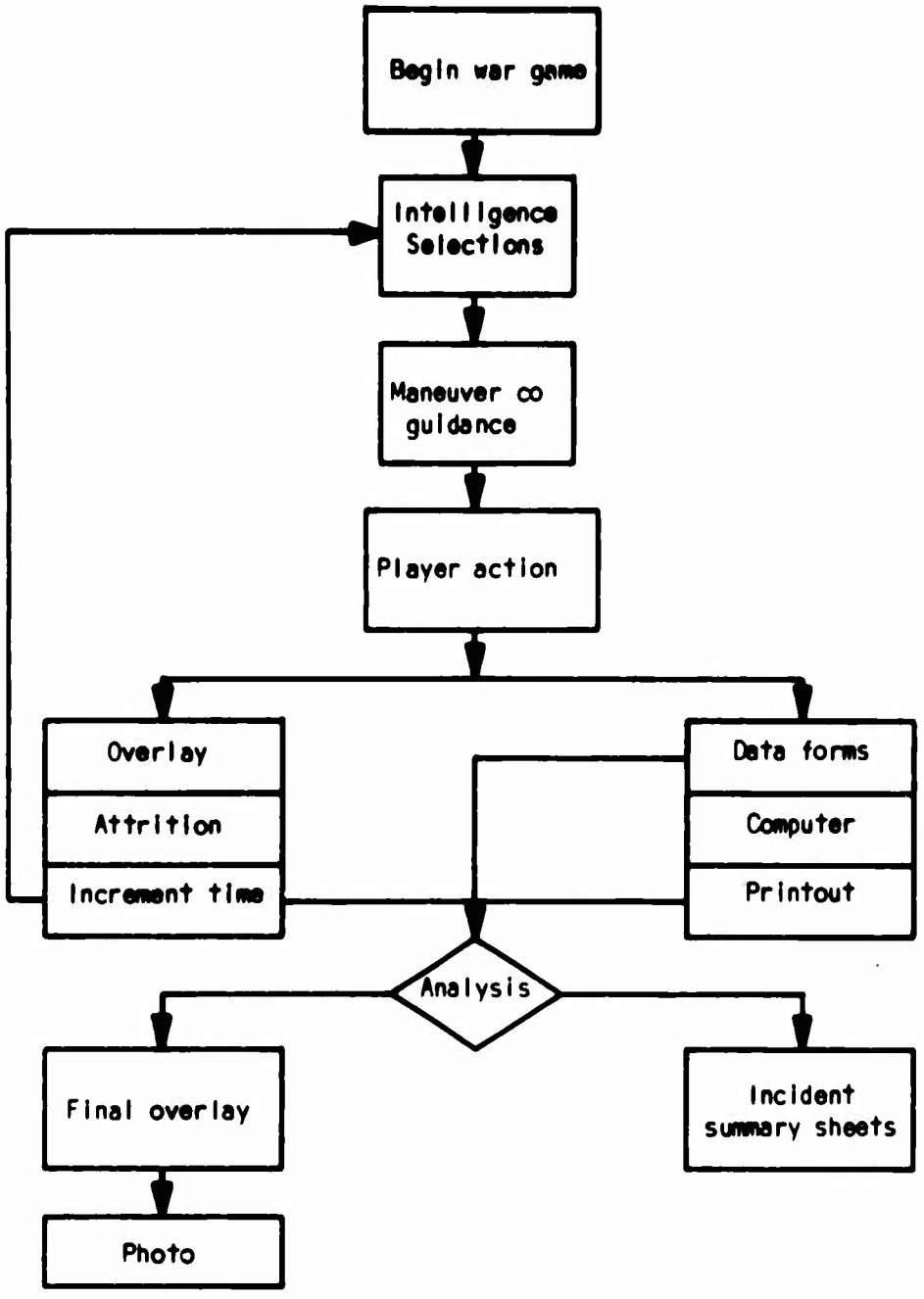


Figure 2-4. War Game Data Flow Chart

of airspace usage necessary to support the maneuver commander as well as the degree of interference to be expected when operating without a formal airspace control system. Data from the background and materiel reviews were also considered in order to determine the degree to which the problem is influenced by competing or conflicting concepts, doctrines, procedures, and organizations, or by inappropriate, incompatible, or unavailable equipment. The workshop consisted of three concurrent activities: Background review, materiel review, and environmental workshop. The methodology used for the war game is shown in figure 2-5.

2-7. War Game Refinement Process.

a. The preprinted data forms were used as input to the computer. The computer was used to construct simplified volumes of airspace for all fire units and aircraft and then to screen all possible intersections of airspace.

b. The overlays were assembled, and one master overlay which contained all airspace usage elements was produced to be used in analysis.

c. Analysis was performed by experts who represented Army aviation, air defense artillery, field artillery and mortars, and the Air Force. They used the computer printout, player data forms, and the master overlay as input. In general terms incidents of interference were displayed on the two-dimensional map overlays as intersections of 1-minute vectors which represented the traces of activities by the supporting arms or services. The computer program was then used to determine in which of the incidents there was possible interference in the third dimension. Once the computer identified intersections of airspace, data on each intersection were manually refined, and a determination was made as to whether or not the intersection was close enough in time and space to be considered a hazard to manned flight. Any incident determined to be a hazard to manned flight was thereafter labeled as a potential incident of interference. Data on the incident were recorded on a preprinted potential incident of interference summary sheet, and the location of the incident was circled and numbered on the master overlay. The master overlay was then photographed, and the analysis procedure was repeated for the next minute's data.

d. The airspace control problem was defined for several tactical situations. Two important considerations influenced the data analysis. First, the principal user of airspace is the maneuver commander; the supporting arms and services that use the airspace do so to support the maneuver commander. Second, airspace control includes one or more of the following actions: Coordination, integration, and regulation of the activities of the supporting arms and services. As a consequence, the analysis was made from the vantage point of the maneuver commander and

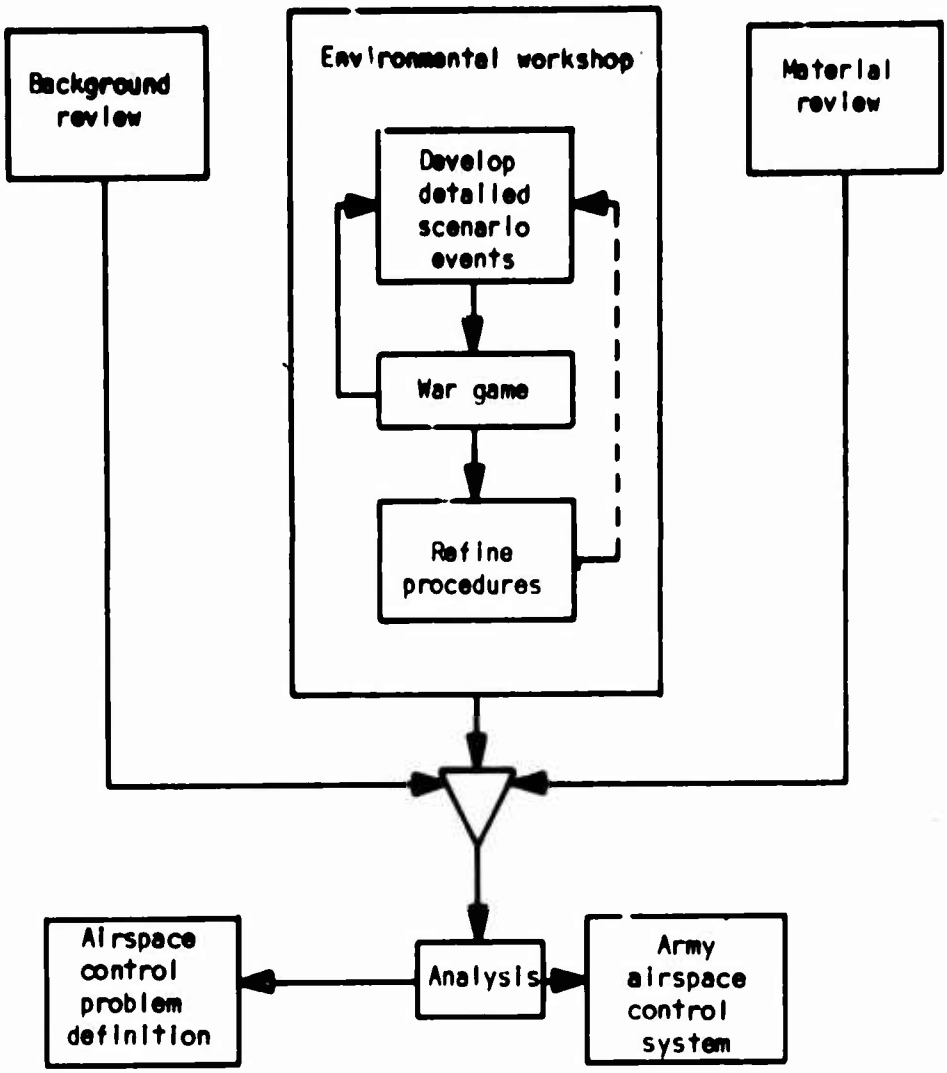


Figure 2-5. War Game Methodology

Para 2-7, War Game Refinement Process (cont)

sought to determine the extent that the problem lay in coordination, integration, or regulation of activities.

e. The refinement procedure was designed to take all of the output of analysis and TT 44-10-1 and then to develop an Army airspace control system. The refinement process was conducted by using essentially the same personnel as were used in the war game. These personnel were organized into teams and were under the supervision of the chief data reducer. Organization of the data refinement teams is shown in figure 2-6.

Team number	Personnel	Type of incidents of interference
1	Control maneuver, ADA AVN, FAM	ADA-AVN, FAM-AVN, AVN-AVN
2	Control maneuver, AF, FAM AVN, ADA	AF-AVN, AF-ADA, AF-FAM AF-AF

Figure 2-6. Refinement Team Organization

(1) The function of control personnel in this stage of the environmental workshop was to direct the refinement process by assisting the player teams in reestablishing the game conditions that existed at the time of the potential incidents to be examined and to provide necessary guidance.

(2) One team was concerned with the Army aviation incidents, and the other was oriented on Air Force incidents. Methodology for the refinement process is shown in figure 2-7.

(3) The reduction process will be accomplished by summarizing the proposed changes to TT 44-10-1. The steps used in the process are listed below:

(a) Step 1. Examine the type of incident and activities that produced the incident to determine how and why the incident occurred. The following questions were addressed: Who initiated the activities? Who had knowledge of the activities? Who approved the activities? Why were the activities initiated at that point in time?

(b) Step 2. Determine who according to TT 44-10-1 should and could have had knowledge of the activities that produced the incident.

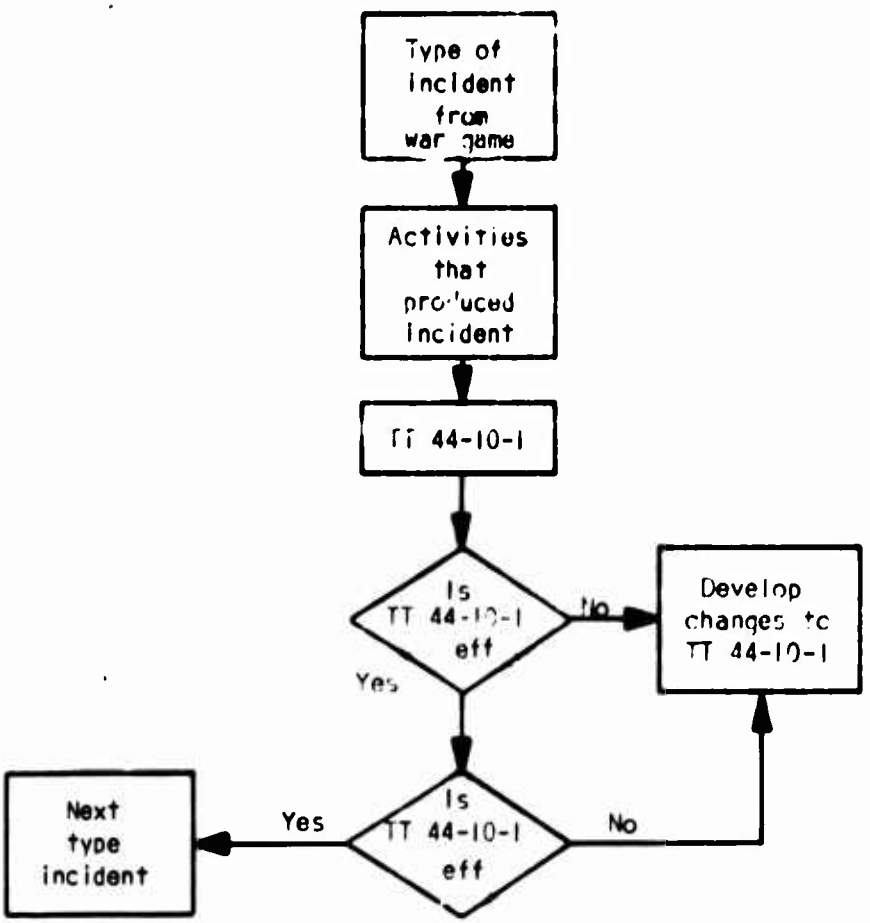


Figure 2-7. Refinement Process Methodology

The following questions were addressed: Who at each command post level has coordination initiative responsibility for each activity? List the persons and actions specified for each activity or function. Did each person listed receive the required input? Did each person listed take the specified action?

(c) Step 3. Determine if each procedure specified in TT 44-10-1 was required and effective. The following questions were addressed: Was any action by any person actually required to prevent the incident? If yes, would the procedures specified in TT 44-10-1 have prevented the incident?

(d) Step 4. Determine if each procedure specified in TT 44-10-1 is efficient. The following questions were addressed: Is the procedure redundant? If so, can an alternative be devised which is less reduandant? Can an alternative be devised which requires less time? Can an alternative be devised which requires fewer communications facilities? Can an alternative be devised which requires fewer personnel?

(4) Data collected and recorded by each of the teams consisted of proposed changes to TT 44-10-1 and supporting rationale. These proposed changes were then examined in a somewhat larger context. They were first examined with respect to problem definition to determine whether or not some aspect of problem definition alleviates the requirement for airspace control. For example, problem definition might indicate small requirements for airspace control above certain altitudes or areas. They were then examined with respect to materiel to determine whether or not the equipment required is available and compatible with that of other services. Last, they are examined with respect to concepts, doctrines, procedures, and organizations of higher echelons and other services to determine whether or not they are compatible and promote unity of effort.

Section IV. WAR GAME EXECUTION

2-8. General. The data produced during the war game were reviewed for accuracy and completeness. The assembled data were then reduced manually and by computer for analysis and evaluation. The process was continuous in nature and is explained below.

2-9. War Game.

a. Duration. The war game was played minute-by-minute for 4 1/2 hours of war game time. These 4 1/2 hours are divided in sequence, as follows:

(1) Two hours of defense under daylight visual meteorological conditions.

Para 2-9, War Game (cont)

(2) One hour of offense under daylight visual meteorological conditions.

(3) One-half hour of offense under daylight instrument meteorological conditions. The meteorological conditions used during this portion of the war game are shown in figure 2-8.

(4) One hour of offense under night visual meteorological conditions.

b. Rates of advance. The average rate of advance for the red forces in the defense phase of the war game was 0.7 kilometers per hour. The average rate of advance for the blue forces in the offense (counter-attack) phase of the war game was approximately 0.7 kilometers per hour.

c. Incident data. Complete data were collected on all potential incidents of interference.

d. Supporting data. Other data collected during the war game which assisted in scenario development were as follows:

(1) Current status of fire units and aircraft at the start of each scenario.

(2) All changes to fire unit and aircraft status.

(3) All player overlays.

(4) The number of airspace missions by area and type.

(5) The number of mission pair combinations by area and type.

e. Attrition. Attrition was played during the war game to add realism and stimulate player actions. The attrition rate was determined by using the best available probability of an event occurring and a random number table. There should be no significance attached to the number of attritions as the war game was not designed to determine the outcome or result of force engagements.

(1) Attrition of blue ground forces was based on the TRICO study. Figure 2-9 shows interpolated losses for 2 hours. Other ground force attrition was not played as it had no effect on airspace usage.

(2) Attrition of red and blue aircraft was based on weapon kill probabilities furnished by the ADA experts. Figure 2-10 shows the weapon kill probabilities used. All blue ADA firing units were assumed to be in an unalerted weapons tight status.

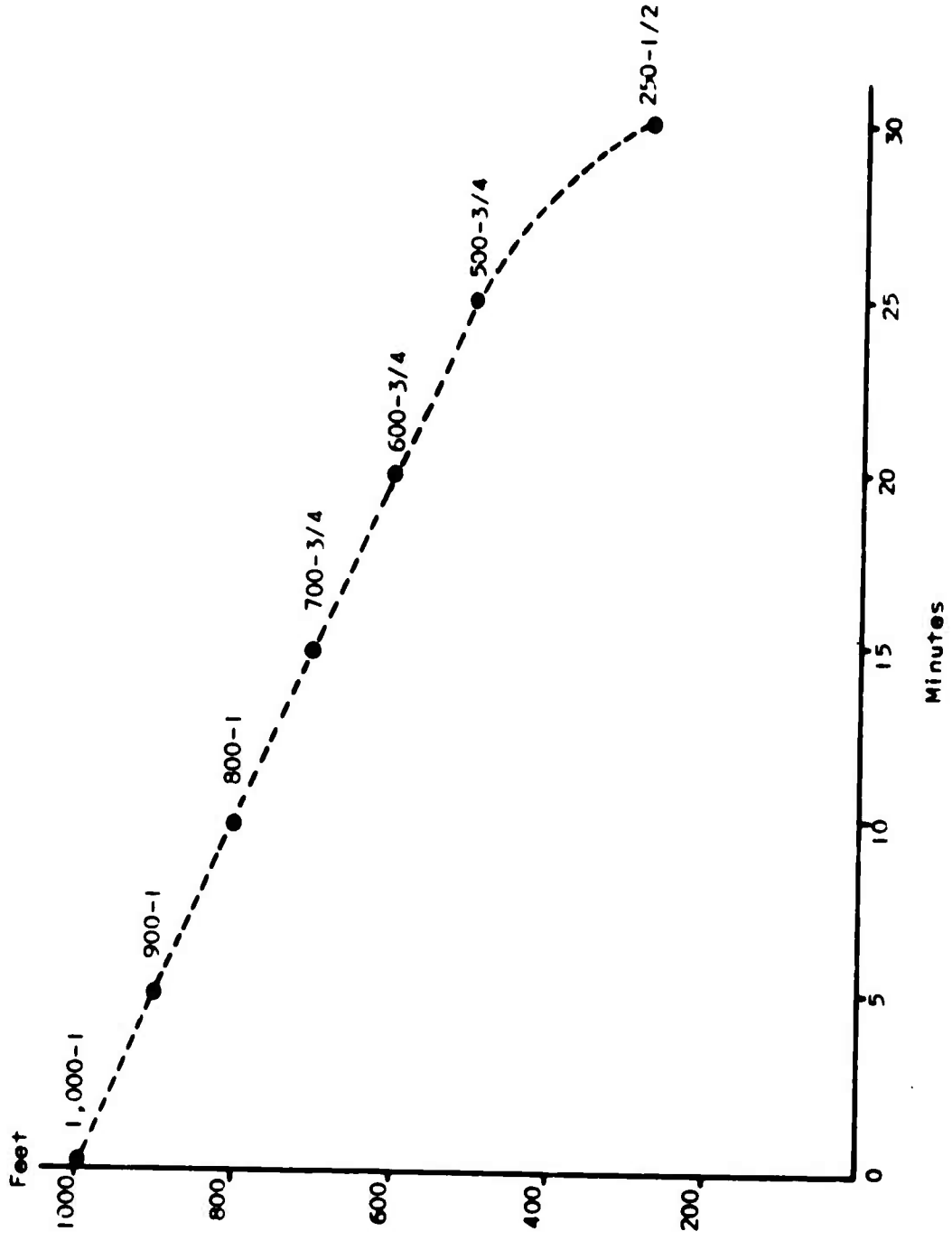


Figure 2-8. Daylight Offense Instrument Meteorological Conditions

Type	Losses in 2 hours
Personnel	135
Tanks and self-propelled artillery	9

Figure 2-9. Attrition of Blue Ground Forces

Weapon	Percentage
Redeye - Grail	0.40
Chaparral - 57 mm	0.50
Vulcan - 23 mm	0.10
Hawk	0.60

Figure 2-10. Attrition Kill Probabilities

(3) Attrition of friendly aircraft which were mistakenly identified as hostile and which were engaged was also played. Past ADA studies show that there is a probability of 0.012 percent that a nonalerted ADA firing unit will identify a friendly aircraft as hostile and engages that aircraft.

CHAPTER 3

WAR GAME PROGRAM AND EVALUATION DETAILS

3-1. General. This chapter contains the detailed results of the war game and provides the basis for development of the airspace control system that was used to begin experimentation. The following terms which are used in this chapter are defined in annex B:

a. Effectiveness of airspace system.

b. Efficiency of airspace system.

c. Mission pair combinations.

d. Ratio of potential incidents to mission pair combinations.

3-2. War Gaming. Data collected during the war gaming included all input and output, results of all analyses, and the results of the refinement process.

a. Overall data.

(1) The driving input for the war game was the intelligence and operational data which were passed to player personnel from the controllers. One input represented one piece of information on one type of activity which was passed to the opposing forces. There were 6,002 inputs passed during the war game. There were 3,129 inputs depicting blue force activities which were passed to the red forces. Figure 3-1 shows graphically the weighted average of these 3,129 inputs. There were 2,873 inputs depicting red force activities which were passed to the blue forces. Figure 3-2 shows graphically these 2,873 inputs.

(2) The input discussed in paragraph (1) above generated player actions. These player actions took the form of airspace user missions. During the war game, there were 1,580 blue force division missions which utilized airspace above the division area. Figure 3-3 shows the average number of missions per hour played during each phase of the war game. Further detailed data on airspace user missions are contained in Annex F, Tabulated Data.

(a) Examination of the definition of a mission (annex B) and the mission data in annex F reveals that missions are not additive by area. In other words, it is not possible to add the total missions that occurred in the battalion's area of the 1st brigade to the number of missions that occurred in the brigade rear area of the 1st brigade and obtain the total number of missions that occurred in the 1st brigade area.

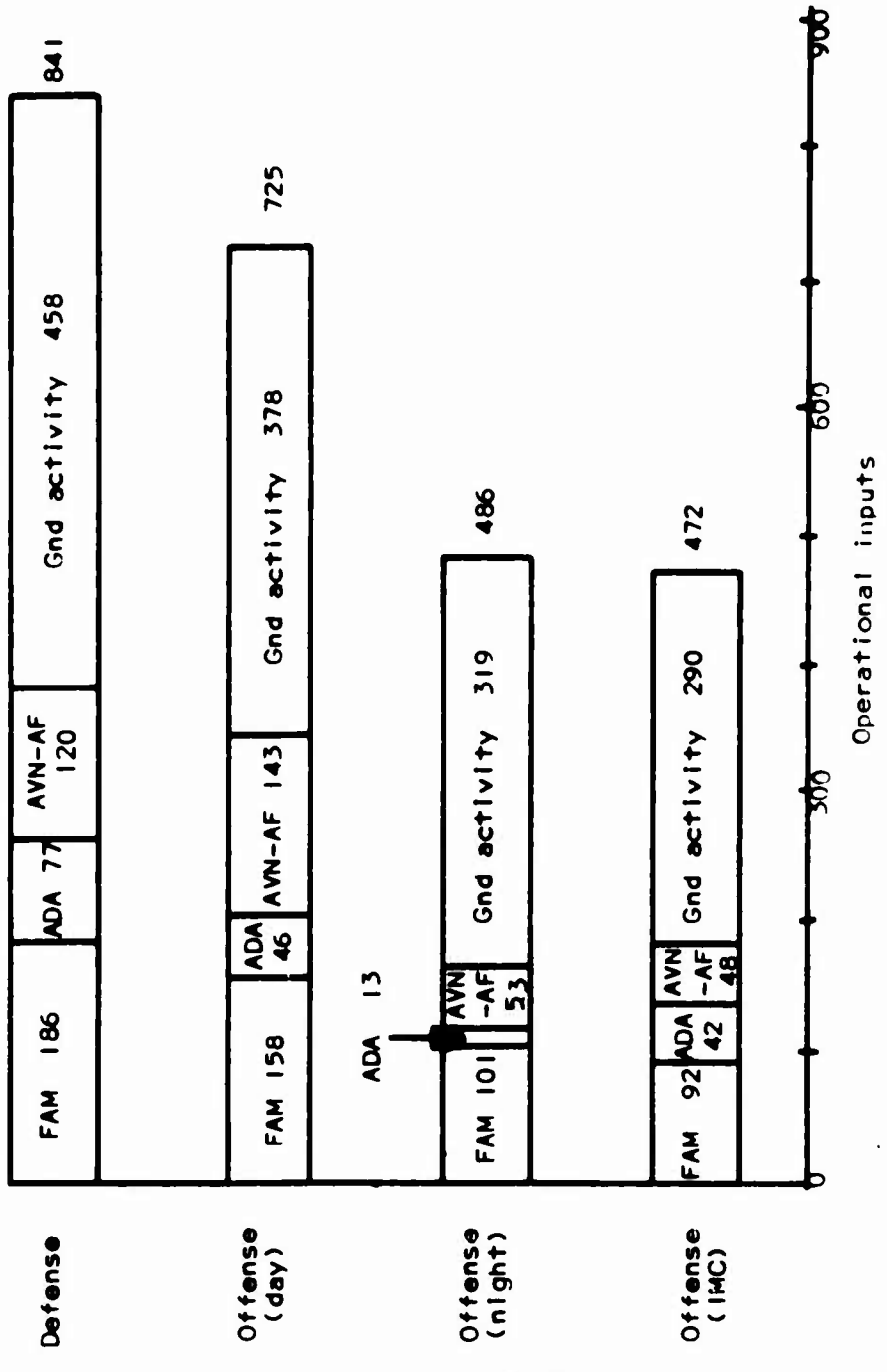


Figure 3-1. Weighted Average of Blue Force Operational Inputs per Hour Passed to Red Forces

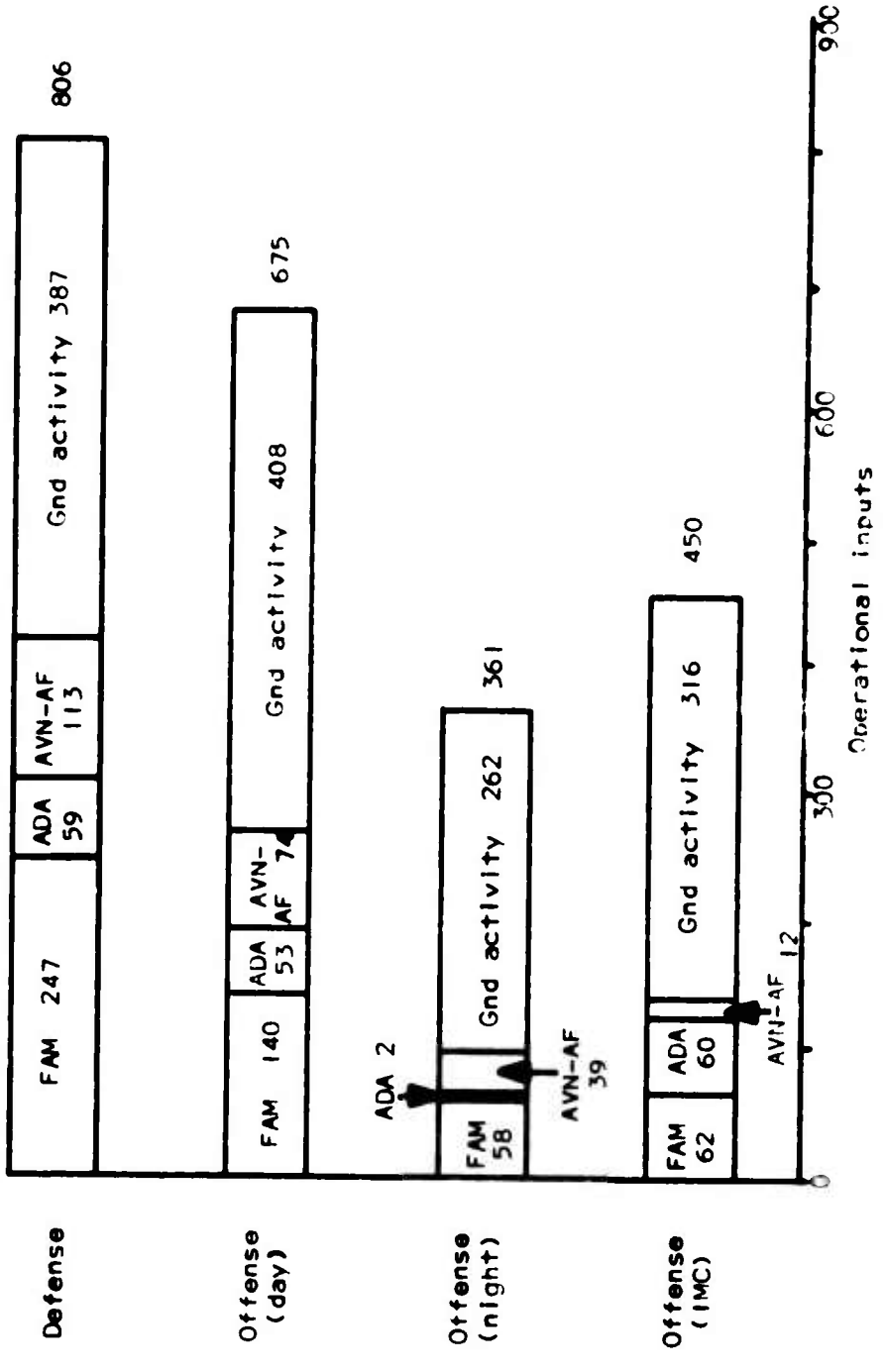


Figure 3-2. Weighted Average of Red Force Operational Inputs per Hour Passed to Blue Forces

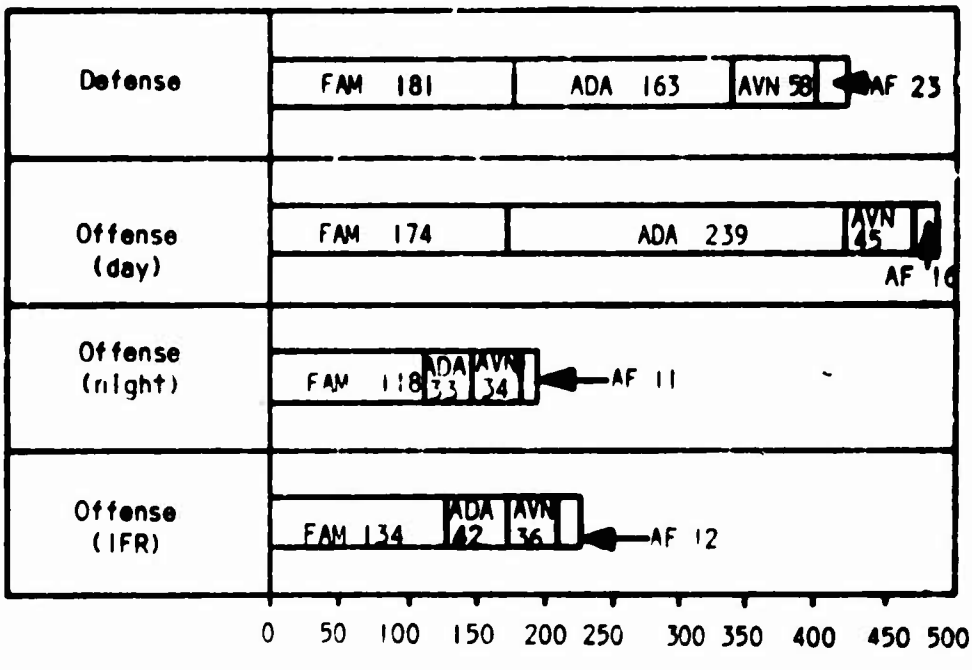


Figure 3-3. Average Number of Missions per Hour

(b) If a single aircraft mission passed through three battalion areas in the 1st brigade, both the brigade rear and one battalion area in the 2d brigade, and through the division rear area, it would be counted as only one mission for the division, one mission for the division rear area, one mission for the 1st brigade area, three missions for the battalion areas of the 1st brigade, one mission for the 2d brigade area, one mission for the 2d brigade rear area, and one mission for the battalion area of the 2d brigade.

(3) There were 407 potential incidents of interference identified during the war game. These were the result of 1,580 blue force division missions which utilized airspace and the fact that no lateral coordination

of airspace was allowed during the war game. When analyzing the magnitude of the total number of potential incidents of interference, it is helpful to realize that the 1,580 missions produced 19,255 mission pair combinations, each of which could have produced an incident and that some missions did produce multiple airspace incidents.

(a) Figure 3-4 lists the 407 potential incidents of interference in the order of frequency in which they occurred. This information is shown graphically in figure 3-5.

(b) Annex F, Tabulated data, contains a complete breakdown of all incidents for each phase of the war game.

(4) The refinement process discussed in paragraph 2-7 examined each potential incident of interference. If TT 44-10-1 addressed the specific set of circumstances for a particular potential incident and if the procedures in TT 44-10-1 would have effectively and efficiently prevented that particular potential incident, then the potential incident was considered to be resolved by current procedures. If TT 44-10-1 failed to either address a particular set of circumstances or to effectively or efficiently prevent a potential incident, then the potential incident was considered to be unresolved. Results of the refinement procedures revealed that procedures outlined in TT 44-10-1 resolved 337 potential incidents of interference. The distribution of the remaining 70 unresolved potential incidents of interference is shown in figure 3-6.

b. Field artillery and mortar findings.

(1) There were 99 FAM-AVN and 185 FAM-AF potential incidents of interference.

(2) No potential incidents of interference occurred above 10,000 feet.

(3) Control procedures outlined in TT 44-10-1 effectively resolved all 99 FAM-AVN potential incidents of interference.

(a) Thirty-six incidents involved field artillery and mortar fires into a cavalry AO. (AO's inherently require that all fires within the AO boundaries be coordinated through the commander assigned the AO.)

(b) Eighty incidents involved aircraft overflying forward area targets. (Normal tactical fire support procedures integrate field artillery and mortar fires with tactical aviation aircraft support.)

Para 3-2, War Gaming (cont)

(c) Thirteen incidents involved aircraft overflying enemy penetrations and enemy airmobile operations. (Normal lateral coordination procedures would have restricted flights in these areas to a minimum and would have integrated the remaining flights as in (b) above.)

(d) All of the remaining incidents involved aircraft overflying field artillery and mortar weapons locations at the time of firing. (Procedures outlined in TT 44-10-1 require that all pilots be given a preflight briefing which includes the current location of all field artillery and mortar weapons in their area.)

Type potential incidents	Area	Number of potentials	Percentage of incidents
FAM-AF	Battalions	160	39.3
FAM-AVN	Battalions	69	17.0
ADA-AF	Battalions	47	11.5
FAM-AVN	Brigade rear	25	6.1
FAM-AF	Brigade rear	22	5.4
ADA-AVN	Battalions	17	4.2
ADA-AF	Brigade rear	12	2.9
AVN-AVN	Battalions	10	2.5
ADA-AVN	Brigade rear	9	2.2
AVN-AF	Battalions	6	1.5
FAM-AVN	Division rear	5	1.2
AVN-AVN	Brigade rear	5	1.2
AF-AF	Battalions	3	0.7
AF-AF	Brigade rear	3	0.7
AVN-AF	Brigade rear	3	0.7
AVN-AVN	Division rear	3	0.7
ADA-AVN	Division rear	3	0.7
FAM-AF	Division rear	3	0.7
ADA-AF	Division rear	1	0.2
AF-AF	Division rear	1	0.2
AVN-AF	Division rear	0	0.0
TOTALS		407	100

Figure 3-4. All Potential Incidents of Interference Listed in Order of Frequency of Occurrence

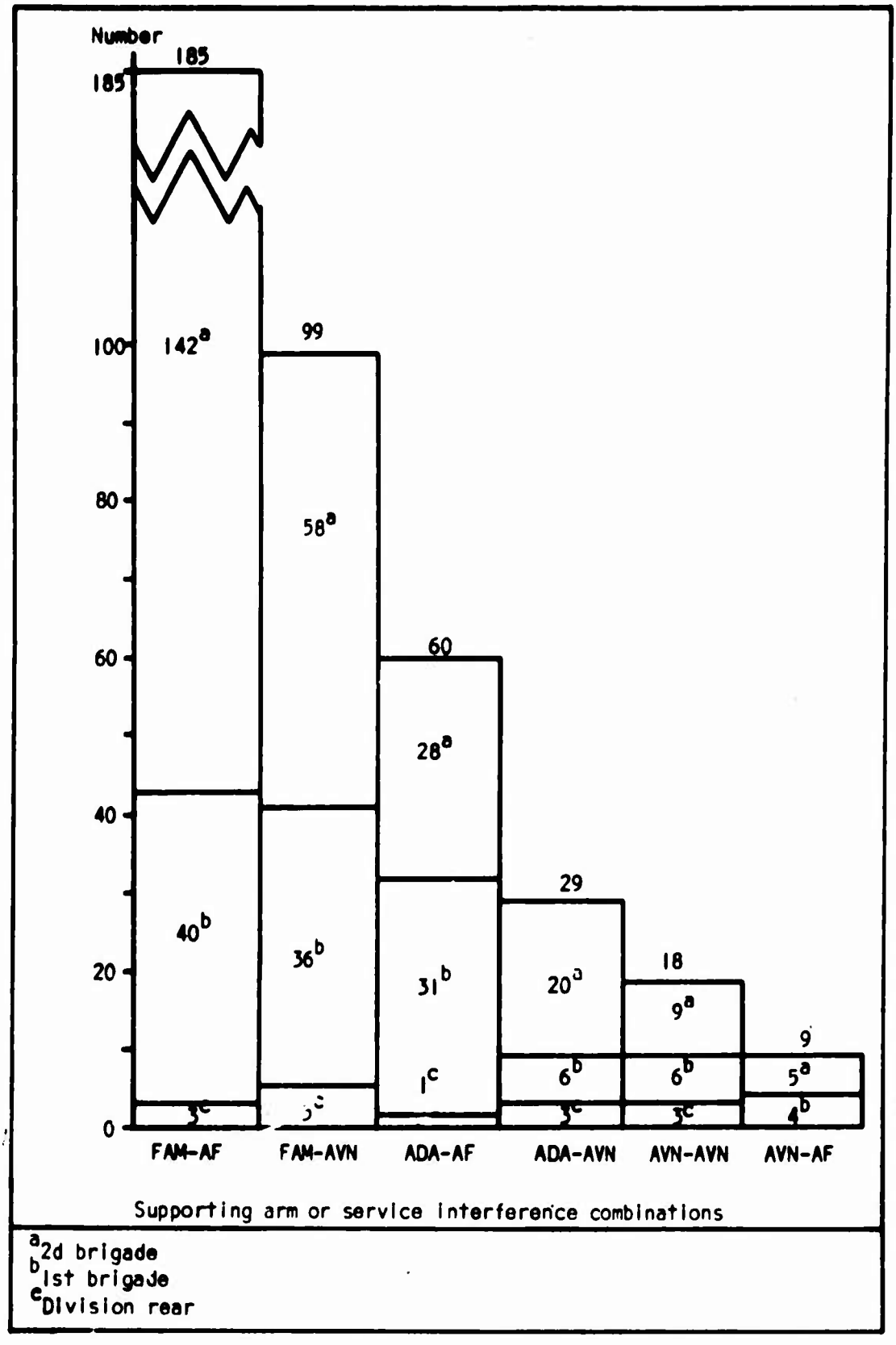


Figure 3-5. Graphical Display of Potential Incidents of Interference

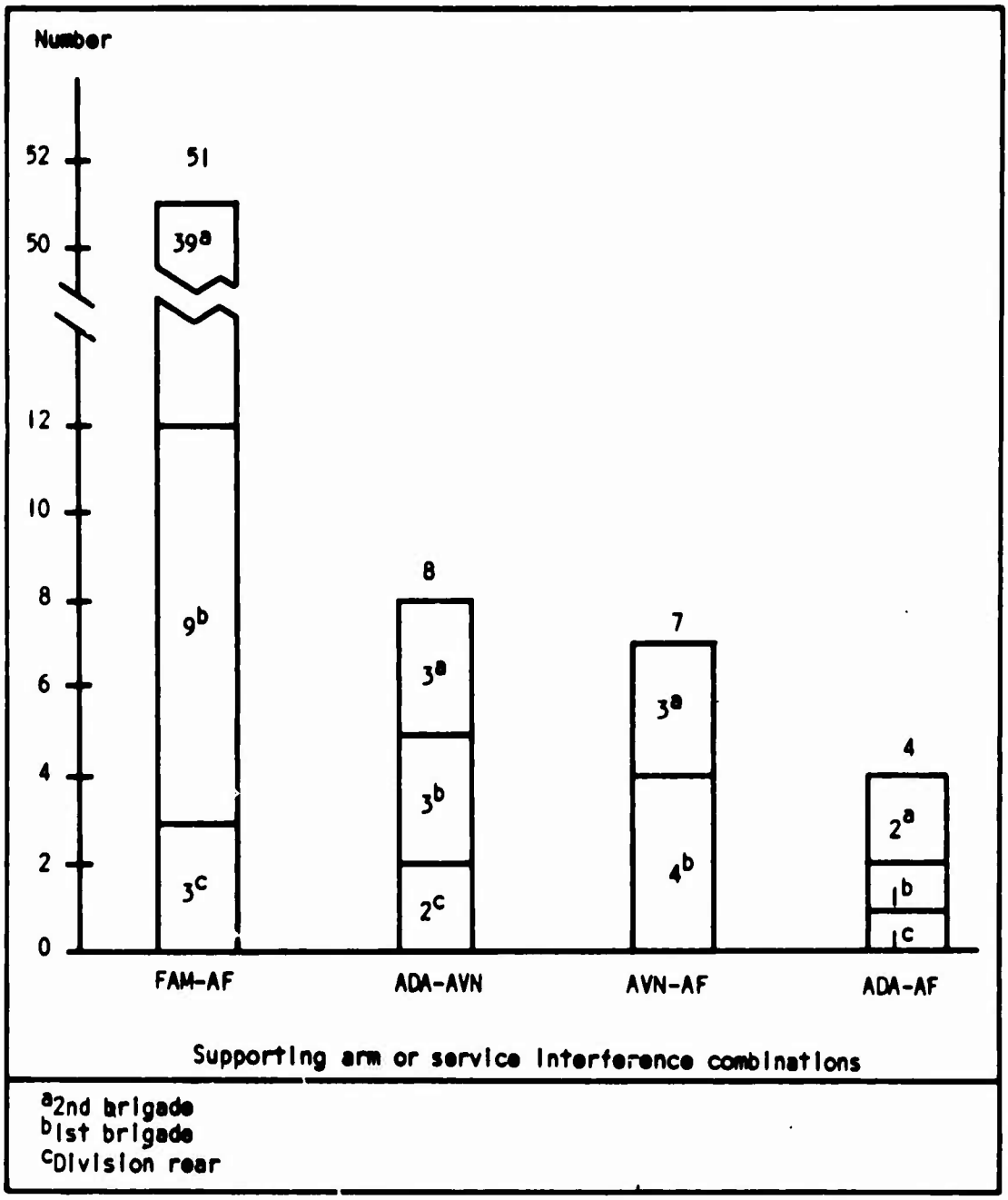


Figure 3-6. Distribution of Unresolved Potential Incidents

(4) Control procedures outlined in TT 44-10-1 effectively resolved 134 FAM-AF potential incidents of interference. (All of these incidents involved Air Force aircraft which were flying missions requested by the division. Whenever the division has requested and is aware of impending Air Force flights, the flow of flight path information is sufficient to adequately allow coordination and integration of these flights with field artillery and mortar fires.)

(5) All 51 unresolved FAM-AF potential incidents of interference involve the passage of transient Air Force aircraft through the division area. (Current procedures outlined in TT 44-10-1 do not provide the division with any information on transient Air Force aircraft and, therefore, no coordination, regulation, or integration of field artillery and mortar fires with these aircraft can be instigated. Figure 3-6 shows that 48 of the 51 unresolved FAM-AF potential incidents of interference occurred in the brigade areas.)

c. Field artillery and mortar conclusion. Based on (5) above, it is concluded that, in order to minimize the hazard to Air Force aircraft, the division and brigade must receive timely information on all Air Force aircraft transiting the division area.

d. Aircraft findings.

(1) There were 34 potential incidents of interference involving two aircraft; 25 occurred under day visual meteorological conditions, six occurred under day instrument meteorological conditions, and three occurred under night visual meteorological conditions.

(2) Current Air Force control procedures effectively resolved all seven AF-AF potential incidents of interference. (In all seven cases, both aircraft would have been under positive radar control at the CRP.)

(3) Control procedures outlined in TT 44-10-1 effectively resolved all 18 AVN-AVN potential incidents of interference. (Fifteen of these incidents occurred under daylight visual meteorological conditions, and normal visual flight rules would be sufficient to resolve them. The three incidents of interference which occurred at night occurred under visual meteorological conditions and would have been resolved by procedures outlined in TT 44-10-1 for the FCC.)

(4) There were nine AVN-AF potential incidents of interference during the war game.

(a) No AVN-AF potential incidents of interference occurred above 500 feet.

(b) Control procedures outlined in TT-44-10-1 effectively resolved two of these potential incidents of interference. (Both of those incidents involved Air Force aircraft which were flying missions requested by the division. Whenever the division has requested and is aware of impending Air Force flights, the flow of flight path information is sufficient to adequately allow coordination, regulation, and integration of these flights with Army aviation flights.)

(c) The seven unresolved potential incidents of interference all involved the passage of transient Air Force aircraft through the division area. (Current procedures outlined in TT 44-10-1 do not provide the division with any information on transient Air Force aircraft, and no coordination, regulation, or integration of these flights with Army aviation flights can be instigated. Figure 3-8 shows that all seven of these incidents occurred in the brigade areas.)

e. Aircraft conclusion. Based on (4)(c) above, it is concluded that in order to minimize the probability of a collision between Army aviation aircraft and Air Force transient aircraft, division and brigade must receive timely information on all Air Force aircraft transiting the division area.

f. ADA findings.

(1) There were 89 ADA-AF and ADA-AVN potential incidents of interference during the war game.

(a) Control procedures outlined in TT 44-10-1 effectively resolved 77 of these potential incidents of interference. (Each of these incidents involved Army aviation and Air Force aircraft passing through friendly air defense fires. Current procedures prohibit ADA firing units from engaging enemy aircraft if friendly aircraft are in the weapons engagement zone.)

(b) The 12 unresolved potential incidents of interference involved friendly aircraft which were mistakenly identified as hostile and were, therefore, engaged by friendly air defense firing units. (Current procedures outlined in TT 44-10-1 do not provide ADA firing units with information on friendly aircraft flights.)

(2) There were 196 Army aviation and 75 Air Force flights in the division area during the war game.

(a) There were 128 Army single aircraft flights in the division area during the war game. The remaining 58 were multiaircraft flights.

Para 3-2, War Gaming (cont)

(b) Of the 128 Army single aircraft flights, 119 were rotary-wing flights, and nine were fixed-wing flights.

(3) During the war game, the experts playing the enemy forces did not permit their rotary-wing, single aircraft flights to engage blue force targets.

g. ADA conclusions.

(1) Based on b(1)(b) above, it is concluded that in order to prevent friendly aircraft from mistakenly being identified as hostile and being engaged by friendly ADA firing units, division and brigade must receive timely information on all Air Force aircraft transiting the division area.

(2) Based on f(1)(b) above, it is concluded that in order to prevent friendly aircraft from mistakenly being identified as hostile and being engaged by friendly ADA firing units, all ADA firing units must be alerted or informed of the passage of friendly aircraft through their area. (Past ADA studies have shown that when ADA firing units are alerted to the impending passage of friendly aircraft, the probability that the aircraft will be mistakenly identified as hostile is significantly reduced.)

(3) Based on b(2) above, it is concluded that alerting or informing ADA firing units of the passage of *all* friendly aircraft is impracticable because of the high density of Air Force and Army aviation flights in the division area.

(4) Based on f(3) above, it is concluded that there is no significant threat to friendly forces from enemy rotary-wing, single aircraft flights.

(5) Based on (3) and (4) above, it is concluded that a rule of engagement which states that air defense artillery firing units will not engage rotary-wing, single aircraft flights, except in self defense, will eliminate the need to alert or inform ADA firing units of these flights.

3-3. Recommendations. Two different systems are recommended for evaluation during Phase II, CPX. These systems will be labelled System A and System B.

a. System A.

(1) Based on the need to have timely information on all Air Force aircraft transiting the division area, it is recommended that a two-way,

Para 3-3, Recommendations (cont)

long-range, secure radio net be established from the Air Force CRP to each Army division served by the CRP. This net will be called the Air Force routing net, and will include equipment and personnel to permit all maneuver brigades to operate in their respective division-CRP radio nets. The brigades will use this net to inform the CRP of minimum risk routes in the brigade area. Division will monitor the transmissions between the brigades and the CRP and will notify the CRP of the minimum risk routes over the division rear area. These minimum risk routes will be furnished when the CRP indicates that an Air Force flight will be transiting the division area.

(2) In order to facilitate the timely control of airspace and dissemination of air defense alert information, it is recommended that a five-man augmentation be established at brigade headquarters to function as a BACE. This augmentation will be organized as shown in figure 1-4.

(3) It is further recommended that a two-way radio net be established from the brigade BACE to the DACE. This net will be called the division airspace net and will be used for coordinating airspace activities within the division.

(4) In order to reduce the probability that friendly aircraft will be mistakenly identified as hostile (para 3-2g(1)), it is recommended that four one-way, long-range, secure radio air defense alert nets be established. Each of the division's three brigades would establish a net between the BACE and all ADA firing units within its brigade boundaries, and the fourth net would be established from the DACE to all ADA firing units within the division rear area. The BACE and DACE would use these nets to alert air defense units of friendly aircraft flights within their respective areas.

(5) It is recommended that the fire support warning net be used to provide general support artillery units with a timely communications channel for informing the BACE and DACE of their fire missions.

(6) Since there was no significant threat from enemy rotary-wing, single aircraft flights (para 3-2g(4)), it is recommended that a rule of engagement be implemented which states that air defense firing units will not engage rotary-wing, single aircraft flights.

(7) It is further recommended that TT 44-10-1 be revised to incorporate all of the above recommendations.

Para 3-3, Recommendation (cont)

b. System B. Justification for the recommendations in System B is the same as in System A and is based on the same conclusions. Listed below are the recommendations for System B.

(1) Establish a two-way, long-range, secure radio net from the Air Force CRP to each Army division served by the CRP. This net will be called the Air Force routing net and will include equipment to permit all maneuver brigades to operate in their respective division-CRP radio net. The brigades will only monitor this net. When the CRP notifies the division that an Air Force flight will transit the division area, the brigades will transmit a minimum risk route for the brigade areas to division headquarters. Division headquarters will consolidate the brigade minimum risk routes with the minimum risk route over the division rear area. Division headquarters will then transmit to the CRP one minimum risk route for transiting the division area.

(2) Conduct brigade airspace control functions with personnel already assigned to the brigade headquarters. Do not create an augmented BACE.

(3) Establish a two-way radio net from the brigade headquarters to the DACE. This net will be called the division airspace net. It will be used for coordinating airspace activities within the division.

(4) Establish a one-way, long-range, secure radio, division and brigade air defense alert net. This net will be used by brigade headquarters to alert air defense units of friendly aircraft flights which will be crossing the brigade area. Division headquarters will use the same net to alert air defense units in the division rear area of friendly aircraft flights which will cross that area.

(5) Revise the use of the fire support warning net. Use this net for general support artillery to notify the BACE or DACE of general support fire missions.

(6) Establish a rule of engagement that air defense weapons will not engage single aircraft, rotary-wing flights except in self defense.

(7) Revise Training Text 44-10-1 to incorporate all of the above recommendations. Modify the manual to eliminate the formation of a BACE.

CHAPTER 4

DETAILED CONCEPT AND CONDUCT OF CPX EXPERIMENT

Section I. GENERAL

4-1. General. This chapter contains a detailed discussion of the concept and conduct of the experiment. The organizations used as the test vehicle and those that supported the experiment are portrayed herein. This chapter presents the discussion of the training conducted and the results of that training. Data collection, reduction, analysis, and evaluation are also addressed in this chapter.

Section II. CPX EXPERIMENT DESIGN

4-2. General. The CPX experiment was designed to measure the effectiveness of the airspace control systems which were developed during the war game. The CPX experiment was conducted to provide information for subsequent analysis. The analysis resulted in a proposed airspace control system.

a. Experimental CPX.

(1) According to the test design, the effectiveness of each proposed airspace control system was measured during a series of tactical situations. The system developed during the workshop was used as the initial input to the first tactical situation and was subjected to CPX play. At the conclusion of two tactical situations, the data collected were analyzed and the system was evaluated. The second recommended system was subjected to evaluation during the next five tactical situations. Data were collected and analyzed, and the system was evaluated based on the CPX play. Analysis of the two airspace control systems (systems A and B) resulted in a revised system (system C) that was evaluated during the final tactical CPX situation.

(2) The basic measures of effectiveness used during the CPX were delays and interferences. If delays in combat support were avoided and the prevention of airspace user incidents were accomplished in an efficient manner, then the system was effective. This is outlined in the logic diagram in figure 4-1.

(3) A modified division-level CPX was conducted in a mid-intensity European-type environment. The tactical situation was superimposed on the area north of Fort Hood. The forces included two mechanized infantry brigade headquarters, (with or without airspace control augmentation

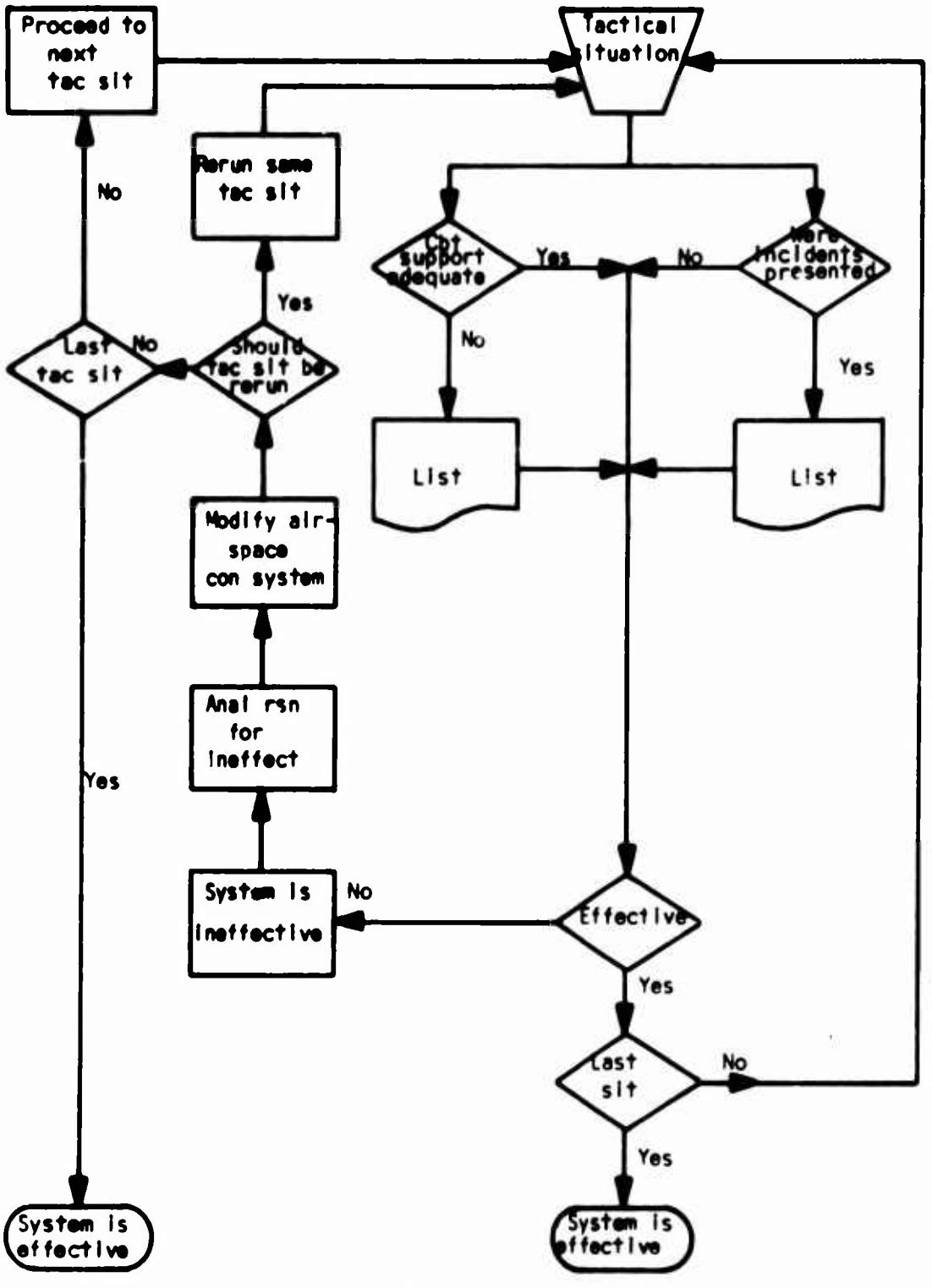


Figure 4-1. Airspace Control System Logic Diagram

depending on the system being measured) and a mechanized division TOC with an airspace control element and selected staff elements. Maneuver battalions, corps headquarters, and selected divisional combat support elements were represented by controller personnel.

b. The seven scenario tactical situations which were used as a vehicle to measure the systems were:

(1) Delay.

(2) Defense.

(3) Counterattack.

(4) Attack.

(5) Exploitation.

(6) Airmobile.

(7) Night attack.

Section III. CPX EXPERIMENT EXECUTION

4-3. CPX Execution.

a. General. A CPX was conducted to measure the effectiveness of the airspace control systems which were developed during phase I (workshops). The CPX was conducted as designed except that the night attack was not evaluated since the war game results showed a decrease in activity, and there was a need for selected scenarios to be rerun against some systems.

b. CPX.

(1) The CPX was conducted over a period of 3 weeks. The systems measured against the various tactical situations are shown in figure 4-2, and a detailed description of each system is found in annex E.

CPX run number	Tactical situations	System[a]
1	Delay	A
2	Defense	A-1
3	Counterattack	B
4	Defense	B-1
5	Attack	B-2
6	Exploitation	B-3
7	Airmobile	B-4
8	Attack	C

[a]Systems are defined in para 4-5a(1).

Figure 4-2. Systems Measured in Tactical Situations

(2) A modified division-level CPX was conducted in a mid-intensity European-type environment. The tactical situations were superimposed on the area north of Fort Hood. The command post workshop area was used in the CPX. The test area layout is shown in figure 4-3. Radio nets were simulated by connecting AN/GRC-39's by wire rather than by RF transmission. Wire nets were simulated by wiring TA-312's directly between users. This eliminnted the use of switchboards.

(3) The organization of the player personnel for each run is found in paragraph 4-4.

(4) The various tactical situations portrayed differing densities of airspace usage. The density of tactical missions is shown in figure 4-4.

(5) There were three MOE's for the systems:

(a) The number of delays in the receipt of combat support provided to the maneuver commander.

(b) The number of incidents of interference among airspace users.

(c) The number of personnel and amount of equipment which were dedicated to the operation of the airspace control system.

(6) Each system was subjected to a scenario play of from 4 to 6 hours. The assumptions are shown for each scenario in figure 4-5.

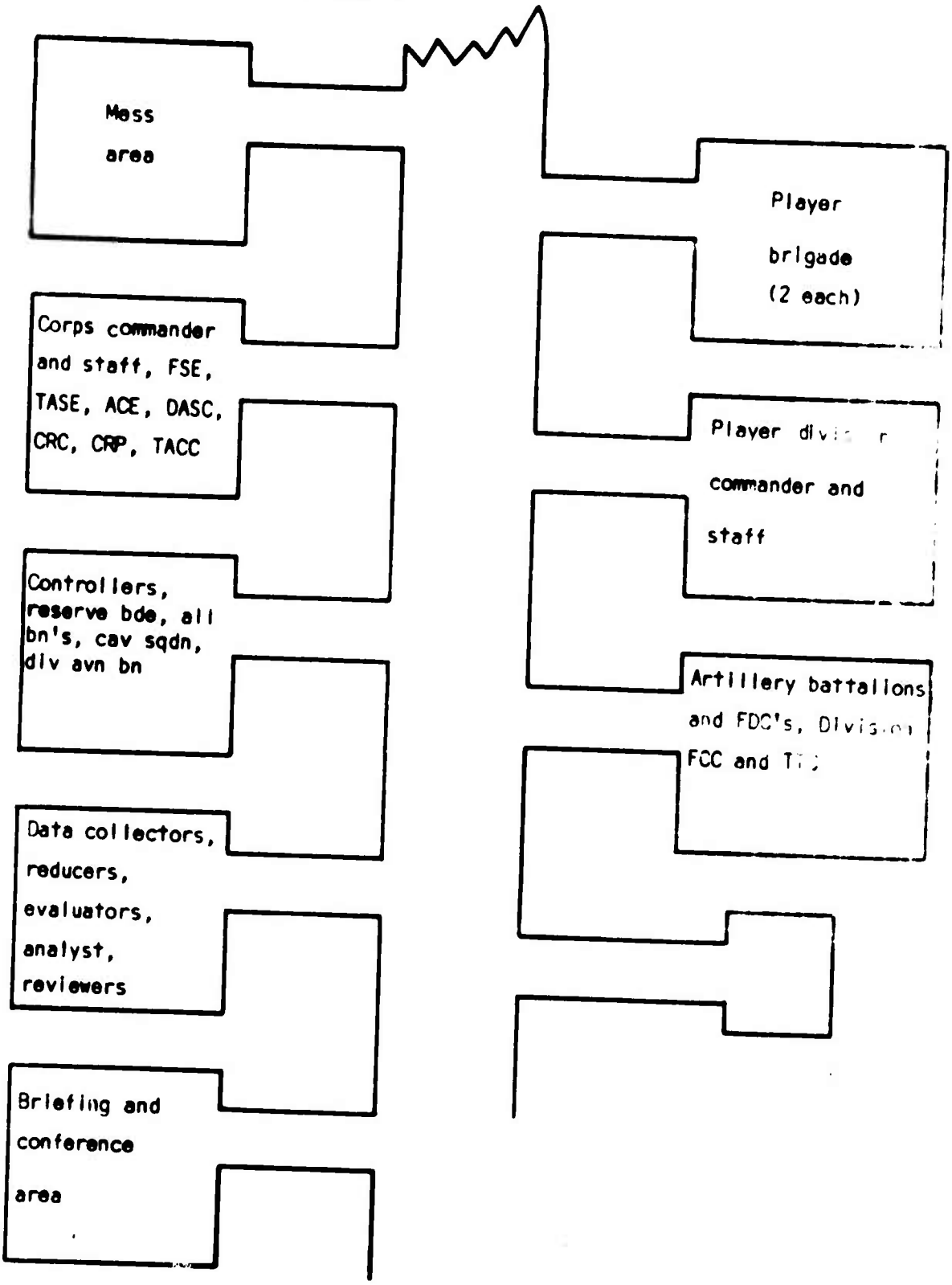


Figure 4-3. Test Area Layout

Air space users	Number of missions by phase							
	Delay	Defense	Counter-attack	Defense	Attack	Exploi-tation	Air-mobile	Attack
FAM	290	288	200	470	455	258	438	402
AVN	68	69	35	91	60	51	124	67
AF	48	69	61	58	53	51	44	54
ADA	81	136	132	127	68	180	134	70

Figure 4-4. Scenario Missions by Airspace User

Situation	Air situation	Type assumption			
		Army aviation density	Field artillery	Air defense artillery	Other
Delay	< Air parity	High	Displace-ment to rear	Minimal controls	Rearward passage of lines
Defense	< Air parity	Average	Min dis-placement Max fires	Minimal controls	
Counter-attack	Air parity	Low	Min dis-placement Min fires	Some restric-tive controls	
Attack	Relative air superiority	Low	Massing of fires	Restric-tive controls	Concentrated tactical air support
Exploita-tion	Relative air superiority	Average	Fires on wide front	Well forward w some restric-tions	Maximum tactical air support
Airmobile	Relative air superiroity	Maximum	Displace-ment forward	Some restric-tive controls	Max planning and coordi-nation Normal tactical support

Figure 4-5. Scenario Assumptions

(7) A detailed analysis period was conducted at the conclusion of the CPX. Team personnel from the United States Army Aviation School and Agency, The United States Army Infantry School and Agency, The United States Army Armor School and Agency, The United States Army Field Artillery Center and Agency, and The United States Army Air Defense School and Agency were used. Representatives from the United States Air Force assisted in the analysis of the effects of Air Force tactics upon the airspace control system.

4-4. Organization. During the CPX, the evaluated headquarters were considered to be organized under the current H-series TOE. Elements of these headquarters that were not involved in airspace control (G1 and S1 sections, company headquarters, security sections, etc.) were not manned or simulated during the CPX. There were other staff elements that made a very minimal contribution to the airspace control effort; therefore, staff sections were consolidated for the purpose of economy. Their input to the airspace control effort was not degraded. An example of this consolidation was the G4 and the division surgeon. Each staff section was manned to a level that allowed the section to play the CPX in such a manner that the demands on the staff member's time were realistic. No effort was planned, or made, to allow for a 24-hour operation or the processing of all staff actions. In some cases a player actually played two or more roles. Complete displays, maps, and status boards were not maintained by all staff sections. For example, the fire support officers did not post the ammunition status. Journal clerks were not played nor were consolidated staff journals maintained. Figure 4-6 depicts the player and controller organization for the CPX. The internal airspace control organization was varied with each system and is shown in figures 4-7 and 4-8.

4-5. Variables.

a. General. The variables in the experimental CPX fell into two categories, airspace control systems and tactical situations. The two categories were varied for each iteration (run) of the CPX. The purpose of varying these two factors was to measure the effectiveness of each variation of the systems and the effects of various tactical situations of the evaluated systems. Each run of the CPX had similarities with the others, but the runs varied sufficiently so that no one run was directly comparable to any other run.

(1) Systems. There were three basic airspace control systems used in the CPX. They were designated A, B, and C. Systems A and B were the results of the analysis of the findings at the end of the airspace workshop. The CPX started with these two systems and they were subsequently modified to optimize their effectiveness. A detailed discussion of the

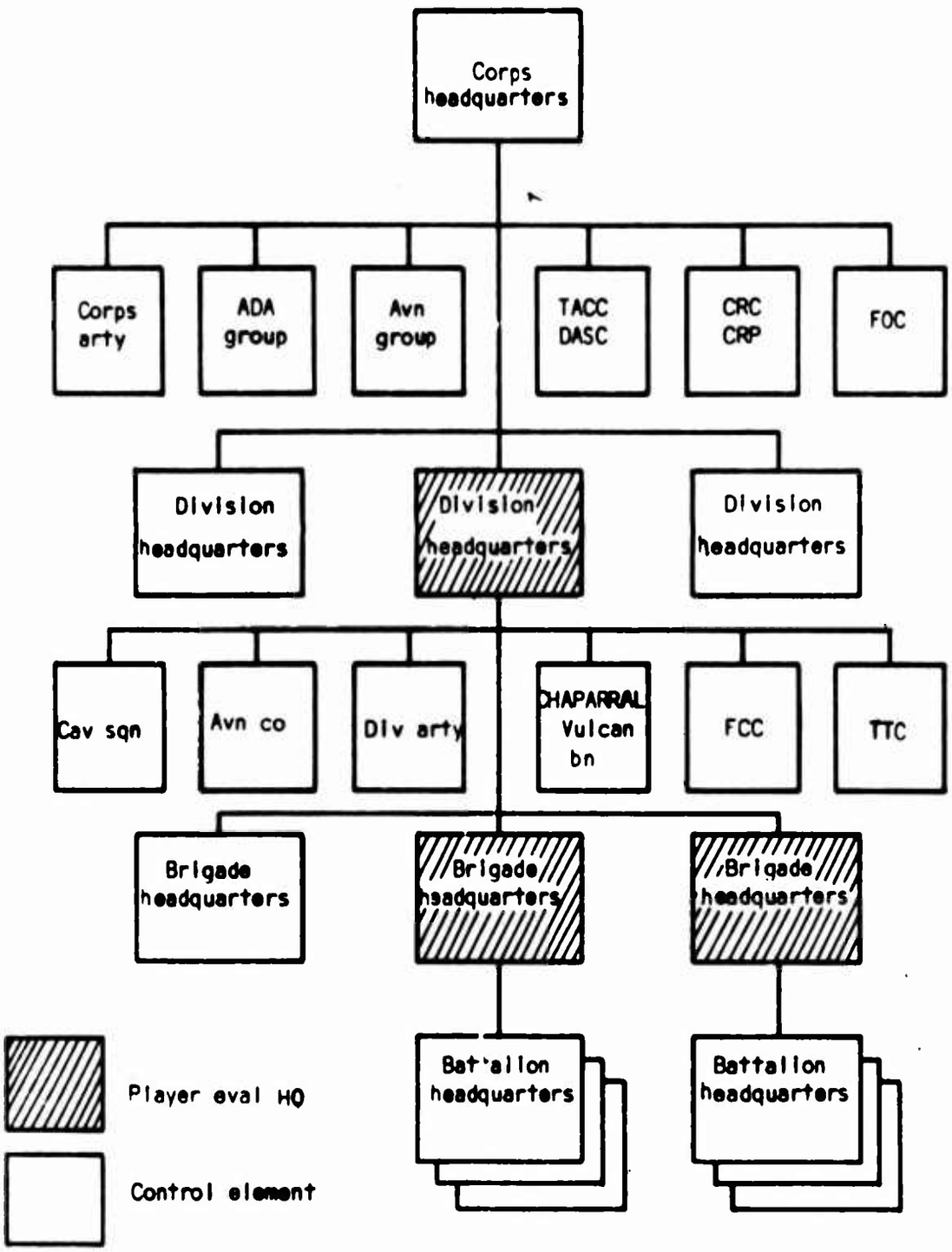


Figure 4-6. Player and Controller Organization

Para	Line	Description	Grade	MOS	Branch	CPX run number							
						1	2	3	4	5	6	7	8
		TOE 37-42H											
01	01	Bde comd	COL	01542	IN	1	1	1	1	1	1	1	1
	06	S3	MAJ	52162	IN	1	1	1	1	1	1	1	1
	03	Asst S3 air	CPT	02163	IN	1	1	1	1	1	1	1	1
	07	Op sgt	SGM	11F50	NC	1	1	1	1	1	1	1	1
	08	Asst op sgt	MGS	11F50	NC	1	1	1	1	1	1	1	1
	21	Op asst	SP4	11F20		1	1	1	1	1	1	1	1
		Augmentation											
XX	01	Avn staff off	CPT	02518	AM	1	1						1
	02	Op off	CPT	01174	AD	1	1						1
	03	Op sgt	SSG	11F40	NC	1	1						
				13E40	NC								1
	04	Op asst	SP4	11F20		1	1						1
		TOE 6-366											
01	05	Fire spt off	CPT	51193	FA	1	1	1	1	1	1	1	1
13	01	Ln sgt	SSG	13E40	NC	1	1	1	1	1	1	1	1
	02	CP carr dvr	SP4	13A1U		1	1	1	1	1	1	1	1
		TACM 55-46, Bde TACP											
		ALO	MAJ	1456	USAF	1	1	1	1	1	1	1	1
		Gnd comm equip rpmn	SGT	30454	USAF	2	2	2	2	2	2	2	2

Figure 4-7. Player Brigades Organization

Para	Line	Description	Grade	MOS	Branch	CPX run number							
						1	2	3	4	5	6	7	8
		TOE 37-04H											
01	01	Div CG	MG	00002	GO	1	1	1	1	1	1	1	1
04	10	Intel asst	SGT	11F20		1	1	1	1	1	1	1	1
05	01	G3	LTC	02162	AM	1	1	1	1	1	1	1	1
	04	Asst G3 air	MAJ	02163	AM	1	1	1	1	1	1	1	1
	06	C, Op sgt	SGM	11F50	NC	1	1	1	1	1	1	1	1
	08	G3 air op sgt	SFC	11F40	NC	1	1	1	1	1	1	1	1
06	01	G4	LTC	02625	NO	1	1	1	1	1	1	1	1
	05	Asst sup sgt	MSG	76Z5K	NC	1	1	1	1	1	1	1	1
09	01	Avn staff off	LTC	02518	NO	1	1	1	1	1	1	1	1
	04	Op sgt	MSG	71P50	NC	1	1	1	1	1	1	1	1
		TOE 6-302H											
01	03	Asst FSCOORD	LTC	51193	FA	1	1	1	1	1	1	1	1
05	03	Tgt anal	CPT	52162	FA	1	1	1	1	1	1	1	1
	05	Op sgt	MSG	13Z50	NC	1	1	1	1	1	1	1	1
	11	Lt veh dvr	PFC	13A10		1	1	1	1	1	1	1	1
		TOE 44-326H											
10	01	Op off	MAJ	01174	AD	1	1	1	1	1	1	1	1
	03	Op sgt	SFC	16H40	NC	1	1	1	1	1	1	1	1
	05	Rad op	SP4	05B20		1	1	1	1	1	1	1	1
		TACM 55-46, Div TACP											
		ALO	LTC	1456	USAF	1	1	1	1	1	1	1	1
		Asst ALO	MAJ	1456	USAF	1	1	1	1	1	1	1	1
		Gnd comm equip rpmn	SGT	30454	USAF	1	1	1	1	1	1	1	1
		Gnd rad tech	SP4	30454	USAF	2	2	2	2	2	2	2	2

Figure 4-8. Player Division Organization

supporting analysis is covered in chapter 5. The resulting variations were designated by a letter and a number; i.e., B-1, B-4, etc. The personnel requirements for each system and run are discussed in paragraph 4-4. The communication requirements and nets are shown in figure 4-9. Procedurally, the A system was a full information system in which all decisions were based on current reported information. Maneuverable air vehicles, such as aircraft, were flown around reported hazards. The operators attempted to minimize risks, not totally eliminate them. All Air Force flights, Army command and control flights, and medical evacuation flights were reported into the system. System B was based on the concept that an experienced operations officer could predict the level and points of heavy activity; therefore, less reporting was required in this system. System C had some features of A and B plus new concepts that were developed as the CPX progressed.

(2) The tactical situation and friendly tactics were developed by the scenarios that were used. The type of ground combat was characteristic of that expected in a mid-intensity European-type conflict. The scenarios were based on information, activities, and force mixes found in the TRICO studies and the results of the war game. Paragraph 4-3 contains information on the specific levels of activity and the scenarios that supported a specific run.

b. Variations by run. Runs 1 and 3 started with a basic system which was subsequently modified in runs 2, 4, 5, 6, and 7. Run 8, system C, was derived from incorporating features of the systems used in previous runs. The procedures, tactics, and techniques used in each run are discussed in annex E.

4-6. Training.

a. General. As in all tests and evaluations, training is of primary importance to the success or failure of the endeavor. A review of existing US Army doctrine on airspace-related procedures disclosed numerous references in various field manuals, but nowhere was there an all-inclusive document which provided airspace coordination doctrine and techniques for the commander. The draft manual, Training Text 44-10-1, attempted to delineate all airspace procedures. For this reason, this training text was selected as the procedural manual for use in the experiment. As a result of the analysis process conducted after the war game, modifications were made to the original training text. Additionally, in the revised versions of the training text which reflected systems A and B, a column titled "Descriptions" was added. This added column contained detailed information requirements and spelled out communications means to be utilized. The use of this document enabled players and controllers to refer to one document for all airspace control procedures.

Authority	Unit	Equipment	Comm net	Section	CPX run number							
					1	2	3	4	5	6	7	8
TOE 37-04H	HHC div	AN/VRC-46	Div CG	G3 ele	I	I	I	I	I	I	I	I
TOE 37-04H	HHC div	AN/VRC-46	Div CG	G3 air	I	I	I	I	I	I	I	I
TOE 37-04H[a]	HHC div	TA-312	FCC line	AAE	I	I	I	I	I	I	I	I
TOE 37-04H[a]	HHC div	TA-312	Bde line	AAE	I	I	I	I	I	I	I	I
TOE 6-302H	HHB divarty	AN/VRC-46	Divarty C&F	FSE	I	I	I	I	I	I	I	I
TOE 44-326H	HHBC/V bn	AN/VRC-46	ADA bn CMD	ADE or ACE	I	I	I	I	I	I	I	I
TOE 44-326H[a]	HHBC/V bn	AN/VRC-46	ADA alert	ADE	I	I	I	I	I	I	I	I
		AN/VRC-46	Fire support warning	ADE	I	I	Not played					
TACM 55-51	Div TACP	(Mark 107) (AN/GRC-106)	AF req	TACP	I	I	I	I	I	I	I	I
TACM 55-51	Div TACP	(Mark 107) (AN/ARC-51)	AF air	TACP	I	I	I	I	I	I	I	I
TACM 55-51[a]	Div TACP	AN/TRC-117	AF alert	TACP ACE	I Terminal in TACP	I	I	Terminal moved to ACE				
TOE 37-42H	HHC bde	AN/VRC-46	Div CG	G3 ele	I	I	I	I	I	I	I	I
TOE 37-42H	HHC bde	AN/VRC-46	Bde CG	G3 ele	I	I	I	I	I	I	I	I
TOE 37-42H	HHC bde	TA-312	Div line	G3 ele	I	I	I	I	I	I	I	I
TOE 37-42H	Bde CP	AN/VRC-46	Bde air-gd	G3 air	Not played in the RACE				I	I	I	I
TOE 37-42H	Bde CP	AN/VRC-46	ADA alert	G3 air					I	I	I	RACE
TOE 37-42H	Bde CP	AN/VRC-46	Div bde	G3 air				I	I	I	I	RACE
TOE 37-42H	Bde CP	AN/VRC-46	AF alert	G3 air					I	I	I	RACE
TOE 6-306H	HHB DS Arty bn	AN/VRC-46	VS tac	FSE					I	I	I	I
TACM 55-51	Bde TACP	AN/VRC-46	Bde CG	TACP						I		
TACM 55-51	Bde TACP	AN/VRC-46	AF alert	TACP					I	I	I	I

Figure 4-9. Division Level Organizational Communications and Nets

Authority	Unit	Equipment	Comm net	Section	CPX run number							
					1	2	3	4	5	6	7	8
None (BACE)	Bde TACP	AN/ARC-51	Bde Air-Gnd	BACE	Not played			In the bde S3 air section				not played
None (BACE)	Bde TACP	AN/ARC-51	ADA alert	BACE	—	—		In the bde S3 air section				—
None (BACE)	Bde TACP	AN/ARC-51	Div-Bde	BACE	—	—		In the bde S3 air section				—
None (BACE)	Bde TACP	AN/ARC-51	AF alert	BACE	In TACP			In the bde S3 air section				—
None (BACE)	Bde TACP	AN/ARC-51	Fire support warning	BACE	—	—	Not played					—

[a]Augmentation

Figure 4-9 (cont). Division Level Organizational Communications and Nets

Para 4-6, Training (cont)

b. Preexperiment training. All players, controllers, and evaluators were required to attend training which was composed of lectures, conferences, practical exercises, evaluations, and critiques. The basic training schedule required that the players, controllers, and evaluators attend a lecture on the overall purpose and objective of the CPX. This was followed by a conference on the basic reference material. The players then went to their staff sections and were organized to play the system being evaluated. Once organized, they further studied, experimented with, and evaluated the procedures. Concurrently, they developed displays, forms, and internal techniques which would allow them to play the procedures. The training was repeated for each new system (i.e., system A and B and for minor modifications as described below).

c. Interim training. Because of the nature of the experiment each day of the CPX was characterized by an initial training and orientation period such as that described in b, above, to familiarize the participants with changes in organizations and procedures which were developed by the evaluator and analyst. The length and scope of the training period was dependent on the extent of the changes.

d. Training evaluation. At the conclusion of the pilot test, player personnel were asked to evaluate the training conducted. Listed below are the results of their evaluation.

(1) Seventy-one percent of the respondents (31 of 46) felt that the training which was conducted increased their knowledge of the subject.

(2) Seventy-eight percent of the respondents (36 of 46) indicated that the practical training during the pilot test increased their knowledge.

(3) Seventy-four percent of the respondents (34 of 46) indicated that the instructional material was an aid to their learning.

(4) Seventy-six percent of the respondents (35 of 46) indicated that the facilities were conducive to the conduct of effective training.

(5) Sixty-one percent of the respondents (28 of 46) were satisfied with the lectures and conferences.

(6) Fifty percent of the respondents (23 of 46) indicated that the practical work periods were of sufficient length.

(7) Thirty percent of the respondents (18 of 46) indicated that more practical exercise time was needed.

Para 4-6, Training (cont)

(8) Fifty-nine percent of the respondents (27 of 46) felt that they were able to perform their functions as a result of training.

e. Examination results. At the conclusion of the pilot test, division and brigade players were administered an examination on TT 44-10-1. Only 41 percent (19 of 46) were able to pass this examination. Since this level of proficiency was far below that desired, retraining was conducted following the initial program discussed in b, above, and prior to the start of run 1. Results of the retraining brought the proficiency of the players to an acceptable level to begin the experiment.

f. Qualification of personnel. During the in-processing phase, the players and controllers completed a questionnaire which reflected their military schooling and field experience. The data were analyzed with the objective of measuring the military academic background of the participants in the career development and specialty courses and in field experience in airspace-related functional areas. The Fort Hood adjutant general section indicated that the percentages listed below are higher than the mean percentage for Fort Hood units.

(1) All of the officers had attained the required level of military schooling for their grade.

(2) Eighty-five percent of the lieutenant colonels and 37 percent of the majors were staff college or equivalent graduates.

(3) Seventy-three percent of the captains were advanced course graduates.

(4) Twenty-seven percent of the senior noncommissioned officers had attended the senior NCO course.

(5) Thirty-nine percent of the E7's and E8's were graduates of an NCO academy.

(6) All of the enlisted men, E4 and below, had completed advanced individual training.

g. Experience level of participants. Utilizing the questionnaire described in e, above, the experience level of the player personnel in airspace-related areas was obtained and is listed in figure 4-10. There were 68 participants: One colonel, seven lieutenant colonels, 19 majors, 26 captains, and 15 lieutenants.

Field of experience	COL	LTC	MAJ	CPT	LT
G2 and S2	1	2	7	10	
G3 and S3	1	6	13	9	3
Air operations		3	9	6	
Fire support coordination		1	3	7	
Air traffic control			1	3	

Figure 4-10. Experience of Personnel

4-7. Data Collection and Reduction.

a. Three different modes of data collection were used during the CPX experiment. This allowed maximum flexibility and at the same time assured that essential data were collected on a scheduled basis.

(1) The first mode of data collection was an hourly collection of all preprinted data forms which the players and player controllers had completed. These forms were immediately reviewed by the data collection team, and errors were corrected.

(2) The second mode of data collection was the unscheduled submission of reports by evaluators during the conduct of the CPX experiment. This mode of data collection permitted problems to be identified immediately and allowed the current CPX experiment airspace control system to be modified during that particular run.

(3) The third mode of data collection was a debriefing of all evaluators. The debriefing was conducted at the termination of each CPX experiment run.

b. Data reduction started immediately after the data collection team finished screening the forms collected. Potential incidents of interference were identified manually and through the use of a computer simulation. All uses of airspace were recorded by the user on one of a series of preprinted computer data forms. These preprinted computer data forms were separated from the other data forms and punched on IBM cards. When all airspace user data for one run had been transferred to data cards, the cards were read into the computer for further editing.

(1) The computer simulation used during the CPX experiment was virtually identical to the simulation employed in the workshop. Aircraft were flown in 1-minute increments through simplified volumes of airspace.

Para 4-7, Data Collection and Reduction (cont)

The FAM projectiles were flown in a parabolic trajectory which has its vertex located midway between the target and firing location. The main difference between the computer simulation used during the workshop and the one used during CPX experiment was the method used to compute ADA incidents of interference.

(2) The ADA misidentification rate that was used during the CPX experiment was the same as that which was used in the workshop; however, attrition was not played. The computer simulation that was used in the CPX experiment determined all ADA engagements of friendly aircraft. It did this by first checking all friendly aircraft flight paths against the range and altitude capabilities of all non-IFF-equipped ADA firing units. If the aircraft flight path was within the range and altitude capability of a firing unit, a random number threshold determined whether or not the aircraft were engaged by the firing unit. Engagements were printed out by the computer as ADA potential incidents of interference. The random number threshold was based on the misidentification rate. The computer simulation which deterined ADA engagements of friendly aircraft was repeated each minute of an aircraft flight. If an aircraft was on a fixed area for more than 1 minute, the determinations described above were made only for the first minute the aircraft was in the fixed box If the ADA firing unit was alerted to the passage of a particular flight, no determinations were made.

(3) Based on the preprogrammed firing unit locations, weapon characteristics, and IBM data and input, the computer printed out a preliminary list of all ADA-AF, ADA-AVN, FAM-AF, FAM-AVN, and AVN-AF potential incidents of interference. Each incident identified by the computer was manually examined. The remaining incidents were used as inputs for analysis.

(a) Army aviation, Air Force, and field artillery delays were determined manually by comparing the scenario with various preprinted computer and log forms. Delays determined in this manner were used as inputs for analysis.

(b) General statistical and work analysis data were collected from all sources.

4-8. Data Analysis and Evaluation.

(a) The basic inputs for analysis were:

(1) The manually confirmed list of potential incidents of interference.

(2) The listing of delays.

(3) General statistical and work analysis data.

(4) Evaluator comments.

b. Potential incidents of interference and delays were used to identify problem areas. The general statistical and work analysis data were used to determine the scope of the problem, and evaluator comments were used to document procedural errors, human failures, adequacy of communication, and other factors that affected system performance. Evaluator comments were also used as an immediate, but limited, means of determining general system effectiveness.

c. Once problem areas were identified, a detailed evaluation was conducted to determine what caused the problem to develop. System failures were categorized into inadequacies of personnel, equipment, or procedures.

d. Changes to the airspace control system were then developed for experimentation in the next run.

CHAPTER 5

CPX EXPERIMENT EVALUATION DETAILS

Section I. GENERAL

5-1. General.

a. This chapter contains the detailed procedures, to include modifications to the concepts discussed in chapter 4, used to process CPX experiment data. Data are traced step-by-step from their basic reduced form to the final recommendations. One major change to the step-by-step evaluation process was the summoning of a general officer airspace control conference. The motive for calling this conference, its purpose, and the results are also discussed here.

b. The following term used in this chapter is defined in annex B: crossover.

5-2. Methodology.

a. Computer data on potential incidents of interference were generally not available for analysis and evaluation before system modifications had to be made for the next experiment run. As computer data became available, they were analyzed and evaluated, and, if appropriate, system changes were incorporated into subsequent experiment runs.

b. Information on delays was generally available for analysis and evaluation before the next experiment run. Other information was processed only when it was deemed appropriate by analysts or evaluator personnel.

c. All evaluators were assembled after each experiment run to review the input and functioning of the component agency and communications net which were a part of that particular airspace control system. All available incident and delay data on present and past runs were presented. A tentative general evaluation of each system was made during this debriefing and, based upon this evaluation, changes were made to the system prior to the next CPX experiment run.

d. If there were major system changes, retraining was conducted, and in some cases short pilot experiments were scheduled.

e. The evaluation process on all runs continued throughout the experiment and for several weeks thereafter. In some cases, such as the ADA crossovers, the significance of the problem did not become evident until after all experiment runs were completed.

f. During all runs, emphasis was placed on the operation of the candidate system components within varying structures. This was done to determine what impact each component had on the overall system performance. The nature of the experiment precluded objective testing of a complete system, and no attempt was made to compare run results.

g. After all CPX experiment runs were evaluated, it was determined that it would be desirable to examine the question of how many potential incidents of interference would result from playing selected scenarios without the use of any type of airspace control system. This was done by using the FAM data of the selected run in the same manner as played in the experiment and by flying all aircraft in straight line paths directly from their origins to their destinations. ADA incidents were generated in the same manner as in the experiment except that there were no alerts given to ADA firing units. The results of these controlled runs which used the attack and defense scenarios are shown as runs 9 and 10 (fig F-12).

5-3. Measures of Effectiveness.

a. The measures of effectiveness which were used to evaluate each system and run of the CPX experiment were the number of potential incidents of interference which occurred, the number of delays which occurred, and the number of personnel and amount of equipment which were dedicated to the operation of that particular airspace control system.

b. The type of potential incident of interference which resulted from a particular run identified a system's problem area. The relative number of potential incidents of interference of a particular type identified the magnitude of the problem. Because of the nature of the experiment, the large number of variables, the difference in system loading, and the use of a continuously changing airspace control system, the number of potential incidents of interference from run-to-run are *not* directly comparable.

c. The type of delay which resulted from a particular run identified system problem areas, and the relative number of delays identified the magnitude of the problem. Again, as with potential incidents of interference, delays from run-to-run are *not* directly comparable.

d. The direct cost of all communications equipment needed to operate each system and the number of additional personnal needed to perform

airspace control functions do not represent the entire system burden. The entire system burden includes not only direct costs but also directly related costs such as the cost of power supplies, means of transport, and the myriad of related logistical support cost.

e. Overall system effectiveness, as used in the CPX experiment, was a trade-off between the benefits and burdens. The benefits are measured by a reduction of potential incidents of interference and delays. The burden is measured by dollars, men, radio frequencies, etc.

5-4. Analysis.

a. Each ADA potential incident of interference resulted from a system failure. When any of the systems were used in the experiment, it was necessary that ADA firing units be alerted to the passage of any aircraft flight that was considered to be ADA vulnerable. Once an ADA firing unit was alerted to a particular friendly flight, there was no probability that the ADA firing unit would identify that flight as hostile.

(1) Once a specific system failure was identified, analysts sorted through all logs and work data to determine where the flow of information became restrictive.

(2) The comments of evaluators who were observing those areas which were identified as being restrictive aided in determining that the restrictions resulted from the failure of personnel, equipment, or procedures.

(3) When alerts for a particular area were passed late, they were played as if passed on time.

(4) The engagement zone of all ADA firing units was assumed to be circular, and the radial distance was assumed to be equal to the maximum firing range.

(5) Three separate ADA alert nets were played during all runs of the CPX experiment. This was done to reduce the volume of traffic over each net as it was determined analytically that use of a single net would result in that net being overloaded and ineffective. The disadvantage of using three ADA alert nets is the enlargement of the ADA crossover problem.

b. Not all FAM potential incidents of interference resulted from a system failure. Some FAM-AVN and FAM-AF incidents involved aircraft which were on minimum risk routes. This type of incident represents an unavoidable risk for that particular airspace control system. All other FAM incidents resulted from a system failure.

Para 5-4, Analysis (cont)

(1) FAM incidents which resulted from a system failure were analyzed as described in a(1) and (2), above.

(2) Battalion-level personnel usage was not played during the CPX experiment. All FAM incidents involving direct support fire units and close air support aircraft in strike patterns were assumed to be resolved at battalion level.

(3) FAM data on potential incidents of interference simply identify the fact that an aircraft flight and a FAM projectile occupied the same large block of airspace during a 1-minute period. The probability that a projectile actually strikes an aircraft is extremely remote. One method of computing these probabilities shows that the probability of a projectile striking an Air Force flight in a close air support box is approximately one in 500 million. The probability that a projectile strikes an Air Force flight traversing an area at 550 knots, is approximately two in 10 million.

c. AF-AVN incidents resulted from the failure to play a coordinating altitude between the Army and the Air Force. Joint doctrine states that a coordinating altitude is required, but it does not state what specific altitude will be used.

d. Each Air Force and Army delay resulted from a system failure. Each of these failures was analyzed as described in a(1) and (2), above. Delay data identified problem areas even though a particular system failure did not produce a potential incident of interference. An example of this is late ADA alerts. Late ADA alerts could not produce incidents because of the assumption discussed in a(3) above.

e. Field artillery delays did not result from a system failure. These delays are best thought of as a trade-off between the burden and/or the loss of opportunity involved in rescheduling or cancelling of artillery fires and the added safety provided to aircraft operating in the airspace. The burden involved in rescheduling or cancelling artillery fires is relatively easy to estimate; however, the acceptable degree of risk to friendly aircraft cannot be subjected to quantitative analysis as there is no consensus as to what is an acceptable degree of risk.

f. The analysis of potential incidents of interference for experiment runs 4 and 10 served as a baseline for the attack and defense scenarios. These runs identified the types of incidents which did not present a significant problem regardless of whether or not an airspace control system was used. They also confirmed that some types of incidents persisted while others were significantly reduced.

Para 5-4, Analysis (cont)

g. Results of preliminary analysis of all airspace control system played during the CPX experiment gave rise to seven fundamental issues which impact heavily on established doctrine, tactics, and techniques as well as on modifications to current command, control, and communication systems.

(1) Listed below are the seven fundamental issues:

(a) Issue 1 is the examination of the ADA identification [illegible] was used during the war game and experiment.

(b) Issue 2 is the possible requirement for an ADA alert net to advise selected ADA firing units of the passage of friendly aircraft.

(c) Issue 3 is the [illegible] a more stringent weapons control [illegible] divisional ADA weapons.

(d) Issue 4 is the possible requirement to establish a procedure reschedule artillery fires which are not used in immediate support of maneuver forces.

(e) Issue 5 is the possible requirement to establish an airspace control element at brigade level.

(f) Issue 6 is the possible requirement for a division net [illegible] net with an Air Force aircraft control center or unit.

(g) Issue 7 is the possible requirement to establish additional communication nets within the division. The additional nets would include the division airspace net, the fire support warning net, the ADA alert net, and the brigade air-to-ground net.

(2) The extended scope and impact of these seven fundamental issues led to a general officer airspace control working conference. The conference was held to resolve these issues.

(3) The understandings reached with respect to the seven fundamental issues presented to the airspace control conference are listed in Annex C, Airspace Control Conference Memorandum for Record.

5-5. Findings.

a. General. The first seven findings are appropriate for all eight runs of the CPX. Other findings are grouped by the run during which they were produced.

Para 5-5, Findings (cont)

(1) Successful transmission of air defense alerts concerning flights ranged from a low of 43 percent to a high of 94 percent. For Army flights ranged from a low of zero to a high of [illegible] percent. Figure F-14, CPX Air Defense Alerts Transmitted on Friendly Air Mis[illegible] gives details concerning each run.

(2) One AF-AVN potential incident of interference in run 3 involved an Army fixed-wing aircraft (OV-1) and occurred at 4,000 feet. All other AF-AVN incidents involved Army rotary-wing aircraft and occurred at or below an altitude of 500 feet. Figure 5-1 gives specific data of AF-AVN incidents.

(3) Brigades did not laterally coordinate close air support [illegible]. Some of the close air support missions extended over an adjacent brigade or division lateral boundary.

(4) Air defense crossover occurred during all runs of the [illegible]. Figure F-12, CPX Potential Incidents of Interference, [illegible] numbers of crossover for each run.

(5) No potential incidents of [illegible] occurred [illegible].

(6) Enemy air force and ADA activities were not considered [illegible] assignment of MRR's.

(7) Players were adequately trained for [illegible] airspace control procedures used during each run.

b. Run 1.

(1) There were potential incidents of interference involving FW, FAM, and ADA. The number of each type incident is shown in [illegible].

(2) Requests for minimum risk routes for Air Force aircraft were sent from the CPP to the DACE and BACE an average of 13.. minutes [illegible] the time the aircraft reached the division rear boundary.

(3) Approved minimum risk routes for Air Force aircraft were sent from the BACE to the CPP an average of 6.7 minutes prior to the [illegible] the aircraft reached the division rear boundary.

(4) Thirty-five Air Force flights experienced delays in the [illegible] of MRR's.

(5) Twenty of the 35 Air Force flights which experienced delays requested the minimum risk routes less than 2 minutes prior to the time the aircraft reached the division rear boundary.

Para 5-5, Findings (cont)

(6) Two hundred and ninety FAM missions were fired during this run. The BACE was required to post and update information concerning all of these missions. This involved an average of 37 FAM missions per hour at each BACE. The BACE was unable to maintain current information on all of these missions.

(7) Five of the AF-FAM incidents involved artillery being fired on non-troop-support missions.

(8) Three of the AF-FAM incidents occurred when Air Force aircraft were in a close air support box.

(9) Two of the Air Force flights involved in AF-FAM incidents were following approved minimum risk routes. None of the Army flights involved in AVN-FAM incidents were following an approved minimum risk route.

(10) Problems were experienced in coordinating the [illegible] because of confusion between Army and Air Force communicators. The confusion dealt with terminology such as "inbound" and "outbound".

(11) The level of training of the players controlling the [illegible] of delays and incidents, but players were adequately trained to [illegible] evaluation of the airspace control procedures that were used [illegible].

(12) The BACE was unable to maintain timely information on [illegible] aircraft.

(13) The representative [illegible] for coordination with the [illegible] to state level was unable to perform [illegible] airspace coordination function.

(14) Army and Air Force [illegible] were [illegible] available.

(15) The BACE did not have an Army air-to-ground communication [illegible]

[illegible]

(17) There were potential [illegible] of interference between AVN, FAM and AFA. Figure 5- [illegible] the number of each type of [illegible]

(2) Requests for minimum risk routes for Air Force aircraft were [illegible] as soon as the Air Force approved the mission. Approved minimum risk routes were passed to the aircraft at an average of [illegible] before the aircraft reached the division rear boundary. The BACE [illegible]

Para 5-5, Findings (cont)

an internal validation of each minimum [illegible]
5 minutes before the aircraft reached [illegible]
call was made if the minimum risk route remained valid [illegible]
no longer valid, the BACE gave another minimum risk [illegible]
via the CRP. This validation procedure was used for the remainder of
the CPX.

(3) Ten Air Force fl[illegible]
minimum risk routes. Six of these [illegible]
timespan. This timespan was the [illegible]
During the peak hour of act[illegible]
19 aviation missions in progress.

(4) Two hundred and [illegible]
run ? Personnel in the [illegible]
each mission. This [illegible]
each BACE.

(5) Twenty-two inci[illegible]
support artillery.

(6) Nineteen of the AF-AA [illegible]
[illegible] were in a close air sup[illegible]

[illegible] two of the Air Force fl[illegible]
to follow approved minimum risk [illegible] Army
AVN-AM incident was not follow[illegible]

[illegible] AVN-AM incident
[illegible] made through the CAFF [illegible]
AVN-AM crossover incident

[illegible]

[illegible]

[illegible] form with aircraft [illegible] crews

[illegible]

[illegible] did not have a[illegible]

[illegible] were 69 Army aviation [illegible] Fe[illegible]
[illegible] communications between [illegible]

Para 4-5, Findings (cont)

aircraft on the brigade's command radio net. The radio net for the overloaded during two different 1 hour segments when there were 21 missions flown.

d. Run 3.

Para 5-5, Findings (cont)

(3) Four hundred and seventy FAM missions were fired during run 4. There was no attempt to post and update data concerning each mission.

(4) There were 32 incidents involving Air Force aircraft and non-troop-support artillery.

(5) Thirty-one of the AF-FAM incidents occurred while the Air Force aircraft were in a close air support box.

(6) One Air Force aircraft was involved in an AF-FAM incident while it was following an approved minimum risk route.

(7) The DACE was unable to handle all of the communications and internal coordination involved with airspace control.

f. Run 5.

(1) There were potential incidents of interference involving AF, AVN, FAM, and ADA. Figure 5-1 gives the number of each type of incident.

(2) Thirteen Air Force and four Army aviation flights experienced delays in the receipt of approved minimum risk routes. Seven of the Air Force flights which were delayed were interdiction missions that were returning through the division zone. The Army received notice of these flights an average of 2 minutes prior to arrival of the aircraft.

(3) Four hundred and fifty-five FAM missions were fired during run 5. There was no attempt to post and update data concerning each mission.

(4) There were 20 incidents involving Air Force aircraft and non-troop-support artillery.

(5) Twenty of the AF-FAM incidents occurred while the Air Force aircraft were in a close air support box.

(6) One Air Force aircraft was involved in an AF-FAM incident while it was following an approved minimum risk route.

(7) The DACE was unable to handle all of the communications involved with airspace control.

g. Run 6.

(1) There were potential incidents of interference involving Air Force, Army aviation, FAM, and ADA. Figure 5-1 gives the number of each type of incident.

Para 5-5, Findings (cont)

(2) Nine Air Force and 16 Army aviation flights experienced delays in the receipt of approved minimum risk routes.

(3) Two hundred and fifty-eight FAM missions were fired during run 6. The brigade FSE plotted scheduled harassment and interdiction fires and cleared all non-troop-support missions fired into the [illegible] zone by general support and general support reinforcing artillery units.

(4) There were five incidents involving Air Force aircraft and non-troop-support artillery.

(5) Five of the AF-FAM incidents occurred while the Air Force aircraft were in a close air support box.

(6) None of the Air Force or Army aircraft which were following approved minimum risk routes were involved in FAM incidents.

(7) Twenty-one non-troop-support FAM missions were delayed in order to improve minimum risk routes for Army and Air Force aircraft. This was the first run in which the concept of delaying FAM missions was used.

(8) Twenty-nine Army aviation flights were initiated during the 2-hour test period. All Army aircraft required airspace coordination. All of these aircraft were vulnerable to ADA incidents. Ten flights incurred delays in receipt of approved minimum risk routes. Communications with these flights caused a heavy traffic load on the brigade air-to-ground radio net.

b. Run 7.

(1) There were potential incidents of interference involving AVN, FAM, and ADA. Figure 5-1 gives the number of each type incident.

(2) Four Air Force and nine Army aviation flights experienced delays in the receipt of approved minimum risk routes.

(3) Four hundred and thirty-eight FAM missions were fired during run 7. The brigade FSE plotted scheduled harassment and interdiction fires and cleared all non-troop-support missions fired into the [illegible] zone by general support and general support reinforcing artillery units.

(4) There were eight incidents involving Air Force aircraft and non-troop-support artillery.

(5) Five of the AF-FAM incidents occurred while the Air Force aircraft were in a close air support box.

Para 5-5, Findings (cont)

(6) Three of the Air Force aircraft which were following approved MRR's were involved in FAM incidents.

(7) Ten non-troop-support FAM missions were delayed in order to improve minimum risk routes for Army and Air Force aircraft.

I. Run 8.

(1) There were potential incidents of interference involving AF, AVN, FAM, and ADA. Figure 5-1 gives the number of each type.

(2) Three Air Force and six Army aircraft experienced delays in the receipt of approved minimum risk routes.

(3) Four hundred and two FAM missions were fired during run 8. One man in the BACE plotted all field artillery location and firing information. The workload overloaded the system.

(4) There were nine incidents involving Air Force aircraft and non-troop-support artillery.

(5) Eight of the AF-FAM incidents occurred while the Air Force aircraft were in a close air support box.

(6) One of the Air Force aircraft which was following an approved MRR was involved in a FAM incident.

(7) The concept of delaying FAM missions was not used during this run.

J. Runs 9 and 10.

(1) There was no significant change in the number of FAM-AF potential incidents of interference.

(2) The number of FAM-AVN potential incidents of interference remained very small.

(3) ADA-AF incidents of interference increased significantly.

(4) There was no significant change in the number of ADA-AVN potential incidents of interference.

(5) The number of AF-AVN potential incidents of interference remained small. As in runs 1 through 8, all AF-AVN incidents involved low-level AF flights or Army fixed-wing flights at approximately 6,000 feet.

Para 5-5, Findings (cont)

Spt arm or service	Number of incidents by type		
	AVN	FAM	AUA
	Run 1		
AF	16	6	10
AVN	-	3	23
	Run 2		
AF	1	22	27
AVN	-	-	3
	Run 3		
AF	4	6	12
AVN	-	1	7
	Run 4		
AF	4	33	9
AVN	-	-	17
	Run 5		
AF	2	21	10
AVN	-	-	6
	Run 6		
AF	5	7	5
AVN	-	4	19
	Run 7		
AF	6	12	13
AVN	-	1	46
	Run 8		
	1	9	13
	-	4	5

Figure 5-1. Potential Incidents of Interference

Section II. CONCLUSIONS

5-6. General. Analysis of the findings led to the conclusions shown below. The first 13 conclusions are appropriate for the overall airspace control system and are not unique for a particular run of the CPX experiment. Other conclusions are grouped by the run from which they were produced.

5-7. Conclusions. These conclusions represent the conclusions of the entire program to date and include the results of the general officer conference.

a. There is no requirement for the Army to prescribe headings and altitudes or other restrictions on Air Force aircraft flying over the battle area. In other words, there is no requirement for the Army to regulate Air Force air traffic.

b. An airspace control system is required for coordination of use of airspace over a division. This system is needed to [illegible] and hazards to Air Force and Army aircraft. Additional personnel and equipment are required to implement the system.

c. To reduce confusion in coordination of airspace activities, Army and Air Force personnel require similar training in techniques and terminology. A common Air Force and Army plotting system is required.

d. Utilization of a minimum risk route reduces the hazard for Air Force aircraft transiting the division area.

e. Results of the CPX dealing with forward area air defense artillery weapons employment indicated a potential hazard to Army and Air Force aircraft because of misidentification and engagement by Chaparral, Vulcan, and Redeye weapons crews. The hazard is alleviated when the likelihood of misidentification and engagement is reduced. Possible methods of achieving this are:

(1) Alerting air defense artillery units concerning flights of friendly aircraft. This would require radio nets between Army units and Air Force air traffic control facilities. Information from this net would be used as input to an Army air defense alert net.

(2) Placing more stringent controls and rules of engagement on forward area air defense artillery weapons. This would decrease the hazard to friendly aircraft and would cause some degradation in effectiveness against enemy aircraft. Currently, the normal weapons control status is weapons tight. Weapons hold is a more stringent weapons control status.

Para 5-7, Conclusions (cont)

(3) A combination of the above; i.e., alert Chaparral and Vulcan crews to Air Force aircraft and large Army aircraft flights, and, at the same time, place the Redeye on a weapons hold weapons control status.

f. Air force aircraft flying through areas of intense field artillery and mortar firing encountered numerous potential incidents of interference with projectiles. The number of potential incidents was significantly reduced when the aircraft flew on a recommended minimum risk route. Minimum risk routes were planned through areas of little or no field artillery and mortar activity. To permit proper determination of recommended routes, the artillery fire support officer at brigade headquarters requires information concerning all field artillery activities within and over the brigade area.

g. Friendly aircraft flying near unit boundaries are subjected to misidentification and engagement by friendly air defense artillery units located in an adjacent brigade or division area. A method of reducing these crossovers is to alert all air defense artillery firing units that are within range of a friendly aircraft's flight path, even if the firing units are located in an adjacent unit's area.

h. Routine coordination minimized the problem of interference between Air Force and Army aircraft. Less coordination is required when Army aircraft use nap-of-the-earth flying techniques.

i. Air Force aircraft flying at altitudes above 10,000 feet were able to transit division areas with only remote possibilities of incidents of interference from friendly weapons systems. This occurred because of infrequency of trajectories reaching that altitude from field artillery, mortar, and divisional air defense weapons.

j. Interferences between Army aircraft and field artillery and mortars will be minimized by aircraft flying nap-of-the-earth and not overflying artillery positions. The only danger zones from artillery for low flying aircraft are at the initial point (gun position) and the terminal point (target). Normal communications with ground commanders will minimize hazards from the terminal section of the artillery flight.

k. Conclusions derived from run I are:

(1) The Air Force liaison team requires augmentation or assistance in order to perform airspace coordination functions.

(2) No procedures existed which reduced or precluded incidents between Air Force aircraft and non-troop-support artillery fires.

Para 5-7, Conclusions (cont)

l. Conclusions derived from run 2 are:

(1) ADA crossovers were not a significant problem in this run because most flight paths were down the center of a brigade's sector.

(2) The BACE was unable to effectively process all airspace coordination data during peak periods of activity.

(3) The Air Force air liaison team requires augmentation or assistance in order to perform airspace coordination functions.

(4) No procedures existed which reduced or precluded incidents between Air Force aircraft and non-troop-support artillery fires.

(5) The brigade command radio net is not a proper radio net for coordinating airspace control activities involving Army aircraft. The levels of combat activity require the greatest amount of time on the net for command communications. This same time period is the peak level for Army aviation activities.

m. Conclusions derived from run 3 are:

(1) The DACE requires augmentation or assistance in order to perform the system's airspace coordination tasks.

(2) The brigade S3 air requires augmentation or assistance in order to perform the system's airspace coordination tasks.

(3) No procedures existed which reduced or precluded incidents between Air Force aircraft and non-troop-support artillery fires.

(4) Information collected on the quantitative measures used to indicate system effectiveness is not as meaningful as that collected in other runs; however, enough data were collected for valid evaluation of the airspace control procedures used during this run.

n. Conclusions derived form run 4 are:

(1) The DACE requires augmentation or assistance in order to perform the system's airspace coordination tasks.

(2) No procedures existed which reduced or precluded incidents between Air Force aircraft and non-troop-support artillery fires.

o. Conclusions derived from run 5 are:

Para 5-7, Conclusions (cont)

(1) The DACE requires augmentation or assistance in order to perform the system's airspace coordination tasks.

(2) No procedures existed which reduced or precluded incidents between Air Force aricraft and non-troop-support artillery fires.

n. Conclusions derived from run 6 are:

(1) Delaying non-troop-support FAM missions is a workable method of reducing AF-FAM incidents.

(2) Obtaining minimum risk routes for *all* Army aviation flights will overload the brigade command and control and the operations radio nets during peak periods of usage of Army aviation.

(3) Because of the short duriation and random nature of Army aircraft flights, leadtime for ADA notification is required if an ADA alert is to be broadcast before the flight has been completed.

q. Conclusions derived from run 7 are:

(1) Delaying non-troop-support FAM mission is a workable method of reducing AF-FAM incidents.

(2) Special coordiantion procedures are required during airmobile operations to pass ADA alert information for both Air Force and Army aircraft.

r. The only conclusion derived from run 8 of the CPX deals with the absence of a CRP terminal at the brigade. The inability to monitor Air Force transmissions over the CPR net contributed to tardiness in the notification of brigades concerning Air Force aircraft which would transit the brigade area. The tardiness lead to aircraft flying without alerts to the ADA units.

s. Conclusions derived from runs 9 and 10 are:

(1) Non-troop-support artillery fires continue to be the major problem contributing to FAM-AF potential incidents of interference.

(2) FAM-AVN conflicts are not a significant problem.

(3) Alerting ADA firing units to the passage of friendly flights significantly reduced ADA-AF potential incidents of interference.

Para 5-7, Conclusions (cont)

(4) A coordinating altitude facilitates airspace control and would reduce AF-AVN potential incidents of interference

Section III. RECOMMENDATIONS

5-8. General. Evaluation of the conclusions led to the recommendations shown below. They represent the recommendations of the entire program to date and include the results of the general officer conference.

5-9. Recommendations. The Army system for airspace control as outlined below be validated in future Army joint field exercises.

(a) Establish a radio net to link an appropriate Air Force air traffic control facility with an Army division. This net will consist of one frequency with terminals at division and brigade headquarters as well as at the Air Force air traffic control facility. This net will require Air Force liaison parties to assist in airspace control functions at division level and at brigade level.

(b) Establish an Army air defense alert radio net from division and brigade headquarters to CHAPARRAL and Vulcan fire units. The net will be used to alert air defense units of flights of friendly aircraft. Net control stations will be located in the headquarters of each committed division and brigade. The divisions and brigades will alert the air defense units located inside their respective tactical zones. Personnel and radios to operate the system should be furnished by the CHAPARRAL-Vulcan battalion. Personnel would include liaison parties to assist in airspace control functions at division level and at brigade level and to operate the alert net control stations at these locations.

(c) Commanders use a weapons hold weapons control status for the Hawkeye as normal operating procedure.

(d) Establish a division airspace control radio net for the coordination of airspace control activities. Stations for the net should be located in each brigade headquarters, the division headquarters, and the flight coordination center. The station in the flight coordination center will provide timely information concerning Army aviation flights. This information will insure timely air defense alerts at each brigade and at the division headquarters. This net will always have activity in a division; consequently, the radios and personnel to operate the net should be added to the division TOE's.

(e) Establish an Army aviation air-to-ground radio net at each brigade when the level of aviation activity justifies the net. This net will be used for the coordination of Army aviation activities within a brigade. The net already exists in some units which have a high aircraft density. In other units, when the level of aircraft traffic within or through a brigade area is significantly high, the personnel and equipment to operate an air-to-ground net should be provided to the brigade. The personnel should include an Army aviation liaison officer provided by the supporting aviation unit or organization to assist in airspace control activities.

(f) Provide liaison parties from field artillery, Army aviation, Air Force, and air defense artillery to assist the G3 and S3 in the performance of airspace control functions. Current doctrine does not provide a liaison officer from the air defense artillery.

(g) Review Army Airspace Control Doctrine, FA 44-10, as shown in annex G.

(h) Review that portion of The Army Air-Ground Operations System, FM 100-26, as pertains to airspace control, as shown in annex H.

ANNEX A

TEST DIRECTIVE

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT
WASHINGTON, D.C. 20310

19 JUN 1972

DAFD-DCD

SUBJECT: Program of Evaluation (POE) Army Airspace Control

Commanding General
U.S. Army Combat Developments Command
ATTN: CDCRE-S
Fort Belvoir, Virginia 22060

1. Reference letter, CDCRE-S, Hq, USACDC, 15 June 1972, subject as above.

2. Your Program of Evaluation is approved. The following item should be added to the Resume Sheet, MASSTER Testing under Purpose:

"4. What organization changes are required?"

3. Request that Department of the Army Staff representative, DAFD-DC, be invited to each USACDC/MASSTER command review as an observer.

4. Recommend that USACDC and MASSTER consider the possibility of compressing the next phase at each command review.

5. Final report will be forwarded to Hq, DA for approval NLT 15 June 1973.

FOR THE ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT:

Kenneth E. Dohleman

KENNETH E. DOHLEMAN
[illegible]
Army [illegible]
Evaluation & Command Systems

CF:
CG, MASSTER,
Ft Hood, Texas

DEPARTMENT OF THE ARMY
HEADQUARTERS
UNITED STATES ARMY COMBAT DEVELOPMENTS COMMAND
FORT BELVOIR, VIRGINIA 22060

CDCRE-S

14 JUN 1972

SUBJECT: Program of Evaluation (POE) Army Airspace Control

HQDA (DAFD-DCD)
WASH D C 20310

1. Reference message, DAFD-DCD, HQ DA, 171414Z May 72, subject as above.

2. In accordance with paragraph 3, above referenced message, the Recommended Concept Plan of Evaluation is attached.

FOR THE COMMANDER:

C. A. BARTOSAVAGE
Major, AGC
Asst AG

1 Incl
as

CF:
CG, CONARC
CG, AMC
CG, ASA
CG, CSC
CG, MASSTER

PROGRAM OF EVALUATION, ARMY AIRSPACE CONTROL

[illegible]: The purpose of this program is to evaluate Army doctrine, [illegible], and organization, for controlling airspace within tactical [illegible] operations and recommend an Army airspace control system, and [illegible] materiel needed to implement the system.

[illegible]: The program of evaluation will:

[illegible] the existing Army doctrine, organization, materiel, and [illegible] for airspace control.

[illegible] Define the extent of airspace usage in the mid-intensity environ-

[illegible] Determine if existing doctrine and procedures satisfy the [illegible]ents of airspace control.

[illegible] Identify existing deficiencies/voids and develop a proposed [illegible].

[illegible] Evaluate and refine airspace control doctrine, organization, [illegible]dures through controlled experimentation, and identify materiel [illegible]ent.

[illegible] Provide recommendations for identified changes in the Army [illegible] control system.

[illegible]IVES:

[illegible]JECTIVE 1: To examine available airspace control doctrine, [illegible]ation, materiel, and procedures as a basis for developing a proposed [illegible]rspace control system for experimentation.

OBJECTIVE 2: To propose airspace control doctrine, organization, procedures for experimentation and identify supporting materiel.

OBJECTIVE 3: To evaluate and refine the test doctrine, organization, procedures for application in battalion, brigade, division, and time [illegible]ting, corps.

OBJECTIVE 4: To recommend an Army airspace control system for [illegible]tion by Army field evaluation.

[illegible]NING GUIDANCE:

The following documents will be used as points of departure for [illegible]ment of the evaluation:

( ) FM 44-10 (To Be)

( ) FM 1-60

( ) FM 44-1

( ) FM 6-20-2

( ) FM 100-26

( ) FM 101-5

( ) TC 44-10-2

(U) Functional Area Description: Airspace Coordination for the Tactical Operation System.

The evaluation will focus on a mid-intensity conflict situation in a European environment.

The evaluation will consider all airspace users (friendly and enemy) in the battalion, brigade, division, and time permitting, the corps area of operation.

The time frame for the evaluation will be from the present through

The examination will concentrate on manual procedures with consideration for possible future automation.

The primary method of examination will be a system simulation supported and modified CPX.

Determination of the scope and recommendations for field evaluations will be contained in the final report.

Selected expertise available within the Army Center Teams and Agencies will be employed to the maximum extent possible.

CDC/MASSTER Command Reviews will be conducted in lieu of coordination and staffing of intermediate reports.

(U) SCENARIO: The scenario contained in "Evaluation of TRICAP Concepts and Organization (TRICO)," (U), 15 December 1971 (ACN 18968), as applied to the armored division will be used as the basis for developing the airspace control scenario. The scenario will depict both defensive and offensive situations that represent the greatest activity by airspace users.

6. METHODOLOGY: The methodology attached at Inclosure 1 outlines the program of evaluation (POE) for conducting a workshop study and series of experiments in order to determine the Army's recommended airspace control system. The POE is divided into five phases: Phase I is the MASSTER/CDC workshop phase and Phase II through Phase V are battalion through corps validation experiments/CPX.

a. Phase I (Workshop): The first phase will consist of three concurrent activities. These activities are background review research, materiel review research, and an environmental workshop.

(1) Background Review: Literature will be assembled from JCS, Army, and other Service documents in order to review, catalog, and analyze current doctrine, organization, and procedures for airspace control. The background review will result in a cataloguing of reference material and identification of required and viable airspace control concepts.

(2) Materiel Review: Information and data will be assembled on the capabilities of existing and proposed airspace control supporting equipment to insure that appropriate procedures for its employment are included in the program of evaluation.

(3) Environmental Workshop: A CDC/MASSTER workshop will be conducted to evaluate the airspace user conflicts in a mid-intensity European environment. The purpose of this workshop will be to develop a scenario for the validation experiments, provide a data base for future analysis and provide a documented system for experimentation.

(4) Analysis: Continuing analysis based on background and materiel reviews and the environmental workshop output will result in an airspace control problem definition and a recommended system for airspace control experimentation.

b. Phases II - V (Validating Experiments): When the problem has been defined and a recommended system developed, a series of validating experiments will be conducted to test the proposed system using the scenario developed in Phase I. Each phase will require approximately eight weeks to design and conduct the experiment, analyze the results, and refine the system. At brigade and higher levels, the refinements incorporated into the system at the end of preceding phases will be evaluated to confirm the validity of the changes. The experiments will be conducted jointly by USACDC and HQ, MASSTER, using current equipment and active duty personnel as players and controllers. Experimental phases will be:

(1) Phase II - Battalion level.

(2) Phase III - Brigade level.

(3) Phase IV - Division level.

(4) Phase V - Corps level.

c. Command Reviews (CR): CDC/MASSTER will conduct scheduled reviews of the airspace control experiment after each phase of the program of evaluation to expedite intra-command coordination and approval. The purpose of these reviews will be to resolve quickly any problems that develop and keep all interested agencies appraised of the progress of the evaluation. A CR can be convened by either CDC or MASSTER at any time that a significant problem or situation arises.

7. RESOURCE REQUIREMENTS:

a. During the problem definition (Phase I), recommended system development phase of the Army airspace control experiment, highly qualified personnel from the CDC community and Army Center Teams will be required for the purpose of providing the expertise to assist MASSTER in developing the necessary procedures for airspace control. These personnel should represent airspace users, i.e., Infantry, Field Artillery, Armor (Attack Helicopter), Air Defense, and Army Aviation.

b. During the airspace control experimentation (Phases II through V) of the program, personnel listed in 7a will be required to monitor and evaluate the recommended system.

c. During Phases II through V, player personnel will be required to represent the airspace users and man airspace control/coordination elements at battalion, brigade, division, and corps levels.

d. Representation by tactical air control systems personnel is needed during the experiment to conduct a total evaluation of airspace user requirements and the development of those procedures necessary for airspace control.

e. The actual number of personnel required during the experimentation is to be determined. The approximate number required by phase is as follows:

(1) Phase I - 75

(2) Phase II - 105

(3) Phase III - 200

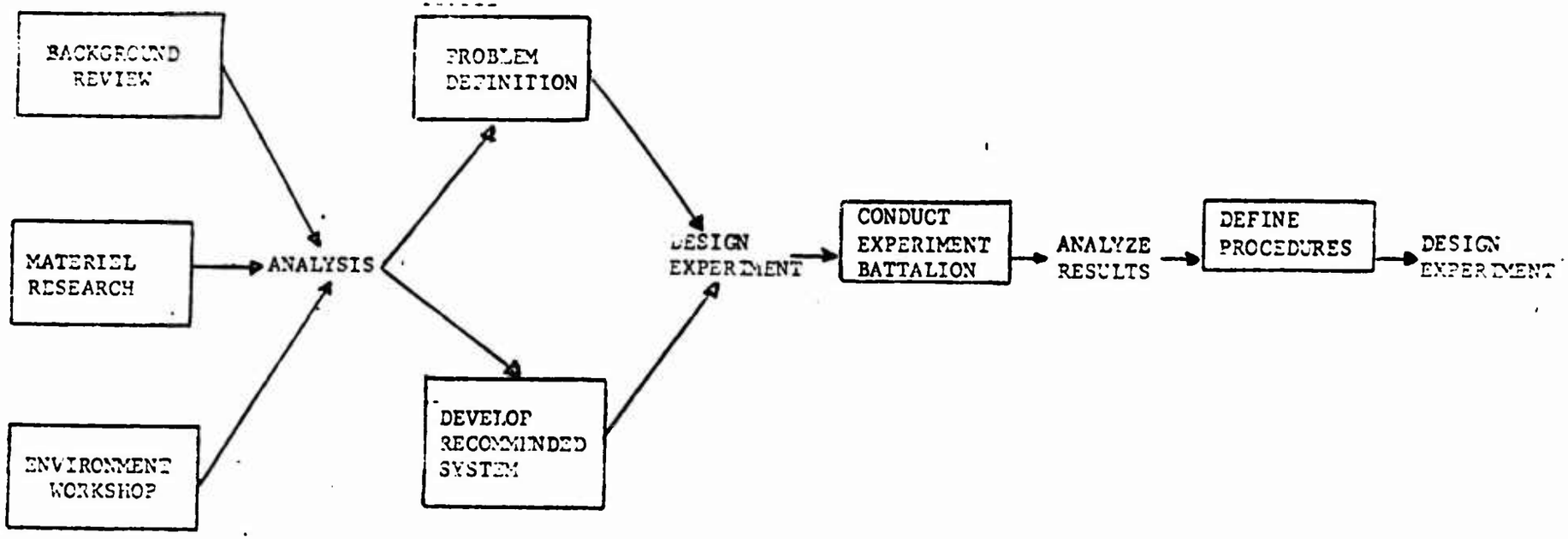
(4) Phase IV - 275

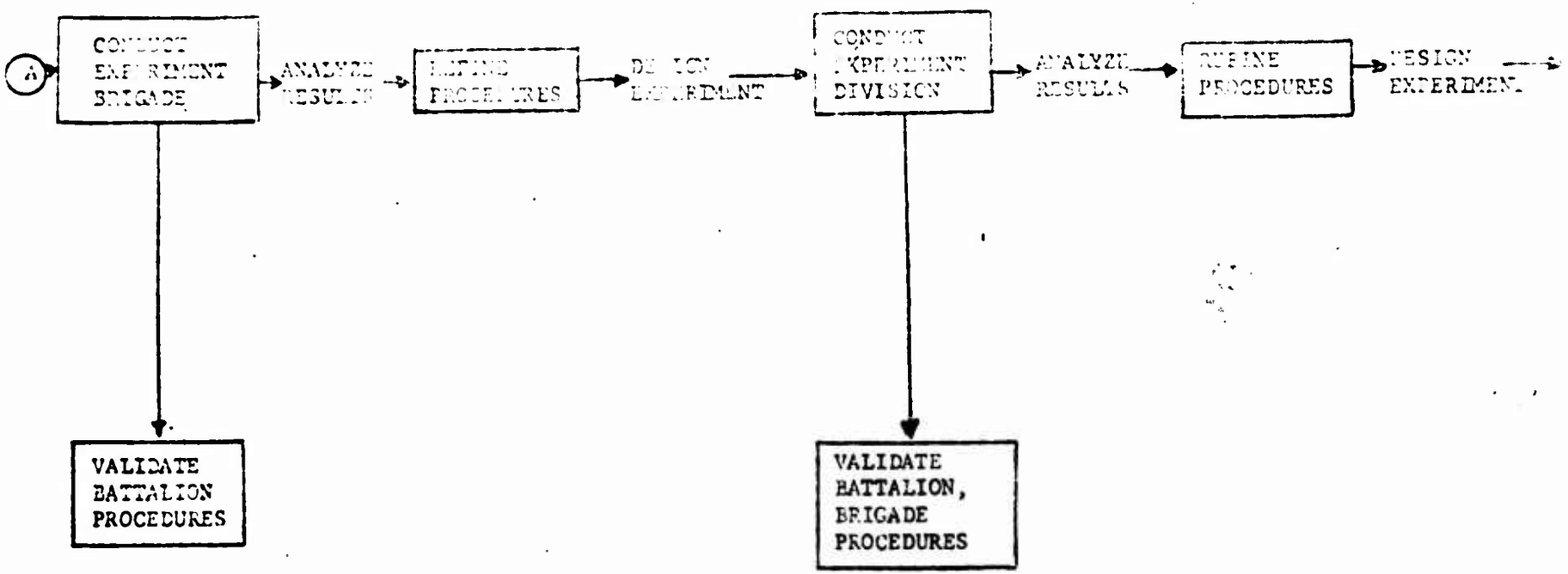
(5) Phase V - 300

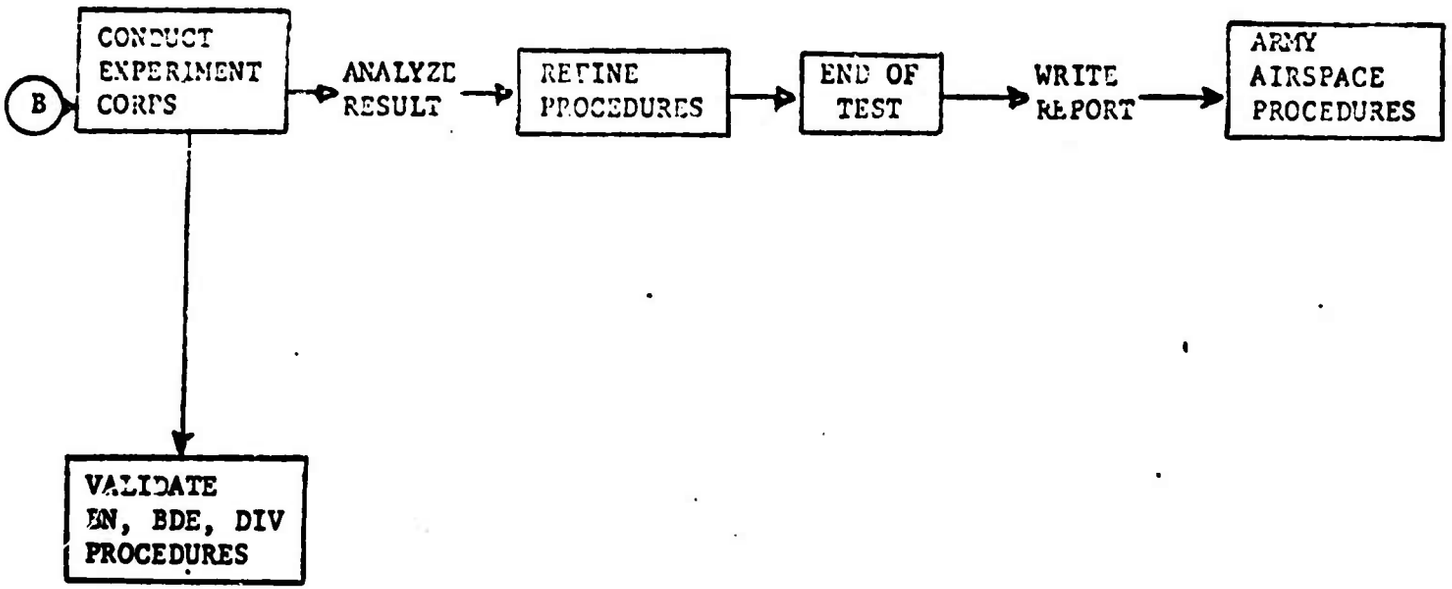
[illegible] (Tentative)

PHASE	EVENT/ACTIVITY	DATE	DURATION
I	Detailed Planning		3 Weeks
	IPR	7 Jul 72	
	Workshop Design		3 Weeks
	Workshop		2 Weeks
	Analysis		3 Weeks
	CR	1 Sep 72	
II	Bn Exp Design		3 Weeks
	Bn Level Exp		2 Weeks
	Analysis		3 Weeks
	CR	27 Oct 72	
III	Bde Exp Design		3 Weeks
	Bde Level Exp		2 Weeks
	Analysis		3 Weeks
	CR	21 Dec 72	
IV	Div Exp Design		3 Weeks
	Div Level Exp		2 Weeks
	Analysis		3 Weeks
	CR (Int Ppt)	12 Mar 73	
V	Corps Exp Design		3 Weeks
	Corps Level Exp		2 Weeks
	Analysis		3 Weeks
	CR (Final Ppt)	27 Apr 73	

METHODOLOGY




A
CONDUCT EXPERIMENT BRIGADE
ANALYZE RESULTS
REFINE PROCEDURES
DESIGN EXPERIMENT
CONDUCT EXPERIMENT DIVISION
ANALYZE RESULTS
REFINE PROCEDURES
DESIGN EXPERIMENT
VALIDATE BATTALION PROCEDURES
VALIDATE BATTALION, BRIGADE PROCEDURES


B
CONDUCT EXPERIMENT CORPS
ANALYZE RESULT
REFINE PROCEDURES
END OF TEST
WRITE REPORT
ARMY AIRSPACE PROCEDURES
VALIDATE BN, BDE, DIV PROCEDURES

ANNEX B

DEFINITIONS

B-1. Active Aircraft (AFM 11-1). An aircraft currently and actively engaged in supporting the flying missions, either through direct assignment to operational units or in the preparation for such assignment or reassignment through any of the logistic processes of supply, maintenance, and modification.

B-2. Adequate (MASSTER). An airspace system is adequate when it is effective. For the definition of effectiveness see paragraph B-57.

B-3. Airborne Operation (AR 310-25). An operation involving the air movement into an objective area, of combat forces and their logistics support for execution of a tactical or a strategic mission. The means employed may be any combination of airborne units, air transportable units, and types of transport aircraft, depending on the mission and the overall situation.

B-4. Air Controller (AFM 11-1). An individual especially trained for and assigned the duty of the control (by use of radio, radar, or other means) of such aircraft as may be allotted to him for operation within his area.

B-5. Air Corridors (JCS PUB 2). Restricted air routes of travel specified for use by friendly aircraft and established for the purpose of preventing friendly aircraft from being fired on by friendly forces.

B-6. Air Defense Action Area (AR 310-25). An area and the airspace above it within which friendly aircraft or surface to air weapons are normally given precedence in operations except under specified conditions.

B-7. Air Defense Artillery Misidentification Rate (MASSTER). The probability that a friendly aircraft is identified as a hostile aircraft and engaged by a friendly air defense artillery unit.

B-8. Air Defense Battle Zone (AR 310-25). A volume of airspace surrounding an air defense fire unit or defended area, extending to a specified altitude and range, in which the fire unit commander will engage and destroy targets not identified as friendly under criteria established by higher headquarters.

B-9. Air Defense Liaison Officer (SOP, 82d Airborne Div). An ADA battalion staff officer whose primary function is to locate at the nearest AADCP, or Air Force facility with a radar capability, and relay

timely aircraft early warning (EW) and Air Defense intelligence information directly to the division's air defense elements.

B-10. Air Force Delay (MASSTER). A delay in providing an MRR to Air Force aircraft. A delay occurred if the MRR was not provided to the aircraft before it entered the division airspace. During the CPX, no flights were actually interrupted because of a failure to provide an MRR. Because of the required reaction time, the provision of an MRR at the minute the aircraft reached the division airspace was not considered adequate; this was a delay. All aircraft which had MRR's furnished after the aircraft entered the division airspace and aircraft which were not furnished an MRR were considered to have experienced a delay.

B-11. Airspace Control (USACDC). The coordination, integration, and regulation of the use of airspace of defined dimensions.

B-12. Airspace Control Area (TACM 2-1). Controlled airspace which is laterally defined by the boundaries of a joint force area of operations.

B-13. Airspace Control Authority (FM 1-60) (A) (TACM 2-1). Airspace control authority is appointed by the joint force commander and after coordination with other component commanders will promulgate broad policies to govern airspace coordination in the combat zone.

B-14. Airspace Control Center (TACM 2-1). The agency designed by the area airspace control authority with responsibility for coordinating, integrating, and regulating the requirements for the use of airspace in an area of operations in accordance with directives, operating procedures, operations plans/orders, and fragmentary orders.

B-15. Airspace Control Element (ACE) (FM 101-5). An element of the TOC which coordinates the use of airspace, provides information on aviation status and recommends allocation of Army aviation resources, coordinates Army air defense operations, coordinates Army air traffic, and provides intelligence through air defense channels. The ACE serves as the commander's focal point for airspace coordination for all airspace users.

B-16. Airspace Control Facility (TACM 2-1). Any of the several service-component control facilities which may be involved in control of airspace in the control area.

B-17. Airspace Control Line (TACM 2-1). The perimeter of a segment of airspace which delineates its lateral boundaries.

B-18. Airspace Control Objective (MASSTER). Provision to the maneuver commander of timely support necessary for him to accomplish his mission.

B-19. Airspace Control Problem (MASSTER). Accomplishment of the airspace control objective while minimizing interference among supporting arms and services who utilize the airspace.

B-20. Airspace Control Sector (TACM 2-1). A sector of the airspace control area, designated by the area airspace control authority.

B-21. Airspace Control System (TACM 2-1). A system operated by the Area Airspace Control Authority and consisting of the combined airspace control facilities and responsibilities of all Service Components in a joint force.

B-22. Airspace Coordination (SOP, 82d Airborne Div). A specialized service to assist the commander in coordinating all airspace use over the division Area of Operations (AO). The service is designed to minimize mission conflict, to promote safety among all airspace users, and to increase mission effectiveness.

B-23. Airspace Management (SOP, 82d Airborne Div). The function of controlling all joint airspace activities above a designated coordinating altitude. Airspace management authority is normally the responsibility of the Air Force component commander and extends through all levels of the Air Traffic Regulation System.

B-24. Airspace Reservation (AFM 11-1). The airspace located above an area on the surface of the land or water, designated and set apart by Executive Order of the President, or by a state, commonwealth, or territory, over which the flight of aircraft is prohibited or restricted for the purpose of national defense or for other governmental purposes.

B-25. Airspace Users (MASSTER). Those arms and branches of service that require use of airspace to accomplish their mission.

B-26. Air Traffic Control (Doctrine and Procedures for Airspace Control in the Combat Area, March 1971). The separation of known air traffic by reference to electronic presentation or to flight plan data and position reports, or to visual observation and instructions of the commander, or his representative employing the aircraft for the purpose of promoting safe, orderly, and expeditious movement of aircraft in an airspace control area and to assist in identification for air defense.

B-27. Air Traffic Control Line (ATCL) (AFM 11-1). An arbitrary line established forward of the forward edge of the battle area along prominent terrain features identifiable to both air and ground. This line serves two major tactical purposes:

a. It enhances freedom of movement of aircraft operating in the vicinity of the FEBA; and

b. It provides air defense with a demarcation line to facilitate identification of aircraft penetrating the FEBA.

B-28. Air Traffic Control Service (AR 310-25). A service provided for the purpose of: 1. Preventing collisions: (a) between aircraft, and (b) on the maneuvering area between aircraft and obstructions. 2. Expediting and maintaining an orderly flow of air traffic.

B-29. Air Traffic Identification (TACM 2-1). The use of electronic devices, operational procedures, visual observation and/or flight plan correlation for the purpose of recognizing friendly aircraft in flight.

B-30. Air Traffic Regulation (AFM 11-1). The employment of all means to promote the safe, orderly, and expeditious flow of air traffic. It incorporates active supervision of aircraft in flight by radar and radio, as well as supervision by directive. Its sole purpose is to provide inflight assistance and avert collisions or other unsafe conditions in the affected airspace. It does not exercise operational control.

B-31. Air Traffic Regulation Center (AFM 11-1). Is normally the primary agency through which all traffic is regulated within a combat area. It is incorporated within the control and reporting center when radar capabilities are required.

B-32. Area Airspace Control Authority (TACM 2-1). An officer designated by the joint force commander as coordinating authority for airspace control service in the airspace control area. See paragraph B-13, Airspace Control Authority.

B-33. Army Air Defense Command Post (AADCP) (AR 310-25). The tactical headquarters of the Army air defense commander.

B-34. Army Airspace Control System (MASSTER). The facilities, equipment, communications, personnel, and procedures essential to a commander for planning, coordinating, integrating, and regulating the operations of assigned and supporting forces that must use the airspace to assist him in accomplishing his mission.

B-35. Army Aviation Delays (MASSTER). A delay in providing recommended routing to Army multiple aircraft, command and control, and/or medical evacuation flights. A delay occurred if the routing was not provided to the aircraft before it began its flight. If the routing was received the same minute that the flight was begun, it was considered adequate and no delay was assessed.

B-36. Army Element (SOP, 82d Airborne Div). Army personnel, representing the ARFOR commander in joint operations, located at the nearest Air Force facility (FACP, CRP, or CRC), who relay flight hazards to the Air Force.

B-37. Assistant Division Air Defense Officer (ADADO) (SOP, 82d Airborne Div). Special staff officer and the ADA battalion commander's representative at division level. This officer is also the chief of the Division Airspace Control Element (DACE).

B-38. Battalion Area (MASSTER). That portion of the combat zone for which a battalion is given responsibility, and which is described by rear and lateral boundaries prescribed by the next higher headquarters (normally a brigade), and an imaginary line beyond the FEBA to the range of dedicated supporting fires.

B-39. Block Altitudes (Doctrine and Procedures for Airspace Control in the Combat Area, March, 1971). Levels above mean sea level which delineate the vertical boundaries of a segment of airspace.

B-40. Brigade Airspace Control Element (BACE) (SOP, 82d Airborne Div). The element within the brigade CP tasked to receive and plot activities of the brigade's airspace users and coordinate the use of airspace in order to avoid conflicts. The BACE is an extension of the DACE.

B-41. Brigade Antiair Package (BAP) (SOP, 82d Airborne Div). The antiair package provided each brigade by the division's organic air defense battalion. This package normally consists of the BACE, a 12 gun, 20 mm Vulcan battery, and 15 Redeye teams.

B-42. Brigade Area (MASSTER). That portion of the combat zone for which a brigade is given responsibility, and which is described by rear and lateral boundaries prescribed by the next higher headquarters (normally a division), and an imaginary line beyond the FEBA to the range of dedicated supporting fires.

B-43. Brigade Rear (MASSTER). That portion of the brigade area which is behind the battalion rear boundaries.

B-44. Combat Area (JCS PUB 1 and AR 310-25). A restricted area (air, land or sea) which is established to prevent or minimize mutual interference between friendly forces engaged in combat operations.

B-45. Component (MASSTER). A part of a whole, as, for example, the grouping within a joint force of the forces of a particular service under the command of an officer of that service.

B-46. Component Commander (Doctrine and Procedures for Airspace Control in the Combat Area, March 1971). The officer designated to command the forces of his service which are assigned to a joint force.

B-47. Control (AR 310-25). Authority which may be less than full command exercised by a commander over part of the activities of subordinate or other organizations.

B-48. Control and Reporting Center (CRC) (AR 310-25). An element of the United States Air Force tactical air control system, subordinate to the Tactical Air Control Center, from which radar control and warning operations are conducted within its area of responsibility.

B-49. Control and Reporting Post (CRP) (AR 310-25). An element of the United States Air Force tactical air control system, subordinate to the Control and Reporting Center, which provides radar control and surveillance within its area of responsibility.

B-50. Controlled Airspace (AR 310-25) Airspace of defined dimensions within which air traffic control service is provided.

B-51. Coordinating Authority (AR 310-25). The authority granted to a commander or individual assigned responsibility for coordinating specific functions or activities involving forces of two or more countries, two or more Services, or two or more forces of the same Service. He has the authority to require consultation between the agencies involved or their representatives but does not have the authority to compel agreement. In case of disagreement between the agencies involved, he should attempt to obtain essential agreement by discussion. In the event that he is unable to obtain essential agreement, he shall refer the matter to the appropriate authority.

B-52. Coordination (USACDC). The process of securing unity of effort in the development of courses of action involving the use of airspace.

B-53. Crossover (MASSTER). A potential incident of interference which occurs when a manned airspace user occupying airspace over a maneuver unit conflicts with one or more airspace users in the adjacent maneuver unit.

B-54. Designated Airspace (Doctrine and Procedures for Airspace Control in the Combat Area, March, 1971. A segment of airspace with laterally and vertically defined limits within which special airspace control procedures are applied by the airspace control facility to which assigned.

B-55. Direct Air Support Center (DASC) (MASSTER). USAF facility designed to operate with a CTOC or an independent DTOC. The DASC provides

a fast-reaction capability to satisfy immediate requests from Army forces for tactical air support.

B-56. Division Airspace Control Element (DACE) (FM 101-5). See paragraph B-15.

B-57. Effectiveness of Airspace System (MASSTER). An airspace system is effective when the elements utilizing airspace provide the commander with sufficient support to allow him to accomplish his mission.

B-58. Efficiency of Airspace System (MASSTER). An airspace system is efficient when an alternative requiring less time, communications, or personnel cannot be devised.

B-59. Estimated Probability of Interference (MASSTER). The ratio of the number of potential incidents above an area to the number of simultaneous missions above that area.

B-60. Field Artillery and Mortar (FAM) Delays (MASSTER). A change in the time of firing FAM missions to accommodate the flight of aircraft. This change could have been early or late firing or cancellation of the mission.

B-61. Flight Coordination Center (FCC) (AR 310-25). A subagency of the flight operations center normally operating in the forward area of the field army, to extend traffic regulation and communication capabilities.

B-62. Flight Operations Center (AR 310-25). The element of the tactical Army air traffic regulation system which provides for aircraft flight following, separation of aircraft under instrument conditions and identification of friendly aircraft to friendly air defense agencies.

B-63. Forward Air Control Posts (FACP) (AR 310-25). A highly mobile United States Air Force tactical air control system radar facility subordinate to the control and reporting center and/or post used to extend radar coverage and control in the forward combat area.

B-64. Integration (USACDC). The process of consolidating requirements for use of airspace in the interest of achieving a common objective at the lowest possible level of effort.

B-65. Interference (MASSTER). The hindrance to operations, to include safety hazards and coordinating delays, resulting when two or more airspace users must use the same airspace at the same time to accomplish their missions.

B-66. Joint Airspace Control Center (Doctrine and Procedures for Airspace Control In the Combat Area, March 1971). See paragraph B-14.

B-67. Joint Force (JCS PUB 1 and AR 310-25). A general term applied to a force which is composed of significant elements of the Army, the Navy or the Marine Corps, and the Air Force, or two or more of these services, operating under a single commander authorized to exercise unified command or operational control over such joint forces.

B-68. Level of Airspace Utilization (MASSTER). The density of ground and aerial weapons systems and aircraft within the commander's tactical sector of responsibility.

B-69. Mid-High Intensity Air Environment (FM 44-10 (Test)). An air environment featuring substantial use of friendly aviation, field artillery, and air defense artillery in the face of enemy aviation, air defense artillery, field artillery, radar surveillance, and electronic countermeasurrers. (This environment has not been experienced by US forces since isolated occurrences during World War II, but must be the environment in which the airspace coordination service is designed to function.) The air environment impacts on doctrine, factors, and materiel.

B-70. Minimum Risk Route (MRR) (MASSTER). A route recommended to Air Force and Army aircraft to minimize the probability of the aircraft being involved in a potential incident of interference. In the report this term is synonymous with the term "recommended route."

B-71. Mission Pair Combinations (MASSTER). Two different airspace users' missions over a maneuver unit which overlap in time.

B-72. Monitoring Service (TACM 2-1). The general surveillance of known air traffic movement by reference to radar scope presentation or other means for the purpose of passing advisory information concerning conflicting traffic or providing navigational assistance. Direct supervision or control are not exercised, nor is positive separation provided.

B-73. Non-Troop-Support Artillery (MASSTER). Artillery fired at targets other than in support of troops in contact.

B-74. Positive Control (JCS PUB 1 and AR 310-25). The operation of air traffic in a radar/non-radar ground control environment in which positive identification, tracking, and direction of aircraft within an airspace is conducted by an agency having the authority and responsibility therein.

B-75. Potential Incident of Interference (MASSTER). Any potential hindrance to operations resulting when two or more airspace users, of which at least one is manned, use the same airspace at the same time in order to accomplish their mission.

B-76. Ratio of Potential Incidents To Mission Pair Combination (MASSTER). The fraction whose numerator is the number of potential incidents of interference by type airspace user and area and whose denominator is the number of mission pair combinations of the same type over that area.

B-77. Regulation (USACDC). The supervision of activities that use the airspace to provide for flight safety.

B-78. Restricted Area (JCS PUB 2). An area (land, sea, or air) in which there are special restrictive measures employed to prevent or minimize interference between friendly forces.

B-79. Sector Airspace Control Authority (TACM 2-1). An officer designated by the area airspace control authority as coordinating authority for airspace control service in an airspace control sector.

B-80. Simplified Volume of Airspace (MASSTER). A rectangular parallelepiped whose dimensions describe the length, width, and depth of airspace utilized over a specified time interval by a projectile or aircraft.

B-81. Simultaneous Missions (MASSTER). The occurrence of two or more simplified volumes of airspace above a unit's area during a specified time period.

B-82. Tactical Air Control Centers (AR 310-25). The principal air operations installation (land or ship based) from which all aircraft and air warning functions of tactical air operations are controlled.

B-83. Tactical Air Control Party (TACP) (AR 310-25). A subordinate operational component of a tactical air control system designed to provide air liaison to land forces and for the control of aircraft.

B-84. Tactical Air Control System (AFM 11-1). The organization and equipment necessary to plan, direct, and control tactical air operations and to coordinate air operations of other services. It is composed of control agencies and communications-electronics facilities which provide the means for centralized control and decentralized execution of missions.

B-85. Nap-of-the-Earth Flight (MASSTER). A flight as close to the earth's surface as vegetation or obstacles will permit, while generally following the contours of the earth.

B-86. Tactical Air Navigation (TACAN) (AFM 51-4). A navigation system which supplies slant range distances and bearings to aircraft.

B-87. Weapons Free (FM 44-1). An air defense weapons control status stipulating that air defense fire units fire at any aircraft not identified as friendly.

B-88. Weapons Hold (FM 44-1). An air defense weapons control status stipulating that air defense fire units do not fire (the right of self-defense is not denied in peace or war).

B-89. Weapons Tight (FM 44-1). An air defense weapons control status stipulating that air defense fire units fire only at aircraft positively identified as hostile in accordance with the hostile criteria.

ANNEX C

AIRSPACE CONTROL CONFERENCE MEMORANDUM FOR RECORD

ATMAS-A 7 February 1973

MEMORANDUM FOR RECORD

SUBJECT: Airspace Control Conference

1. References:

a. Msg, CDR CONARC, ATIT-RD-CP, 152137, Jan 73, subject: Airspace Control Seminar.

b. Msg, CDR CONARC, ATIT-RD-CD, 171825, Jan 73, subject: Airspace Control Seminar.

c. Ltr, CDR MASSTER, ATMAS-CG, 29 Jan 73, subject: Airspace Control Conference.

2. A general officers airspace control conference was held from 020800-021700 Feb 73 at Building 38M, Fort Hood, Texas. The purpose of the working conference was to discuss seven fundamental issues identified by the MASSTER Army airspace control war game and CPX-experiment with a view toward resolving these issues. The conference was chaired by LTG G. P. Seneff, Jr.

3. The following is a list of attendees:

FORT BENNING	BG Richardson
	LTC Jones
	CPT Sprague
	Mr. Himes
FORT BLISS	MG Shoemaker, Raymond
	COL Russo
	COL Small
	MAJ Lyles
	Mr. Fries
HQ CDC	BG Vaughn
CDC COMSGP	BG Gudgel
	COL Adkins
	LTC Seago

ATMAS-A
SUBJECT: Airspace Control Conference

CDC CONFORGP	BG Lynn COL Moore LTC Farmer
CONARC	COL Soler MAJ Nettles
FORT KNOX	MG Desobry LTC Anderson
FORT RUCKER	MG Burdett COL Gaddis MAJ McLeomore MAJ Warren
FORT SILL	MG Wetherill COL Caid COL Constance COL Nadeau COL Wildrich LTC Wingate MAJ Jemison CPT Gordon
FORT HOOD	LTG Seneff MG McChrystal MG Shoemaker, Robert BG Starker COL Harrison

4. This memorandum summarizes the understandings reached with respect to the seven fundamental issues presented. Comments by attendees on a draft of this memorandum are included as inclosure 1.

a. Issue #1, examination of the ADA misidentification rate used during the war game and experiment. It was agreed that the misidentification rate used was a reasonable estimate of what can be expected in an average Army unit and permitted a valid identification of airspace control problems relating to ADA misidentification.

b. Issue #2, the possible requirement for an ADA alert net to advise selected ADA firing units of the passage of friendly aircraft. It was agreed that an ADA alert net is desirable down to Chaparral-Vulcan firing

units. It was also agreed that further investigation is needed into the method of operating this net and into the feasibility of using organic Chaparral-Vulcan communications for this net. A majority of the conferees agreed that this ADA alert net should not include Redeye firing units and that Redeye firing units should be controlled through existing organic command nets. A minority still saw a requirement to include Redeye firing units in the ADA alert net.

c. Issue #3, the use of a more stringent weapons control status for divisional ADA weapons. It was agreed that:

(1) No change is needed in the definition of ADA weapons control status.

(2) No change is necessary on the normal division ADA weapons control status for Chaparral-Vulcan fire units with respect to fixed wing high performance aircraft; however, it may be necessary to write out what might be a more normal situation concerning rotary wing aircraft for all weapons systems and the normal weapons control status on Redeye.

(3) The division commander is obligated to spell out detailed criteria for the employment and use of ADA for a given tactical situation.

d. Issue #4, the possible requirement to establish a procedure to reschedule artillery fires not in immediate support of maneuver forces. It was agreed that rescheduling of this type of artillery fires is currently provided for through the use of restrictive fire planning procedures. The brigade fire support officer presently has incomplete data on some fires not in immediate support of the maneuver forces. The Field Artillery Center, Fort Sill, will develop procedures as how to best make this information available at the brigade level, which may require adjustments to present radio nets, tactical air request forms, field manuals, and SOP's.

e. Issue #5, the possible requirement to establish an airspace control element at brigade level. It was agreed that:

(1) The control of airspace at the brigade level is an integral function of normal staff procedures to be performed by the operations officer assisted by combat support staff officers, commanders and liaison officers assigned in support of the brigade.

(2) No separate staff organization is necessary to perform the airspace control function at the brigade level. (Also see paragraph 5d below.)

(3) The brigade operations center should include liaision officers from field artillery, air defense artillery, Army aviation, and Air Force when this type support is being provided the brigade.

(4) That the ADA alert net terminus be located in the brigade operations center. Additional personnel may be required for 24-hour a day operation of this net.

f. Issue #6, the possible requirement for a divisional communications net with an Air Force aircraft control center/post. It was agreed that:

(1) There appears to be a requirement that a radio net be established to link an Air Force control facility and an Army division. A majority of the conferees agreed that this will be one frequency with terminals at the division headquarters and each brigade as well as at the Air Force control facility. The communications between the division headquarters and the Air Force control facility will be monitored by the brigades to facilitate the speedy transmission of on-the-way instruction to the ADA alert net. A minority felt that there may not be a requirement for brigades to monitor this net. (Also see paragraph 6, Incl 1.)

(2) It would be appropriate for the Air Force to provide the equipment and personnel to operate this net. The objective of this net is to reduce risks for Air Force aircraft which transit the airspace over a division and facilitate Air Force control of Air Force aircraft.

g. Issue #7, the possible requirement to establish additional communication nets within the division, to include the division airspace net, the fire support warning net, the ADA alert net, and the brigade air-to-ground net. A composite of required airspace control communications nets is depicted graphically at inclosure 2. It was agreed that:

(1) A Division Airspace Net is required between division headquarters and the brigades for the purpose of passing airspace control information.

(2) The Fire Support Warning Net may not be required. Current procedures, with some minor modifications, provide adequate capabilities for coordination of field artillery firings. The Field Artillery Center is determining the modifications which must be made to provide the brigade fire support officer information concerning all artillery and heavy mortar fire which transits the airspace over the brigade.

(3) An ADA Alert Net is required. Discussion concerning this net is included in paragraph 4b above.

(4) There is a requirement for an Army Aviation Air-Ground-Net in the brigade area. Some units such as the airmobile division and the TRICAP division already have equipment and personnel for this net. The type division and Army aviation units expected to be in support of the division would largely dictate what special provisions would have to be made to establish this net.

5. General.

a. Training is required for Army aviation use of identification friend or foe (IFF) equipment. The training should cover as a minimum the following areas:

(1) Training of pilots in the operation of IFF equipment.

(2) Operational use of IFF equipment during training exercises.

(3) Inclusion of IFF information in communication electronics operating instructions (CEOIs).

b. Consideration should be given to the use of the air defense artillery alert net for additional tasks such as nuclear strike warnings and enemy aircraft flight alerts.

c. All Army elements should receive air defense training. Emphasis should be in the area of aircraft recognition.

d. It was suggested that the airspace control function at brigade level might be handled as a part of an integrated Combat Support Element as proposed by DASSTER in the TEST 113 report, IBICS: Staff Organization and Procedures Test Report. The Combat Support Section (CSS) is shown at inclosure 3.

e. Consideration should be given to further CPX-experiments/war games to validate the airspace control system with the following modifications:

(1) Place the lower terminals of the ADA alert net at the Redeye Sections instead of at the Redeye Teams. Each section would use its internal communications to retransmit alerts to the individual teams.

(2) Place the lower terminals of the ADA alert net at the Chaparral-Vulcan battalion. The Redeye would not receive ADA alerts.

(3) Organization of the brigade operations center with the personnel

outlined in paragraph 4e above as part of an integrated combat support section performing airspace control functions as well as their normal liaison functions on a 24 hour a day basis.

(4) Vary the ADA alert status and/or rules of engagement. Modifications should be made both by type weapons system and by geographical location of the weapons.

f. Briefings should be given to various Air Force units concerning the probability of Air Force and field artillery and mortar (FA-M) conflicts.

3 Incl
as

JOSEPH B. STARKER
Brigadier General, USA
Chief of Staff

ATMAS-A

SUBJECT: Comments, Airspace Control Conference Memorandum for Record

1. Reference, ltr, CDR MASSTER, ATMAS-A, 7 February 1973, subject: Memorandum for Record, Airspace Control Conference.

2. The letter referenced in paragraph 1, above, asked that attendees of the Army Airspace Control Conference held at Fort Hood, Texas on 22 February 1973, comment on the draft memorandum for record of the conference.

3. The following verbatim comments were received from the U.S. Army Continental Army Command, Fort Monroe, Virginia:

a. Review of draft MFR has been completed. This HQ agrees with summarization of comments presented.

b. Comments, concurrence and/or nonconcurrences will be provided after CONARC review of finalized MFR.

4. The following verbatim comments were received from the U.S. Army Combat Developments Command, Combat Systems Group, Fort Leavenworth, Kansas:

a. The memorandum was reviewed as requested. With exception of the comment in paragraph 2, the memorandum accurately summarizes the understandings reached at the conference.

b. The point mentioned near the close of the conference by BG Vaughn that the evaluation continue is not included in the memorandum. This headquarters considers it essential to examine the system which is to be recommended to Department of the Army as the Army Airspace Control System.

5. The following verbatim comments were received from the U.S. Army Field Artillery School, Fort Sill, Oklahoma:

a. The Field Artillery Center has reviewed the understandings reached during the 2 February Army Airspace Control Conference and concurs with paragraph 4d and paragraph 4a(2).

b. The Field Artillery Center is reviewing current procedures used by the Brigade Fire Support Officer to determine the best method to

attain the objectives agreed upon. Adjustments may be required to the present radio nets, tactical air request forms, field manuals, and SOP's.

6. The following verbatim comments were received from the U.S. Army Aviation School, Fort Rucker, Alabama:

a. Concur with summary of issues 1-5 as stated.

b. The USAAVNS position as pertains to issues 5-7 is maintained as stated below:

(1) Existing doctrine (FM 1-60) governing the Army's Air Traffic Control System provides for a communication link with the CRC/P and the FOC/FCC to better accomplish the air traffic control mission. This net was not played during the CPX experiment nor was its supporting potential considered in evaluating the BASE concept or in determing the need for a new divisional communications net with the Air Force CRC/P. The communication capabilities of the FOC/FCC system (i.e., FM, VHF, UHF, HF and teletype) should be thoroughly evaluated under field conditions to determine what extent expanded utilization of existing ATC personnel and equipment could contribute to airspace management. An important objective in such an evaluation would be to identify potential savings in personnel, radio frequencies and equipment redundancy under that of proposed solutions evolving from the airspace control experiment.

(2) The above comments are supported by operational experience gained by the USAAVNS Air Traffic Control Company (72d ATC) in numerous joint exercises conducted by the Readiness Command and the 18th Airborne Corps. These exercises have successfully demonstrated that the communications capabilities of the FOC/FCC can provide (in addition to flight following) alert and other airspace information to Air Force and Army Aircraft, as well as to other Airspace Control Agencies. This has been successfully accomplished by co-locating and interconnecting the FOC and CRC/P communications to insure timely acquisition and dissemination of essential airspace data to the FCC and Div TOC which are similarly located and linked communications wise.

(3) In order to provide a better baseline for decisions associated with airspace management. It is recommended that the FOC/FCC system be evaluated during the forthcoming GALLANT HAND Exercise to determine the extend of its capability to support the functions of airspace control.

7. The following verbatim comments were received from the U.S. Army Air Defense School, Fort Bliss, Texas:

a. Reference paragraph 4a. The absolute values presented during the airspace control conference are not considered a valid identification of airspace control problems relating to ADA in that there is a great deal of difference between the potential incidents identified by the computer and the shooting down of airplanes. This is primarily due to the computer's inability to play system limitations (i.e., rear aspect only for Chaparral and Redeye) plus the fact that attrition was not played. This allowed mistaken engagements and even multiple mistaken engagements which would not have occurred in real life. Additionally, it must be remembered that the mistaken engagement problems in an all arms problem rather than a pure Air Defense Artillery problem due to the fact that one of the weapon systems under discussion is an all arms weapon. Recommend that the memorandum for record be modified to indicate that the mistaken engagement rate is valid for identification and quantification of the problem only if system limitations, proper tactics and attrition are played.

b. Reference paragraph 4b. Further investigation of the ADA alert net without regard to other airspace control functions is seen as a refinement to a system which has not been validated. Further investigation should be made of the entire airspace control system so that some base reference may be established which, in turn, can be subjected to risk analysis to determine an acceptable risk level for aircraft. The accepted risk level must drive the determination of airspace control requirements and functions. Without determination of an acceptable risk level, testing of individual elements of a system is of necessity inconclusive and may lead to conclusions which are not supportable by logic or data.

c. Reference paragraph 4e. If any conclusions can be drawn from the CPX conducted in November 1972, one might be that the existing staff cannot absorb the airspace control function and still perform its present functions. A consensus of views expressed during the seminar indicate that a Tactical Support Center or Combat Support Center should be formed to accomplish the airspace control function. It was agreed that the name of such an entity was of no importance but that recognition of the need for a coordinating agency was very important. Further discussion indicated that the airspace control entity would not be a TOE organization but would be formed during combat and combat training situations to coordinate all combat efforts in the brigade under the staff supervision of the Brigade S3. Recommend that the memorandum for record be changed to reflect the agreement that a Tactical Support Center or Combat Support Center (name immaterial) be formed to accomplish the airspace control function.

d. Reference paragraph 4f(1). The requirement for a communications net between the CRC/CRP and the brigades in addition to the division headquarters has not been fully validated. This point was raised during subject seminar. In addition, the Division Airspace Net discussed in paragraph 4g(1) of subject document could be utilized for passage of on-the-way information. Recommend that memorandum for record be changed to reflect the need for further evaluation in this area.

e. Reference paragraph 5d. A rerun of the CPX experiment will be of doubtful value unless a complete airspace control system is tested. A base data reference was not established during the previous CPX in that no system tested yielded the desired results (i.e., no potential incidents of interference). A system can be validated only if it proves to produce acceptable results. At that point, refinements such as those mentioned in the referenced paragraph may be in order but not before.

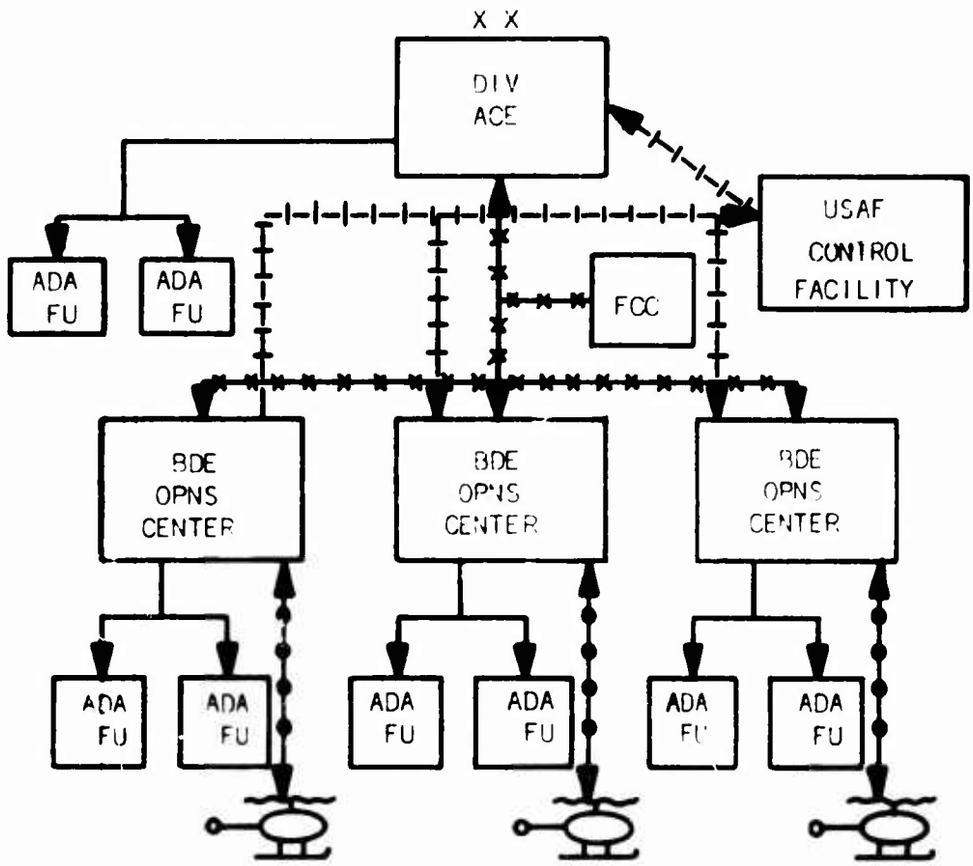
f. In summary, it is felt that further investigation of the entire airspace control system in the form of another workshop and/or CPX is required and that further refinement of the individual elements should be deferred until a system with an acceptable risk level is designed, evaluated, and validated.

8. The following verbatim comments were received from the U.S. Army Infantry School, Fort Benning, Georgia:

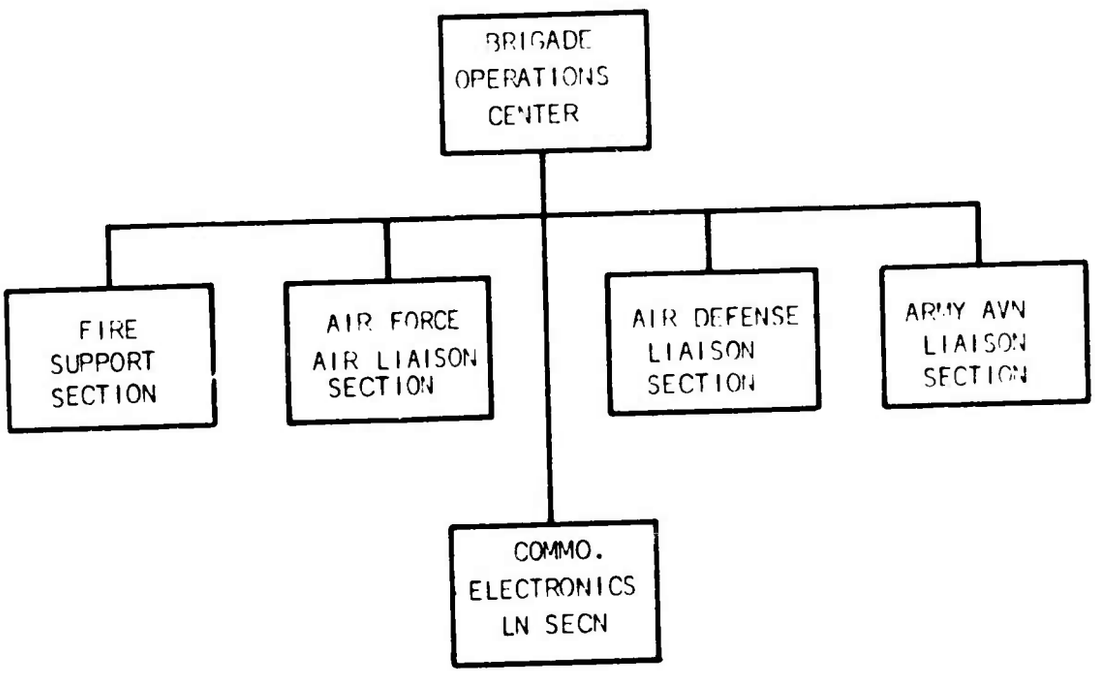
a. Concur with the summary of all issues except that part of (1) of issue #5 which states, "the control of airspace at the brigade level is to be performed by the operations officer . . ." The USAIS prefers the summary statement by Colonel Harrison that "control of airspace at the brigade level is a lesser function by the coordinators on the brigade commander's staff. Functions of airspace control are necessary but not a separate element in every organization and the magnitude changes with the organization." Rationale for this preference is that responsibility for airspace control among the brigade staff was an unresolved issue between the S3/S3 air and further investigation may reveal that this function can be delegated at the discretion of the brigade commander without adversely affecting mission accomplishment.

b. Recommend that paragraph 5e of the inclosure to the reference be rewritten to reflect that the subject briefings were suggested as a task for the Field Artillery School.

9. The following verbatim comment was received from the U.S. Army Armor Center, Fort Knox, Kentucky: "The draft memorandum for record of the Army Airspace Control Conference has been reviewed and found to accurately reflect that which transpired."



AIRSPACE CONTROL COMMUNICATIONS



COMBAT SUPPORT SECTION
IN A BRIGADE

ANNEX D

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ANNEX E

SYSTEM PROCEDURES, TACTICS, AND TECHNIQUES

E-1. Run 1.

a. System A, which was evaluated during run 1 on 6 November 1972, used Scenario 1, Delay. System A used a BACE as the brigade's primary agency for airspace control. The critical information passed between agencies is shown in figure E-1.

b. The tactics and techniques used by the player organization are shown below:

(1) The delay operation was conducted in accordance with FM 61-100, chapter 8, section IV. The division delayed in zone across a front 25 kilometers wide with two brigades abreast along successive positions. The reserve brigade was positioned in the center of the division zone. This facilitated its employment throughout the division. The divisional armored cavalry squadron protected the division's right flank. Its air cavalry troop screened the right brigade's front. The air cavalry troop was attached to the division and screened the left brigade's front.

(2) The field artillery fires which were available to the division included the division artillery assigned battalions and the following additional artillery: Seven 155-millimeter howitzer batteries, five 8-inch howitzer batteries, and four 175-millimeter gun batteries. The employment of these fires was characterized by mixed calibers in depth. Targets were engaged at long range and by increasing volumes of fire as they closed on the delay position. The priority of fires was to engaged forces of company size.

(3) The divisional ADA and Redeye weapons were employed to protect the brigade and division command posts, LOC's, and forward elements.

(4) Close air support strikes were employed against platoon-size mechanized and tank targets near the friendly forward elements and battalion-size and command facilities targets in the enemy rear. Twenty-eight percent (13 of 48) of the air missions over the division were close air support. The supporting aircraft used an aerial maneuver space 3 kilometers by 4 kilometers by 8,000 feet. These strikes were on station an average of 10 minutes. The aircraft penetrating the division airspace on interdiction, combat air patrol, and reconnaissance missions were flying between 0 and 500 feet.

Agency	Information	Originator	Receiver
BACE.	MRR.	MRR to CRP for AF flights. Gave corridors. The DACE monitored, concurred in the route over the division rear, or did not concur and changed the route.	AF flight information and request for MRR from CRP.
	Recommend route.	Recommend routes to DACE for Army aviation (multiple aircraft, medical evacuation, and C and C).	Army flight information from DACE. The 2d bde also received some flight information from the brigade S3.
	ADA alerting.	Friendly aircraft alerting to ADA in brigade area. Occasionally hostile flight information was also passed on this radio net.	
	FAM location.		FAM locations within the brigade area from FSO or unit FDC.
	FAM firing.		FAM firing within the brigade area from FDC via fire support warning net.
DACE.	Army flights.	Army flight information to BACE.	Army flight information from FCC.
	ADA alert.	Friendly aircraft warnings to ADA in division rear.	
	MRR.	Informed CRP of concurrence in minimum risk route or changed the minimum risk route.	

Figure E-1. Information Passed During Run 1

Agency	Information	Originator	Receiver
	FAM locations.		Division rear FAM location information from FSE or unit FDC via FSWN.
CRP.	USAF.	AF flight info and request for MRR's from BACE.	Flight information from pilot.
	MRR.	Passed routing to AF pilots.	
		Did not consider an MRR approved until both the DACE and BACE responded.	MRR's received from the DACE and the BACE.
		Did not give "on the way" to the BACE as required.	
FCC.		Request for recommended route for multiple aircraft, medical evaluation, and C and C flights.	
		Routing information to Army aviators.	FAM locations from DACE.
FA units.	Location.	Locations from FDC to BACE or DACE via FSO's or FSE on the unit command fire net.	
	Firing.	Notification of firing from FDC to BACE or DACE via FSWN.	
Mortars.	Location.	Location to battalion S3 or FSO.	
	Firing.	Notification of firing from FDC on FSWN.	

Figure E-1 (cont). Information Passed During Run 1

Agency	Information	Originator	Receiver
USAF pilots.	Flight information routing.	Flight information to CRP.	MRR from CRP.
US Army aviators.	Flight information routing.	Flight information to FCC (C and C, medical evacuation, and multiple aircraft flights).	MRR from FCC.

Figure E-I (cont). Information Passed During Run I

[illegible] (cont)

(4) Army aviation was used in command and control, observation, and [illegible] roles. Air and attack cavalry elements were missioned to the [illegible] the division front. No air or attack cavalry elements were [illegible] of operation.

[illegible]

[illegible] System A-1, which was evaluated on 7 November 197[illegible] [illegible] System A-1 used a BACE as the primary agency for [illegible] control. The changes made from the design of System [illegible] are shown [illegible].

[illegible] tactics and techniques used by the player organization are [illegible] below.

[illegible] defense was conducted in accordance with FM 61-100, [illegible] III, V, and VI. The division defended in zone [illegible] front [illegible] kilometers wide with two brigades on line in an [illegible]. The reserve brigade was positioned to the rear of the 3d brigade [illegible] brigade zone which was astride the major avenue [illegible] into the division. The divisional armored cavalry squadron [illegible] rear area security mission. Its air cavalry troop protected the [illegible] right flank.

[illegible] artillery fires available to the division included the [illegible] assigned battalions and the following additional [illegible] 155-millimeter howitzer batteries, five 8-inch howitzer [illegible], and four 175-millimeter gun batteries. The employment of [illegible] mixed caliber in depth. Priority of [illegible] brigade. Interdiction and counterbattery program [illegible].

[illegible] divisional ADA and Redeye weapons were employed to protect [illegible] and brigade CP, reserves, MSR, and defensive positions.

[illegible] air support strikes were employed against combined arms [illegible] near the friendly forward elements, assembly areas, and [illegible] in the enemy rear. Of the air missions over the division, [illegible] percent (27 of [illegible]) were close air support. The supporting aircraft [illegible] maneuver space 5 kilometers by 5 kilometers by 10,000 feet. The aircraft were on station an average of 10 minutes. The aircraft [illegible] the division air space on interdiction, combat air patrol, and reconnaissance missions were flying between 0 and 5,000 feet.

(4) Army aviation was used in command and control, observation, medical evacuation, and liaison roles.

Agency	Information	Originator	Receiver
US Army aviators.	Flight information.	Flight information was passed to appropriate brigade staff officer on the command net.	Staff officer notified MACE.
CRP.	Aircraft routes.	The CRP provided the location of the origin of a radial system (TACAN) to DACE and BACE. Positions on these radials were used in lieu of coordinates.	DACE and BACE plotted origin and radials on their maps.
	'On the way.'	CRP passed "on the way" information as required.	DACE and BACE received "on the way" notice.
DACE and BACE	Minimum risk route.	MRR's were passed to the CRP when determined. If they were over 5 minutes old, they were revalidated. Changes were made as appropriate.	
	Field artillery firings.	Pass from DACE to BACE via BACE/BACE hotline.	
BACE.	Displays.	Separate displays were used to post FAM, AF, and AVN mission information. Aviation information was limited to multiaircraft combat missions.	

Figure E-2. Information Passed During Run 2

Agency	Information	Originator	Receiver
2d brigade.	Specific displays	Used multicopy message forms for internal coordination. Used two maps (1:[illegible],000) for posting information. One map was for FAM, the other was for AF and Army aviation. Plotted only target area for AF flights with a directional arrow. Did *not* plot enroute portion of AF flights. "Eyeballed" MRR for enroute flights.	
3d brigade.	Specific displays.	Used single copy card for internal coordination. Used one board with white grid sheet backing (1:25,000) for posting information. Plotted enroute portion of USAF flight.	

Figure E-2 (cont). Information Passed During Run 2

E-3. Run 3.

a. System B which was evaluated on 8 November 1972, used Scenario 3, Counterattack. System B used existing elements in the current TOE, without S3 Army personnel augmentation, for control of airspace. TOE equipment was augmented with radios. The brigade S3 air was the primary agency for control of airspace. It appeared that the three personnel in the S3 air section worked only on airspace control. The basic philosophy of this system was to assign a minimum risk route based on general knowledge of the tactical situation rather than on detailed knowledge of the activities of FA", AF, and Army aviation elements. The critical information passed between agencies is shown in figure E-3.

(1) Changes that were made to system B are listed below:

(a) After 1645 hours the brigades no longer monitored the CRP net.

(b) At 1700 hours 3d brigade elements moved into a jump CP. The radio nets available in the jump CP included the brigade command net, direct support battalion CO-S3; DS Bn C&F FSO, NCO; Air Req Net ALO, NCO.

(c) Only one map was available in the jump CP.

(2) In the main brigade CP, operations and techniques used in system B were the same as those used in system A, with the exceptions noted below:

(a) In the 2d brigade the S3 air (one officer, one NCO, and one [illegible]) had no map and did not plot routes; the FSO had radial displays on the map for aircraft locations.

(b) In the 3d brigade the S3 air (one officer, one NCO, and one [illegible]) actually plotted routes on the displays, and they were located near the FSO.

(3) It appeared that the majority of the AF minimum risk routes were assigned along the division and brigade boundaries.

b. The tactics and techniques used by the player organization are shown below:

(1) The counterattack was conducted in accordance with FM 61-100, chapter 7, section III. The division counterattacked in zone across a front 11 kilometers wide with one brigade in order to reduce an assumed penetration and seize two battalion objectives. The reserve brigade was positioned 19 kilometers to the rear and was committed in the 2d brigade zone. The divisional armored cavalry squadron executed a rear area security mission. The air cavalry troop remained under squadron control.

Agency	Information	Originator	Receiver
DACE.	MRR.	Selects minimum risk route through division. MRR to CRP for AF missions.	AF flight information from CRP.
	Recommended route.	Army flight information to brigade S3 air on C and C, medical evacuation, and multiaircraft flights.	Army flight information from FCC.
	ADA alerts.	Friendly aircraft warnings to ADA in rear area.	
	FAM locations.		FAM locations from FSE.
	FAM firings.		FAM firing *is not* reported.
S3 air at brigade.	AF flight information.		AF flight information and request for MRR from DACE.
	AVN flight information.		Army flight information from DACE.
	MRR.	Recommends MRR for AF aircraft to DACE over DACE S3 air line.	
	Recommended route.	MRR Army aviation to DACE over DACE S3 air line (multiaircraft, medical evacuation, and C and C flights only). Routing of Army aircraft within brigade area over air-to-ground net.	
	ADA alerts.	Friendly aircraft warnings to ADA in brigade area.	
	FAM locations.		FAM locations from FSO's or unit FDC's.
	FAM firings.		FAM firing is not reported, but is available to FSO's on demand.

Figure E-3. Information Passed During Run 3

Agency	Information	Originator	Receiver
CRP.	AF flight information.	AF flight information and requests for MRR to DACE.	Flight information from pilots.
	MRR.	MRR to AF pilot.	MRR from DACE.
FCC.	Aviation flight information.	Army flight information and request for MRR (medical evacuation, C and C, and multiaircraft flights only).	Flight information from pilots.
	Recommended routes.	Advisory on hazards to pilots.	Recommended routes from DACE.
	FAM locations.		Artillery locations.
Field artillery.	Locations.	Locations from unit FDC to brigade FSO or Div FSE of force in whose area the unit is located.	
	Firings.	Pass firing information *only on demand* of FSO. This demand never occurred.	
Mortars.	Locations.	Location from battalion S3 to brigade S3 in brigade area.	
FSO/FSE.	FAM hazards.	FAM locations to S3 air or DACE. FSO assists S3 air in selection of MRR's.	FAM unit FDC provides information to FSO/FSE or through S3 channels to FSO.

Figure E-3 (cont). Information Passed During Run 3

Agency	Information	Originator	Receiver
AF pilots.	Flight information.	Flight information to CRP.	
	Minimum risk route.		MRR from CRP.
Army	Flight information.	Flight information to FCC.	
	Recommended routes.		Routing from FCC. Routing from brigade S3 air in brigade area.

Figure E-3 (cont). Information Passed During Run 3

Para E-3, Run 3 (cont)

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Seven 155-millimeter howitzer batteries, five 8-inch howitzer batteries, and four 175-millimeter gun batteries. The employment of these fires was characterized by positioning in depth. Medium artillery supported the counterattack from current or alternate positions. Heavy volumes of fire were used to isolate the penetration and to neutralize elements within the penetration. Priority of fires was to forces in contact until the counterattacking forces crossed the line-of-departure, at which time they had priority of fires.

(3) The divisional ADA Redeye weapons were employed to protect the division and brigade CP, the counterattacking forces, and the elements in control.

(4) Close air support strikes were employed against armor and mechanized elements in the penetration and reinforcements in the enemy rear. Of the air missions over the division, 33 percent (20 of 61 [illegible] close air support. The supporting aircraft used an aerial maneuver space 6 kilometers by 7 kilometers by 10,000 feet. These aircraft were on station an average of 15 minutes. The aircraft penetrating the division air space on interdiction, combat air patrol, and reconnaissance missions were flying 5,000 feet.

(5) Army aviation was used in command and control, liaison, and medical evaluation roles. No air or attack cavalry elements were given an area of operation.

E-4. Run 4.

a. System B-1, which was evaluated during run 4 on 13 November 19[illegible], used Scenario 2, Defense. B-1 involved only minor modifications from system B. The modifications involved changes in the physical layout of the working area for the S3 air at brigade. Except for the changes noted below, the procedures were the same as those used in system B.

(1) The brigade copied all information transmitted on the CRP net. When division asked for minimum risk routes, the brigade was ready.

(2) During the first 40 minutes, the brigades did not monitor the CRP net.

(3) At 1415 hours the 3d brigade elements moved into a jump CP. The radio nets and personnel available in the jump CP were:

(a) Bde cmd net: Co.

(b) DS bn C&F net: FSO, NCO.

(c) Air req net: ALO, NCO.

(4) The FSO had the only map which was available in the jump CP.

b. The tactics and techniques used by the player organization are shown below:

(1) The defense operation was conducted in accordance with FM 61-100, chapter 7, sections III, V, and VI. The division defended in zone across a front 24 kilometers wide with two brigades on line in an area defense. The reserve brigade was positioned to the rear of the 3d brigade for employment in that zone which was astride the major avenue of approach into the division. The divisional armored cavalry squadron had a rear area security mission. Its air cavalry troop was protecting the division's right flank.

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Seven 155-millimeter howitzer batteries, five 8-inch howitzer batteries, and four 175-millimeter gun batteries. The employment of these fires was characterized by mixed calibers in depth. Priority of fires was to the 2d brigade. Interdiction and counterbattery programs were active.

(3) Division ADA and Redeye weapons were employed to protect the division and brigade CP's, the reserve, the MSR, and the main defensive positions.

(4) Close air support strikes were employed against combined arms elements, near the friendly forward elements, assembly areas, and LOC's in the enemy rear area. Of the air missions over the division, 36 percent (21 of 58) were close air support. The supporting aircraft used an aerial maneuver space 7 kilometers by 7 kilometers by 10,000 feet. These strikes were on station an average of 10 minutes. The aircraft penetrating the division air space on interdiction, combat air patrol, and reconnaissance missions were flying 400 to 10,000 feet.

(5) Army aviation was used in command and control, medical evacuation, liaison, and observation roles. No air or attack cavalry elements were given an area of operation.

E-5. Run 5.

a. System B-2, which was evaluated during run 5 on 15 November 1972, used Scenario 4, Attack. B-2 used an augmented brigade S3 air section as the primary agency for control of airspace. The basic philosophy and operational procedures of system B-2 were the same as system B except for the areas noted below:

(1) The brigade S3 air sections had one officer, one NCO, and one RATELO. The sections plotted the routes of aircraft.

(2) The FSO at 2d brigade plotted close air support boxes.

(3) The layouts of the two brigades are shown in figures E-4 and E-5.

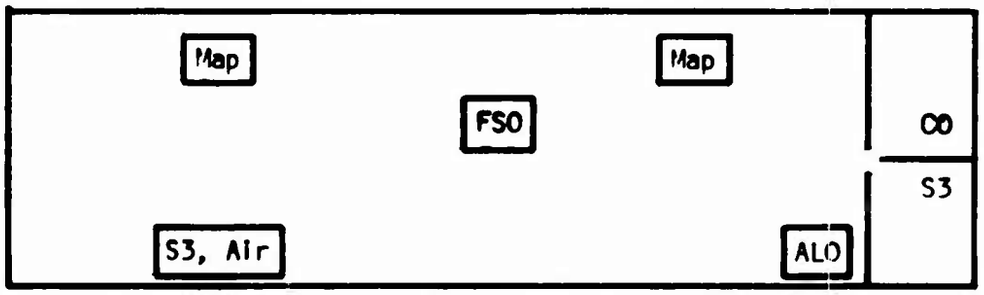


Figure E-4. Layout of 2d Brigade in Run 5

Figure E-5. Layout for 3d Brigade in Run 5

Para E-5, Run 5 (cont)

b. The tactics and techniques used by the player organization are shown below:

(1) The attack was conducted in accordance with FM 61-100, chapter 6, sections I, II, V, and VIII through XI. The division attacked in zone across a front 22 kilometers wide with two brigades abreast. The reserve brigade was positioned to the rear of the 2d brigade for employment in that zone. The divisional armored cavalry squadron protected the division's east flank. The air cavalry troop remained under squadron control.

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Three 155-millimeter howitzer battalions, one 8-inch howitzer battalion, and two 175-millimeter gun battalions. The employment of these fires was characterized by forward positioning and heavy volumes of fire. Priority of fires was to the 2d brigade. Preparation and counterbattery programs were active.

(3) The divisional ADA and Redeye weapons were employed to protect the CP, MSR, attacking forces, and fire support means. Each attacking brigade had a **Chaparral**-Vulcan battery in direct support.

(4) Close air support strikes were employed against fixed defensive positions, hard targets, and armored and mechanized elements near the friendly forward elements, and reserve forces were targeted in the enemy rear. Of the air missions over the division, 39 percent (20 of 53) were close air support. The supporting aircraft used an aerial maneuver space 8 kilometers by 8 kilometers by 10,000 feet. These aircraft were on station an average of 10 minutes. The aircraft penetrating the division air space on interdiction, combat air patrol, and reconnaissance missions were flying 500 to 10,000 feet.

(5) Army aviation was used in command and control, medical evacuation, observations, and liaison roles. Air and attack cavalry teams were missioned to brigade level.

E-6. Run 6.

a. System B-3, which was evaluated during run 6 on 16 November 1972, used Scenario 5, Exploitation. System B-3 used the procedures and organizations as in system B-2 except as noted below:

(1) The DACE constructed an 8 kilometer by 8 kilometer box with a 10,000 foot altitude around the target location for each Air Force close air support mission. The DACE posted the box along with times (entry and exit) on displays.

Para E-6, Run 6 (cont)

(2) The FSE could not recommend the use of any permissive fire support coordination measures such as NFL and FSCL. Because of (1) above, the FSE was forced to coordinate and schedule all FA fires into the division zone by corps artillery GS and GSR units and division artillery GS and GSR units firing non-troop-support type fires. The FSE observed the DACE display of close air support boxes (8 kilometers by 8 kilometers) and placed the box with date and time group on the FSE display. When the division artillery FDC or corps artillery FDC called the division FSE concerning an upcoming non-troop-support mission that conflicted with a box, the FSE advised the FDC of the following choices: Select another firing unit, accelerate firing, delay firing, or do not fire. The FSE plotted scheduled fires on displays and coordinated with the appropriate tactical FDC when conflicts with boxes were apparent. Initially, the FSE advised the DACE of scheduled non-troop-support fires but because of the workload was forced to stop.

(3) Field artillery units cleared all non-troop-support missions with the FSE prior to firing.

(4) S3 air.

(a) An additional RATELO was added in the 3d brigade. This gave the section a total of four people involved in airspace control.

(b) Only "on the way" information was monitored on the CRP net.

(5) Army aircraft. Beginning at 1400 hours, scenario time, *all* aircraft were required to call into the appropriate brigade S3 air. These calls initiated alerts to ADA units on all aircraft flights traversing their area.

b. The tactics and techniques used by the player organization are as shown below:

(1) The exploitation operation was conducted in accordance with FM 61-100, chapter 6, section VI. The division exploited in zone across a front 23 kilometers wide with two brigades abreast on six battalion axes. The reserve brigade was positioned to the rear of the right brigade for employment in that zone. The divisional armored cavalry squadron protected the right flank. The air cavalry troop remained under squadron control. An attack helicopter squadron was under operational control of the division and had a troop in direct support to each of the lead brigades and the squadron (-) under division control.

Para E-6, Run 6 (cont)

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Seven 155-millimeter howitzer batteries, five 8-inch howitzer batteries, and four 175-millimeter gun batteries. The employment of these fires was characterized by engagement of targets of opportunity. Fires were used to destroy enemy forces.

(3) The divisional ADA and Redeye weapons were employed to protect the advance elements, major command posts, and main supply routes.

(4) Close air support strikes were employed against pockets of resistance and reserves. Of the air missions over the division, 31 percent (16 of 51) were close air support. The supporting aircraft used an aerial maneuver space 8 kilometers by 3 kilometers by 10,000 feet. These strikes were on station an average of 12 minutes. The aircraft penetrating the division air space on interdiction, combat air patrol, and reconnaissance missions were flying at 500 to 9,000 feet.

(5) Army aviation was used in command and control, liaison, and medical evacuation roles. Air and attack cavalry elements were missioned to brigade level.

E-7. Run 7.

a. System B-4, which was evaluated during run 7 on 17 November 1972, used Scenario 6, Airmobile Operation. System B-4 used the procedures and organization used in B-3 except as noted below. For the first 2 hours, there were less than perfect flying conditions (3,000 feet and 5 miles). The 2d brigade reported all aircraft on the ADA alert net, even though there was no formal requirement for passing information on single aircraft Army flights (except for command and control and medical evacuation).

(1) DACE. Same as B-3 except during first 2 hours. During the bad weather conditions, the close air support box was reduced to 8 kilometers by 3 kilometers by 3,000 feet.

(2) FSE. Close air support boxes were plotted on the FSE map. Field artillery firings were coordinated from the map as opposed to utilizing DACE displays.

(3) S3 air.

(a) The 3d brigade used four people for airspace control.

Para E-7, Run 7 (cont)

(b) The CRP net was not used at brigade level. All minimum risk route and "on the way" data were passed from the CRP to the DACE to the brigade S3 air.

b. The tactics and techniques used by the player organization are as shown below.

(1) The airmobile operation was conducted in accordance with FM 61-100, chapter 11, sections I through III and chapter 12, section XV. The division was attacking in zone across a front 24 kilometers wide with two brigades abreast, and an infantry battalion was placed OPCON to the 2d brigade for an air assault. The reserve brigade was positioned behind the 2d brigade. The divisional armored cavalry squadron protected the division's right flank. The air cavalry troop was in direct support of the assaulting infantry battalion. It escorted the lift aircraft and screened the airhead line. An attack helicopter squadron and an aviation battalion were under operational control of the division during the assault and until linkup was accomplished. The aviation battalion had two assault companies and one assault-support company.

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Two 155-millimeter howitzer battalions, one 8-inch howitzer battalion, and two 175-millimeter gun battalions. The employment of these fires was characterized by aerial fires during the preparation and the assault. Priority of fires was to the airmobile assault and then to the linkup force. Counterflak and preparation programs were active.

(3) The ADA priority was to command and control facilities, aircraft staging and support facilities, and the linkup force.

(4) Close air support strikes were employed against landing zones in the objective area, combined arms elements, and hard targets near the friendly forward elements. Enemy reserves were targets in the enemy rear area. Of the air missions over the division, 46 percent (19 of 41) were close air support. The supporting aircraft used an aerial maneuver space 8 kilometers by 8 kilometers by 5,600 feet and 8 kilometers by 8 kilometers by 3,000 feet during poor weather. These strikes were on station an average of 10 minutes. The aircraft penetrating the division airspace on interdiction, combat air patrol, and reconnaissance missions were flying at 500 to 9,000 feet.

(5) Army aviation was used in troop lift, resupply, command and control, medical evacuation, and observation roles. Air and attack cavalry elements were missioned to battalion level and supported both the airmobile assault and the linkup.

Para E-7, Run 7 (cont)

(6) No artillery, only 4.2-inch mortars, were taken into the airmobile objective area. No ADA weapons other than Redeye accompanied the air assault force.

E-8. Run 8.

a. System C, which was evaluated during run 8 on 21 November 1972, used Scenario 4, Attack. Under system C the BACE collected all information from Army elements which affected airspace control. The onl information passed to the DACE was that which was requested by the DACE. The DACE was only interested in information dealing with AF MRR. The system C had the extension of the brigade lateral boundaries from the brigade rear boundary to a point in the division rear which encompassed all of the field artillery firing positions located in the division area. This extension of the boundary was used for coordination of airspace control activities. All field artillery units were required to pass firing data to the appropriate front line brigade over the FSWN. This eliminated the requirement for an FSWN receiver at the division headquarters. The DACE did not plot any artillery firing information. At the BACE one man did the plotting of all field artillery location and firing data. He was overloaded, and it is doubtful that he could have maintained this level of activity throughout an 8-hour shift. The Army aviation officer in the BACE plotted all flight information. The two Air Force personnel at the BACE were not utilized for airspace control activities at the BACE. The FCC was not give artillery unit locations or artillery firing information. The critical information which was passed between agencies is shown in figure E-6.

b. The tactics and techniques used by the player organization are shown below:

(1) The attack was conducted in accordance with FM 61-100, chapter 6, sections I, III, V, and VIII through XI. The division attacked in zone across a front 22 kilometers wide with two brigades abreast. The reserve brigade was positioned to the rear of the 2d brigade for employment in that zone. The divisional armored cavalry squadron protected the division east flank. The air cavalry troop remained under squadron control.

Para E-8, Run 8 (cont)

(2) Field artillery fires available to the division included the division artillery assigned battalions and the following additional artillery: Three 155-millimeter howitzer battalions, one 8-inch howitzer battalion, and two 175-millimeter gun battalions. The employment of these fires was characterized by forward positioning and heavy volumes of fire. Priority of fires was to the 2d brigade. Preparation and counterbattery programs were active.

(3) The divisional ADA and Redeye weapons were employed to protect the CP, MSR, attacking forces, and fire support means. Each attacking brigade had a Chaparral and Vulcan battery in direct support.

(4) Close air support strikes were employed against fixed defensive positions, hard targets, and armored and mechanized elements near the friendly forward elements; and reserve forces were targeted in the enemy rear area. Of the air missions over the division, 33 percent (17 of 51) were close air support. The supporting aircraft used an aerial maneuver space 8 kilometers by 8 kilometers by 10,000 feet. These aircraft were on station an average of 10 minutes. The aircraft penetrating the division airspace on interdiction, combat air patrol, and reconnaissance missions were flying 500 to 8,000 feet.

(5) Army aviation was used in command and control, medical evacuation, observation, and liaison roles. Air and attack cavalry teams were missioned to brigade level.

ANNEX F

TABULATED DATA

Supporting arm or service	Area					
	Div	1st bde	Bn 1st bde	2d bde	Bn 2d bde	Div rear
	First hour					
Air defense artillery	160	49	53	124	157	25
Air Force	32	24	36	29	30	29
Aviation	63	30	24	29	21	36
Field artillery and mortar	220	103	136	124	158	16
	Second hour					
Air defense artillery	163	52	39	152	136	30
Air Force	14	14	10	10	23	15
Aviation	56	16	6	32	24	35
Field artillery and mortar	162	75	93	93	117	16
	All					
Air defense artillery	323	101	92	276	293	55
Air Force	45	38	46	38	51	44
Aviation	116	46	30	58	41	7
Field artillery and mortar	362	170	217	202	252	25

Figure F-1. Total Missions, Defense, Day

Supporting arm or service	Area					
	Div	1st bde	Bn 1st bde	2d bde	Bn 2d bde	Div rear
	Day, 1 hour					
Air defense artillery	239	183	167	139	88	25
Air Force	16	8	8	14	16	16
Aviation	45	22	14	18	9	3
Field artillery and mortar	174	79	109	103	124	13
	Instrument flight rules, 1/2 hour					
Air defense artillery	21	11	8	18	7	4
Air Force	6	4	7	5	6	4
Aviation	18	8	6	8	6	1
Field artillery and mortar	67	36	44	31	46	[illegible]
	Night, 1 hour					
Air defense artillery	33	14	3	31	31	33
Air Force	11	7	11	11	12	15
Aviation	34	20	9	19	19	34
Field artillery and mortar	118	45	73	77	93	12
	Offense, All					
Air defense artillery	293	208	178	188	126	62
Air Force	30	18	25	28	33	35
Aviation	86	47	26	40	31	9
Field artillery and mortar	325	143	204	193	241	28

Figure F-2. Total Missions, Offense

Area	Combination of supporting arms or service							Totals
	Field artillery and mortar with		Air defense artillery with		Aviation with		Air Force with	
	AF	Avn	AF	Avn	Avn	AF	Air Force	
	Day first hour							
1st Bde	14	16	4	2	0	2	4	42
Bn areas	12	14	2	1	0	2	2	33
Bde rear	2	2	2	1	0	0	2	9
2d bde	49	22	16	6	6	2	1	102
Bn areas	46	19	13	4	5	2	1	90
Bde rear	3	3	3	2	1	0	0	12
Div rear	1	2	0	0	0	0	0	3
Division	64	40	20	8	6	4	5	147
	Day second hour							
1st bde	12	5	0	2	0	0	0	19
Bn areas	11	5	0	1	0	0	0	17
Bde rear	1	0	0	1	0	0	0	2
2d bde	26	24	3	10	1	2	1	67
Bn areas	21	14	2	7	1	0	0	45
Bde rear	5	10	1	3	0	2	1	22
Div rear	1	2	0	0	0	0	1	4
Division	39	31	3	12	1	2	2	90

Figure F-3. Number of Potential Incidents of Interference, Defense

Area	Combination of supporting arms or service							Totals
	Field artillery and mortar with		Air defense artillery with		Aviation with		Air Force with	
	AF	Avn	AF	Avn	Avn	AF	Air Force	
	Day all							
1st bde	26	21	4	4	[illegible]	[illegible]	4	61
Bn areas	23	19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50
Bde rear	3	2	2	2	[illegible]	[illegible]	[illegible]	11
2d bde	75	46	19	16	[illegible]	4	[illegible]	163
Bn areas	67	33	15	11	[illegible]	[illegible]	1	135
Bde rear	8	13	4	[illegible]	1	[illegible]	1	34
Div rear	2	4	0	0	[illegible]	[illegible]	1	[illegible]
Division	103	71	23	[illegible]	7	6	[illegible]	237

Figure F-3 (cont). Number of Potential Incidents of Interfe[illegible] Defense

Area	Combination of supporting arms or service							Total
	Field artillery and mortar with		Air defense artillery with		Aviation with		Air Force with	
	AF	Avn	AF	Avn	Avn	AF	Air Force	
	Day I hour							
1st bde	14	12	27	2	5	2	0	62
Bn areas	14	10	24	2	3	1	0	54
Bde rear	0	2	3	0	2	1	0	8
2d bde	29	4	7	4	2	1	0	47
Bn areas	18	3	5	2	1	1	0	30
Bde rear	11	1	2	2	1	0	0	17
Div rear	0	0	0	2	1	0	0	3
Division	43	16	34	8	8	3	0	112
	Instrument flight rules 1/2 hour							
1st bde	0	2	0	0	0	0	0	2
Bn areas	0	2	0	0	0	0	0	2
Bde rear	0	0	0	0	0	0	0	0
2d bde	1	2	0	0	0	0	0	3
Bn areas	1	1	0	0	0	0	0	2
Bde rear	0	1	0	0	0	0	0	1
Div rear	0	0	0	1	0	0	0	1
Division	1	4	0	1	0	0	0	6

Figure F-4. Number of Potential Incidents of Interference, Offense

Combinations of supporting arms of service missions	Area					
	Div	1st bde	Bn 1st bde	2d bde	Bn 2d bde	Div rear
	Offense and Defense, All					
Air defense artillery - Air Force	.033	.060	.053	.033	.021	.016
Air defense artillery - Aviation	.007	.007	.005	.012	.010	.011
Air Force - Air Force	.047	.066	.015	.022	.006	.020
Aviation - Air Force	.010	.019	.015	.014	.008	.000
Aviation - Aviation	.016	.041	.033	.031	.036	.012
Field artillery with mortar - Air Force	.066	.057	.034	.109	.058	.016
Field artillery with mortar - Aviation	.013	.028	.026	.026	.016	.013
	Defense, All					
Air defense artillery - Air Force	.024	.025	.013	.038	.020	.000
Air defense artillery - Aviation	.008	.026	.015	.013	.010	.000
Air Force - Air Force	.059	.085	.018	.030	.008	.028
Aviation - Air Force	.010	.018	.014	.016	.007	.000
Aviation - Aviation	.009	.000	.000	.030	.037	.000
Field artillery with mortar - Air Force	.061	.061	.036	.102	.050	.022
Field artillery with mortar - Aviation	.015	.031	.031	.031	.022	.022

Figure F-5. Ratio of Potential Incidents of Mission Combinations

Combinations of supporting arms of service missions	Area					
	Div	1st bde	Bn 1st bde	2d bde	Bn 2d bde	Div rear
	Offense, All					
Air defense artillery - Air Force	.044	.075	.071	.026	.024	.032
Air defense artillery - Aviation	.005	.003	.003	.008	.009	.027
Air Force - Air Force	.000	.000	.000	.000	.000	.000
Aviation - Air Force	.009	.020	.016	.008	.011	.000
Aviation - Aviation	.030	.075	.063	.032	.029	.026
Field artillery with mortar - Air Force	.067	.047	.029	.109	.065	.010
Field artillery wtih mortar - Aviation	.009	.024	.020	.015	.006	.005

Figure F-5 (cont). Ratio of Potential Incidents of Mission Combinations

Supporting arm or service		Area				
	Div	1st bde	Bn 1st bde	2d bde	Bn ad bde	Div rear
Field artillery and mortar	687	313	421	395	493	51
Air defense artillery	616	309	270	464	419	117
Aviation	202	93	56	98	72	151
Air Force	75	56	71	66	84	74
TOTAL	1,580	771	818	1,023	1,068	398

Figure F-6. Total Missions, Offense and Defense

Type mission	Defense	Offense	Total
Hawk	50	41	91
Vulcan	68	60	128
Chaparral	54	86	140
Redeye	151	106	257
TOTAL	323	293	616

Figure F-7. Air Defense Artillery Missions, by Type

Type mission	Defense	Offense	Total
155-mm howitzer direct support	113	110	223
8-inch howitzer general support (GS and GSR)	48	56	104
155-mm howitzer general support (GS and GSR)	28	34	62
175-mm gun general support (GS and GSR)	22	22	44
4.2-inch mortar	81	76	157
81-mm mortar	70	27	97
TOTAL	362	325	687

Figure F-8. Artillery and Mortar Missions, by Type

Type mission	Defense	Offense	Total
Attack	19	18	37
Reconnaissance	40	18	58
Medical evacuation	16	20	36
Liaison	17	14	31
Screening	4	3	7
Courier	4	5	9
Maintenance and resupply	16	8	24
TOTAL	116	86	202

Figure F-9. Army Aviation Missions, by Type

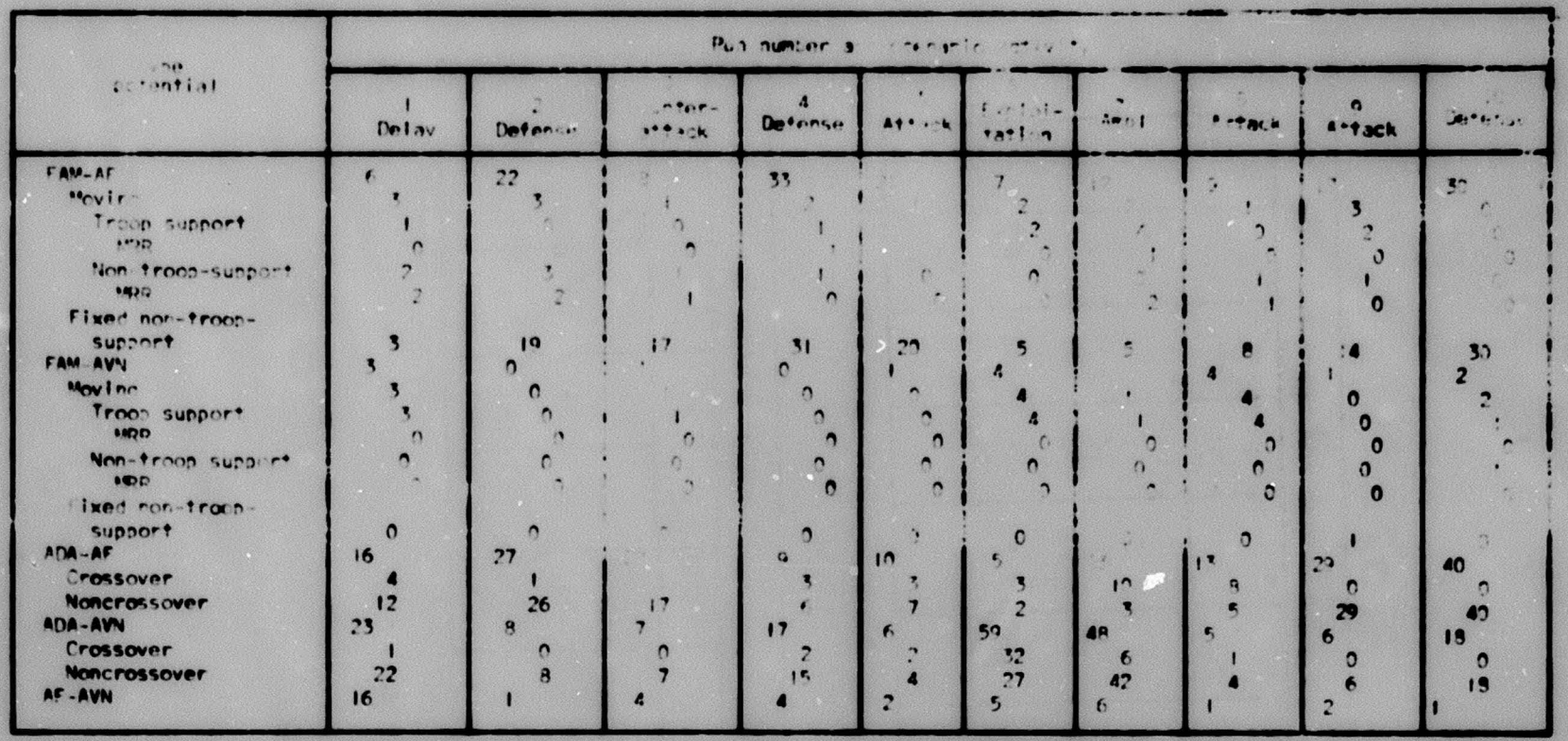
Type mission	Defense	Offense	Total
Counter air	1	12	13
Close air support	12	13	25
Interdiction	10	8	18
Forward air control	3	5	8
Reconnaissance	2	4	6
Airlift	2	3	5
TOTAL	45	30	75

NOTE: There were 157 sorties; 69 during the defense phase and 88 during the offense phase.

Figure F-10. Air Force Missions, by Type

Area	Combination of supporting arms or service							Totals
	Field artillery and mortar with		Air defense artillery with		Aviation with		Air Force with	
	AF	Avn	AF	Avn	Avn	AF	Air Force	
1st bde	40	36	31	6	6	4	4	127
Bn areas	37	32	26	4	3	3	2	107
Bde rear	3	4	5	2	3	1	2	20
2d bde	142	52	28	20	9	5	2	264
Bn areas	123	37	21	13	7	3	1	205
Bde rear	19	21	7	7	2	2	1	59
Div rear	3	5	1	3	3	0	1	16
Division	185	99	60	29	18	9	7	407

Figure F-11. Total Number of Potential Incidents of Interference (Offense and Defense)



Fire potential	Run number and scenario group									
	1 Delay	2 Defense	3 Counter-attack	4 Defense	5 Attack	6 Exploitation	7 Approach	8 Attack	9 Attack	10 Defense
FAM-AF	6	22	8	33	8	7	12	3	14	30
Moving	3	3	1	2	1	2	1	1	3	6
Troop support	1	0	0	1	1	2	4	0	2	0
MRR	0	0	0	1	0	0	1	0	0	0
Non-troop-support	2	3	0	1	0	0	3	1	1	0
MRR	2	2	1	0	0	0	2	1	0	0
Fixed non-troop-support	3	19	17	31	20	5	8	4	8	30
FAM-AVN	3	0	1	0	1	4	4	1	2	2
Moving	3	0	0	0	0	4	4	0	2	1
Troop support	3	0	1	0	0	4	1	0	0	0
MRR	0	0	0	0	0	0	0	0	0	0
Non-troop support	0	0	0	0	0	0	0	0	0	0
MRR	0	0	0	0	0	0	0	0	0	0
Fixed non-troop-support	0	0	0	0	0	0	0	1	0	0
ADA-AF	16	27	9	10	5	5	13	23	40	0
Crossover	4	1	3	3	3	10	8	0	0	40
Noncrossover	12	26	6	7	2	3	5	29	40	18
ADA-AVN	23	8	7	17	6	59	48	6	18	0
Crossover	1	0	0	2	2	32	6	0	0	19
Noncrossover	22	8	7	15	4	27	42	6	19	1
AF-AVN	16	1	4	4	2	5	6	2	1	

Figure F-12. CPX potential incidents of interference

Type activity	Run number and scenario set with							
	1 Delay	2 Def	3 Catk	4 Def	5 Atk	6 Kolt	7 Ambl	8
Air Force								
No of delays	35	10	5	4	13	3	4	
Sqt not delayed	27	85	92	93	75	92	79	96
MRR not given	16	6	1	2	7	1	2	3
Aviation								
No of delays	3	0	4	5	4	15	3	
Sqt not delayed	92	100	76	90	87	74	77	100
Artillery								
No of delays	0	0	0	0	0	11	10	

Figure F-13. CPX Delays

A A alerts	Run number							
	1	2	3	4	5	6	7	8
AF flights								
No given	42	67	41	102	95	104	71	3
Sqt given	43	48	59	88	84	84	52	41
Army flights								
No given	0	3	15	16	13	28	20	39
Sqt given	0	21	68	41	54	62	15	1

Figure F-14. CPX Air Defense Alerts Transmitted on Friendly Aircraft

ANNEX G

ARMY AIRSPACE CONTROL DOCTRINE

ANNEX G

ARMY AIRSPACE CONTROL DOCTRINE

G-1. Purpose. This annex describes MASSTER-proposed revisions to Army airspace control doctrine. It also discusses the differences between these revisions and FM 44-10 (Test), Army Airspace Control Doctrine, dated March 1973.

G-2. MASSTER Recommendation. The revision recommended by HQ, MASSTER is contained in appendix 1.

G-3. Major Items Included in Both FM 44-10 and the MASSTER-Recommended Revisions. Appendix 2 contains details concerning this subject.

G-4. Major Items in FM 44-10 but Omitted from MASSTER Recommendations. Appendix 3 contains details concerning this subject.

G-5. Major Items in the MASSTER-Recommended Revisions but Excluded from FM 44-10. Appendix 4 contains details concerning this subject.

APPENDIX I

REVISIONS RECOMMENDED BY HQ, MASSTER

PREFACE

This manual promulgates Army airspace control doctrine based on the Department of the Army approved Field Army Airspace Utilization Study (FAAUS II). The manual provides doctrine for airspace control for all echelons of the field army, specific policies and procedures applicable to implementation of that doctrine, and a summary of communications requirements.

Airspace control consists of the coordination, integration, and regulation of the use of airspace of defined dimensions. In this context, coordination is that degree of authority necessary to achieve effective, efficient, and flexible use of the airspace without providing command authority. Integration considers the needs, by to consolidate requirements for the use of this airspace in the interest of achieving a common objective at the lowest possible level of effort. Regulation indicates the requirement to supervise activities in the airspace to provide for flight safety, and connotes the authority required to insure such safety.

Army aircraft are mutinely controlled through the chain of command. Unit commanders communicate directly with officers/aviators in charge of aircraft to effect tasking, tactics, and techniques. This is a most positive and precise form of control. The great majority of Army aviation operations are conducted under weather condition in which eyeball contact with friendly and enemy forces is an essential part of employment techniques. When conditions require Army aircraft to be operated under instrument flight rules (IFR), the commander requires the assistance of an air traffic regulating agency. Army aviation has proven its capability to operate in weather conditions down to a 200-foot ceiling and 1/2-mile visibility. During the limited periods of time when marginal and adverse weather conditions prevail, it is necessary to have available IFR facilities and IFR capable aircrews to accomplish minimum essential battlefield tasks. Because of the overall nature of ground combat during marginal and adverse weather, it is not anticipated that the intensity of IFR traffic would approach that under normal weather conditions.

In sum, the overwhelming majority of Army aviation operations will be controlled through the chain of command under Army visual flight rules. There will be requirements for limited numbers of operations under IFR for limited periods of time when commanders are assisted by air traffic regulating agencies.

CHAPTER 1

INTRODUCTION

1-1. PURPOSE AND SCOPE

a. *Purpose.* This manual promulgates interim Army airspace control doctrine for field evaluation and input to the combat developmemts process.

b. *Scope.*

(1) This manual provides doctrine for airspace control for the field army and specifies policies and procedures applicable for implementation of that doctrine. A summary of airspace control communications requirements is included. The appendixes provide a list of references, FM 100-26, The Air-Ground Operations System, provides Army doctrine for requesting and coordinating Air Force tactical air support and Army aviation support.

(2) The manual is oriented toward operations by a US unified command in a general and limited war environment, but is generally applicable in all organizations and environments. US Forces normally operate within a combined (multinational) structure; thus requiring modification of this manual to reflect combined force organizational and operational methods, terminology, and the host country's rules and procedures for airspace use.

(3) This manual is in consonance with NATO/CENTO STANAG 2134, Offensive Air Operations, which is identified at the beginning of each appropriate chapter.

1-2. BACKGROUND

The Joint Chiefs of Staff agreed in 1965 to a broad concept for control of the airspace over the combat zone. This manual provides Army doctrine required to fill the void between the agreement and detailed procedures such as those found in Appendix B, Army Airspace Control Implementing Instructions and local standing operating procedures (SOPs).

CHAPTER 2

PRINCIPLES, RESPONSIBILITIES, AND ORGANIZATION (STANAG 2134)

2-1. PRINCIPLES

a. The maneuver force (field army, corps, division) commander requires freedom of use of designated airspace immediately over his force for maximum flexibility to employ organic aircraft and weapons whenever land forces are committed to combat. The extent of airspace designated to insure this flexibility will vary with the situation and theater. The maneuver force commander may delegate authority for control of designated airspace to subordinate commanders as necessary for effective mission performance. The primary purpose of the designated airspace is to allow maximum freedom of fire and maneuver and attain maximum safety in that airspace, while reducing minute-to-minute coordination requirements. The subordinate commander's authority for control of designated airspace is defined by lateral boundaries agreed upon by the commanders concerned.

b. *Airspace control*, as defined in the Preface, affects all operations and is therefore a command function. All airspace users have requirements for use of the airspace in support of the commander's decisions; however, airspace requirements frequently conflict. Airspace control must provide a timely and effective means for minimizing and resolving conflicts in accordance with the commander's priorities.

c. Airspace control rules and procedures must be developed in plans and SOP and exercised in the field prior to hostilities because an effective control effort cannot be improvised without unacceptable delay and confusion.

2-2. AIRSPACE USERS

a. *Users*. Field army airspace users include Army aviation, field artillery and naval gunfire, Army air defense, other-Service aviation, and maneuver force weapons.

b. *Activities*. Airspace activities may be grouped as follows --

(1) *Army aviation*. Army aviation is employed in attack helicopter fire and maneuver operations, attack helicopter fire support, aerial reconnaissance and surveillance support, airmobile operations, air cavalry operations, aeromedical evacuation support, Army Security Agency operations, and logistical and administrative lift support. Army aviation fires are nonnuclear.

(2) *Field artillery and naval gunfire.* Army field artillery and Navy ships furnish quick response and preplanned cannon and missile fires. Both nuclear and nonnuclear fires may be provided.

(3) *Army air defense.* Army air defense units provide quick response surface-to-air fires and quick-response and preplanned surface-to-surface fires, and are capable of providing nuclear and nonnuclear fires.

(4) *Other-Service aviation.* Air Force, Navy, and Marine aviation provide immediate and preplanned close air support, tactical air reconnaissance support, tactical and administrative airlift support, interdiction, air defense intercept, and aeromedical evacuation support, and are capable of employing both nuclear and nonnuclear weapons.

(5) *Maneuver force weapons.* The organic rifles, machine guns, Redeye-type weapons, and other weapons of the maneuver forces may be used in defense against air attack; therefore, these elements are airspace users. Organic mortars are also airspace users.

c. *Densities.* Army aviation, field artillery, and mortar activities are densest in the division area, with the greatest potential airspace control problem at low altitudes near the line of contact or forward edge of the battle area (FEBA). Army air defense is spread throughout the battle area, with greatest numerical density of short-range low-altitude air defense weapons in the division area. Air Force, Navy and Marine aircraft use all the battle area airspace, at least on a transient basis, but the greatest potential control problem is in the low-altitude airspace over the forward areas.

d. *Objectives.* The theater counterair and the Army air defense element's missions objectives require them to strive for dominance of the airspace by ridding it of or denying its use to the enemy element. The other airspace users must use the airspace in furtherance of their particular objectives without undue mutual interference or interference from the enemy. Attainment of these varied objectives requires effective coordination between elements of the Army force and with other services.

2-3. COMMAND RESPONSIBILITIES

a. The joint force commander will normally assign the Air Force component commander overall responsibility for theater airspace control. Subject to the authority of the joint force commander, and after coordination with the other component commanders, the threater airspace control authority will promulgate broad policies to govern airspace control in the combat zone. His authority in this regard is that of a coordinating authority, as defined in AR 310-25 and JCS Pub 1. The airspace control authority will, in recognition of land combat requirements, insure the maneuver force maximum possible freedom of action in the airspace over the combat zone.

b. Each commander is responsible for the control of his own forces and for compliance with the joint force airspace control rules and procedures.

c. The maneuver unit commander is the most important minute-to-minute controller and coordinator of airspace users in the vicinity of the line of contact or the forward edge of the battle area. Combat support is provided in response to his requests, and he is the final authority on application of these means. The commander exercises control and coordination through his unit or general staff, special staff, liaison officers, and subordinate unit commanders. His principal assistants are the operations officers, field artillery fire support (liaison) officers, forward air controllers, field artillery and mortar forward observers, air defense officers, and aviation officers.

d. The command responsibility for provision of airspace control extends throughout the combat zone. Forward maneuver unit commanders and their designated assistants can and should resolve local problems; however, some problems must be resolved at higher echelons. For example, a flight of Army or Air Force aircraft originating from division, corps, or field army rear in response to a forward commander's request will not come under that commander's direct influence until the enroute flight phase is essentially completed. While enroute, the aircraft could conceivably interfere with every other type of airspace activity. Further, while in the process of ordnance, troop, or materiel delivery, these aircraft in some cases could interfer with the operations of adjacent units or other activities not under the local commander's influence. Therefore, higher echelons must perform certain on-the-spot control and coordination in addition to insuring that SOP provides for timely coordination at and among all levels.

e. Responsibility for compliance with the rules of flight, rules of engagement, and firing restrictions lies with all commanders, leaders, and the individuals in control.

2-4. ORGANIZATION

a. *General.* The Army's airspace control process must be sufficiently flexible to be effective under any airspace organization that may be implemented in the field.

b. *Organizational Structure.*

(1) *General.* An organizational structure within which the various airspace user systems may be employed in shown in ANNEX B and is discussed in the following subparagraphs.

(2) Provides guidance and information to the FCC for regulating Army air traffic. Provides information on prohibited or restricted areas and other restrictions imposed on air traffic by the commander, higher headquarters, the theater air defense commander, and airspace control authority or through agreement with other services. Based on these restrictions, the DACE disseminates the plan to the TOC, the direct air support center, and the Army aviation and air defense units as required. Through close coordination with other TOC elements, the DACE determines those combat and combat support activities that will influence air traffic and disseminates changes to the airspace utilization plan.

c. *The DACE assists the commander in supervising Army air defense operations.* This function is performed by the air defense section of the DACE which --

(1) Maintains continuous estimates of the air defense situation, and represents the air defense officer in recommending changes in the allocation and employment of Army air defense means. The air defense section provides information on the air defense situation, including air defense coverage, to other TOC elements. Periodic and spot reports from air defense artillery units allow the DACE to remain abreast of the air defense situation. When specific details are required, the air defense section requests the information from the appropriate air defense artillery unit headquarters. The DACE also maintains Redeye information in summary form.

(2) Assists the commander in regulating air defense weapons fires and preventing undue interference with other operations by advising on the air defense weapons control status. Weapons control status changes may be initiated by higher Army headquarters or the area air defense command, or may be recommended by the air defense section. Dissemination authority is as specified by the SOP.

d. *The DACE receives and disseminates airspace control information.* Information flow is typically as follows --

(1) Information regarding the number of air defense weapons which are operational and their deployment is sent from the division ADA battalion AADCP to the air defense section of the DACE through the ADA battalion command net (FM) or through the division communications system. If distance requires the use of AM radio, the AADCP AN/GRC-106 radios operating in a division net or the battalion's liaison net may be used. Redeye information, in summary form, is received from the brigades, division artillery, and the cavalry squadron.

(2) Information regarding the number of Army aircraft available and their deployment is disseminated from the aviation unit S3 to the aviation section of the DACE through the division area communications system or the

division operations and intelligence radio teletypewriter (RATT) net. Other TOC elements also provide this information; e.g., FSE for aerial field artillery.

(3) Field artillery information (field artillery fire plans, firing battery locations, and restricted areas as approved) is provided to the DACE by the FSE.

(4) Other-Service air support information is disseminated from the tactical air support element (TASE) to the DACE. The TASE provides pre-planned and immediate close air support information as missions are requested and performs airspace coordination with the DACE as part of the coordination and approval process. Fragmentary orders and on the way messages are passed from the CRP to the DACE. The DACE provides recommended minimum risk routes to the CRP on request. Other-Service air support information of an administrative or logistical nature may be received from the transportation officer.

(5) Information on large, multiple-aircraft Army flights by organic, attached, or supporting aircraft is transmitted from the aviation unit operations section to the FCC through the division communications systems or through the division operations and intelligence RATT net when the flight plan is filed. The FCC will pass on the information to the DACE.

(6) Alert information regarding friendly air activity in the division rear airspace is disseminated to the division rear air defense fire units on the division alert net. The DACE is the NCS for this net. This information complements the aircraft identification capabilities of the air defense units. Recommended priorities for passage of friendly air movement information are:

(a) Emergency information.

(b) Incoming other-Service flight(s).

(c) Incoming Army flight(s).

(d) Local other-Service flight(s).

(e) Outgoing other-Service flight(s).

(f) Local Army aviation formation flight(s).

(g) Outgoing Army aviation formation flight(s).

(h) Local Army single-aircraft flight(s).

(i) Outgoing Army single-aircraft flight(s).

(j) Field artillery and mortar airspace usage information.

CHAPTER 3

DIVISION AIRSPACE CONTROL (STANAG 2134)

3-1. CONTROL LEVELS

Control of the use of division airspace is accomplished incrementally. Individuals and agencies responsible for division airspace control can be divided into two groups, task and location, with the understanding that the dividing line is not distinct.

a. *Task oriented.*

(1) *Command and staff level.* The division commander is responsible for control of division airspace operations. He establishes guidelines to permit ample training for timely reaction to changing situations. The division air defense officer, aviation officer, fire support coordinator, and other staff members under general staff supervision of the G3, plan for the coordinated, integrated, and regulated use of division airspace in accordance with SOP, operation plans, joint air defense and airspace control regulations, and the commander's guidance. Command guidance includes the concept of airspace use, and airspace usage priorities in terms of control and restrictive measures for each airspace user. The command guidance is based on command and staff assessment of the operational objective and the overall concept of the division operation, task organization, the air threat, terrain and weather, and higher echelon guidance and priorities. Similar activities occur at lower levels that have a need for airspace control.

(2) *Airspace control elements.*

(a) The DACE is the focal point for division airspace control and functions as a management facility under the supervision of the division G3. The DACE integrates information on airspace usage and recommends minimum flight routes for aircraft flights in and through the division area. Additionally, the DACE is a planning and management facility. The SOP should delegate airspace control authority and responsibility to the lowest level having the requirement or capability.

(b) The operations center at maneuver brigade level extends the airspace control capability forward by coordinating and regulating brigade airspace utilization in accordance with the commander's priorities. Airspace control functions are performed under the staff supervision of the S3. Performance of these functions will require assistance of liaison parties from supporting field artillery, air defense artillery, Army aviation, and the USAF.

(3) *Operator-level control.* Minute-to-minute control and limited airspace coordination are performed by the airspace users employing their own specialized control systems in accordance with established SOP, plans, orders, and command guidance. These systems include all individuals and facilities that exercise direct control of aircraft and weapons; e.g., the division's Army air traffic regulation system, Army pathfinders operating in the forward area, the air defense control system, the USAF tactical air control system elements operating in the division area, the field artillery and mortar fire direction centers, and maneuver unit command posts. The operator-level systems, by themselves, cannot provide a fully coordinated airspace control effort throughout the division area.

b. *Location oriented.*

(1) *Forward.* Forward-oriented control elements are most concerned with activities near the FEBA. These activities are normally at the request of the local commanders. Due to the possible density and the time-criticality of operations in the forward area, the forward elements are most likely to become closely involved with minute-to-minute control.

(2) *Rear.* Elements such as the DACE are concerned with the overall division airspace control effort. They are also responsible for detailed coordination of airspace activities beyond the control of forward elements. The DACE is also a minute-to-minute controller of airspace in the division rear area.

3-2. OPERATIONAL EMPLOYMENT POLICY - ARMY AIR DEFENSE.

a. Engagement control of division air defense weapons is normally decentralized to the fire unit level, based on the division SOP and the commander's decisions. The division SOP must be compatible with the theater air defense commander's published rules and procedures.

b. The division SOP should include the following air defense control measures. Application of these weapons controls in accordance with the commander's analysis of the air situation and the theater air defense rules contributes to effective airspace control.

(1) *Weapons control status.* The three standard weapons control statuses are the division commander's primary tools for control of the fires of his organic air defense weapons.

(a) *Weapons tight. Fire only at aircraft positively identified as hostile in accordance with the SOP hostile criteria.* This should be the normal status imposed on division air defense weapons except for Redeye; however, the system controlling these units must be prepared to recommend weapons free ((b) below) when appropriate, and respond to weapons hold ((c) below, as ordered.

(b) *Weapons free. Fire at any aircraft not identified as friendly.* Under this status hostile aircraft and aircraft of unknown or doubtful identification may be engaged. A command decision to employ this status requires availability to the commander of adequate air situation information. Lacking this, weapons free may be initiated only when no friendly aircraft are in the area or when the commander is willing to accept some risk to friendly aviation in the face of an overriding requirement for air defense of his forces. Predetermined code words may be used to establish weapons free areas and to specify time limits. Friendly aircraft should make every effort to clear the designated area before weapons free goes into effect. Joint air defense rules and division policy will specify the levels authorized to permit weapons free operations.

(c) *Weapons hold. Do not fire.* The right of self defense is not denied in peace or war. This status should be applied selectively with time, area, or unit limited and may be further limited as to class of aircraft protected. Predetermined code words may be used to establish weapons hold areas and specify time limits. This rule may be used when the commander desires absolute assurance against friendly air defense fires in the area of major friendly air operations. Any force commander employing air defense weapons is authorized to impose weapons hold on these weapons.

Note: Statuses may be mixed -- one may be applied to fixed wing aircraft, and another to helicopters.

(2) *Hostile criteria.* The division SOP must provide clear guidance as to criteria by which aircraft may be classed as hostile. Typical examples under which division air defense units may classify an aircraft as hostile are when the aircraft is --

(a) Attacking friendly elements.

(b) Bearing the military insignia or having the configuration of an aircraft employed by a known enemy nation.

(c) Entering a restricted or weapons free area, unless otherwise identified as friendly.

(d) Entering a prohibited area.

(e) Operating at a prohibited altitude, speed, or direction of flight.

(f) Responding improperly to electronic identification, friend or foe (IFF) interrogation.

(g) Discharging spray or smoke over friendly elements without prior coordination.

(h) Discharging parachutists or unloading troops in numbers in excess of the normal aircraft crew without prior coordination.

(i) Engaging in minelaying operations without prior coordination.

(j) Engaging in improper departure from an area or corridor designated as "safe."

(k) Dropping electronic countermeasure devices· e. g., chaff and reflectors, over friendly territory without prior coordination.

Notes:

1. Although criteria (a) and (b) above are the primary criteria for the visually-directed division air defense weapons, the remaining criteria may be included in the joint force rules and procedures and may be exploited as useful indicators for focusing attention on probably hostiles.

2. Criteria may be further limited to specific classes of aircraft; e.g., fixed-wing aircraft and helicopters.

(3) *"Safe" areas.* Air defense weapons will not engage aircraft operating in weapons hold areas or in designated "safe" areas, routes, or corridors. The right of self-defense is not denied.

(4) *Policy for all Army air defense weapons.* All Army air defense weapons will be employed by unit leaders and commanders in accordance with current orders and SOP. All weapons may be used in exercising the individual and collective right of self-defense against hostile *attacking* aircraft. Engagement of other hostile aircraft will be on orders through the unit chain of command.

(5) *Procedures for change.* The division SOP should define the normal procedures. Commanders direct changes as the situation warrants as follows:

(a) *From division level.* The DACE may recommend changes to the G3, or emergency changes may come from joint air defense or the higher Army echelons. The DACE must be ready to receive emergency changes in weapons control status and to disseminate these changes immediately to all units concerned. This requires that the G3 have the authority to make the weapons control status either more or less restrictive and the procedures for such

change be clearly specified in the SOP. Authorized disseminations will be made from the DACE via the chain of command or, in an emergency, via any available broadcast means.

(b) *From lower levels.* All users of organic and attached air defense means control their own weapons, subject to limitations of the division SOP. The authority to declare weapons free is not normally delegated below division, nor are the lower levels normally allowed to countermand a division-ordered weapons hold. The right of self-defense is not denied.

c. The control measures outlined in b above assist the commander in coordinating Army air defense operations with other airspace user activities. The air defense alert nets will disseminate information regarding ongoing friendly aerial activity to all Army air defense units that will be affected.

d. Air defense unit command posts and the force G2/S2 have the basic responsibility for disseminating information regarding hostile aerial activity. Tentative IFF information is also available from the forward area alert radar (FAAR).

3-3. OPERATIONAL EMPLOYMENT POLICY - ARMY AVIATION

Division SOP should provide the following procedures for Army aircraft. The purpose of these procedures is to assist Army aviators in avoiding hazards to flight while operating in the division area. The primary method for accomplishing this purpose is to provide the aviator a minimum risk route. These procedures are an augmentation to FOC/FCC Army air traffic system.

a. *Army Aircraft Entering or Departing Division Airspace.*

(1) Integration of aircraft entering the division rear area airspace will be accomplished by the division flight coordination center (FCC) and the DACE. This may be done by SOP and may not require the filing of a flight plan with the FCC for each flight.

(2) Integration of aircraft entering the brigade airspace will be accomplished by the brigade operations center.

(3) The FCC (approach and departure control) will hand off to an appropriate air traffic regulation facility all flights under their control crossing the division rear or lateral boundaries, as required.

(4) The DACE, through the FCC, will furnish minimum risk routes for multiple aircraft flights which are to enter or leave division rear area airspace. Single aircraft flights will be provided minimum risk routes on request based on predetermined priorities.

b. *Army Aircraft Flights Within the Division Area.*

(1) Aircraft will to the best of their ability avoid flying over field artillery, heavy mortar, Hawk, and other ADA firing positions.

(2) Aircraft will avoid air defense weapons free areas, areas reserved for high performance aircraft, and areas predesignated as restricted or prohibited.

(3) The DACE will furnish the FCC the locations of the areas mentioned in (2) above. Requirements for the use of restricted or prohibited airspace will be forwarded through normal command channels to the agency imposing the restriction or prohibition. Pilots in command may contact the FCC or BOC with immediate requirements for the use of restricted or prohibited airspace in the division rear or brigade areas, respectively. The FCC will forward these requirements to the DACE.

(4) Flight coordination requirements for *single aircraft* are:

(a) Pilots in command will file a flight plan with their unit flight operations section.

(b) Pilots in command will maintain frequent contact with the FCC, maneuver unit operations center, pathfinders, or aviation unit operations section for receipt of hazards to flight information. Arrangements vary with mission type, scope and area of operations, communications capabilities, and airspace control requirements.

(c) Pilots in command will have the radio call sign and frequency of the FCC and the appropriate brigade operations center in order to obtain minimum risk routes in the brigade area.

(d) Aircraft will operate at an altitude and along routes where they can best perform their mission, minimize their exposure to hostile fire, and avoid interference with other airspace users. This normally will be at nap-of-the-earth.

(5) Flight coordination requirements for large multiple aircraft flights are: ("Large flights" are defined as formations so large as to significantly restrict maneuver room of approaching or overtaking aircraft. It will vary with areas and the intensity of air activity.)

(a) Flight leaders will file a flight plan with the FCC. The data will then be forwarded to the DACE or brigade operations center, as appropriate, for minimum risk routes and hazards to flight warnings as necessary.

(b) Paragraph a(4)(b) through (d) above provide additional flight leader guidance.

c. *Communications Failure.* Joint procedures for use during communications loss must be provided in the SOP for both instrument and visual meteorological conditions. These may be based on Department of Defense flight information publications, modified as necessary to be applicable in the particular tactical environment.

3-4. INTERFACE - ARMY AND OTHER SERVICE AVIATION.

Procedures for coordinating Army aviation with the Air Force, Navy, and Marine aviation use of the airspace are prescribed by the theater airspace control authority. The joint air traffic regulations should include the following control requirements:

a. *Instrument Flight Rules (IFR).*

(1) Aircraft of any component may operate in the airspace regulated by another commander after flight plan data have been transmitted to the receiving commander's control facility and an air traffic clearance has been forwarded to the requesting pilot or aviator.

(2) In-flight aircraft on an IFR flight plan that desire to make a change in flight plan will contact the air traffic regulation facility exercising control. This facility will accomplish the required coordination and issue an amended clearance.

(3) In an emergency the aircraft declares the emergency by mayday emissions, executes emergency flight procedures, and contacts the nearest air traffic regulating facility (e.g., FOC/FCC, CRC/CRP, or airfield control tower). The attempt is made over established military channels.

(4) The Army air traffic regulation system is responsible for keeping the DACE informed of any flights arranged through it and for acting on any problem prevention guidance received from the DACE.

b. *Visual Flight Rules (VFR).*

(1) Aircraft under VFR are operating normally on a see-and-be-seen basis. Despite the see-and-be-seen nature of VMC flights, coordination is important to reduce conflicts especially when both high- and low-performance aircraft operate in the same low-altitude airspace.

(2) All air traffic regulation facilities will be made available to all aircraft commensurate with tactical requirements within established priorities.

(3) Minimum risk routes will be recommended on request to facilitate low-level penetration of division airspace by high-performance aircraft. The DACE will coordinate and take action to insure affected users are informed.

(4) Techniques such as the use of corridors, restrictive areas, or a coordinating altitude may be established to facilitate airspace control. These techniques should be used sparingly as they restrict the use of airspace.

c. *Procedures During Communications Failure.* See paragraph 3-3c.

3-5. INTERFACE - AVIATION AND FIRE SUPPORT

Army aviators are responsible for knowing firing unit locations and for maintaining frequent contact with the appropriate FCC or brigade operations center as discussed in the recommended procedures which follow --

a. The division FSE or brigade FSCC will provide the coordinates of all field artillery firing battery positions in the division area to the DACE. The artillery FDCs located in a brigade area will provide the coordinates of all field artillery battery positions in the brigade to the operations center. Maneuver battalions will also advise the brigade operations center of the coordinates of their heavy mortars. Information on preplanned fire missions will also be provided.

b. Aviator knowledge of field artillery and heavy mortar firing positions, very-low-altitude flight, and contact with the supported unit in the target area will reduce the risk of airspace interference between field artillery, mortars, and aircraft.

(1) *FDC and FCC.* The fire direction centers (FDC) of direct support field artillery battalions, division artillery, and corps field artillery battalions transmit fire mission data to the division FSE and brigade operations center. The FCC will receive a recommended route from the DACE for FCC use when issuing IFR clearance, providing vectors around hazards, clearing aircraft, and issuing advisories to transient aircraft in the division area.

(2) Brigade organic aircraft in or entering brigade airspace will normally obtain information from the brigade operations center. This requires that the FDCs report their fire mission data direct to the brigade operations center. The artillery information, augmented by other (e.g., mortar, ADA,

other-Service) information available at the operations center, will be the basis for recommending routes to aircraft upon request.

c. Pilots in command or flight leaders should contact the operations center prior to entering the brigade airspace.

d. Helicopters initiating a mission from ground alert within the brigade area will be provided recommended flight routes with the mission tasking message if appropriate.

e. See paragraph 3-3c.

3-6. OPERATIONAL EMPLOYMENT POLICY - AIRSPACE CONTROL ELEMENT AND ITS COMPONENTS (AVN SEC AND AD SEC) DACE

The DACE, under G3 supervision, is the commander's focal point for division airspace control. DACE activities are in compliance with higher headquarters directions and the commander's concepts. DACE coordination of use of the airspace includes virtually all airspace activity, subject only to time and information handling limitations.

The DACE:

a. *Assists the commander (G3) in controlling the use of division airspace.* This is the basic DACE function and is accomplished through the joint efforts of the TASE, FSE and the air defense, and the aviation sections of the DACE. Activities are as follows --

(1) *General.* The G3 air, in conjunction with the fire support element (FSE) and the tactical air support element (TASE), determines how airspace requirements can best be met and submits recommendations to the G3 and issues necessary instructions. The DACE normally prepares airspace utilization annex to division operation plans and orders. The DACE also maintains airspace utilization displays in the form of an airspace utilization map and an airspace utilization board. Typical displays combine Army air defense, Army and Air Force air support, and field artillery and mortar information to the maximum degree feasible. They display airspace utilization information regarding preplanned and ongoing air activity for those areas where they have airspace control responsibilities. Data are maintained on air traffic regulation facilities and standing and temporary regulatory or restrictive measures (e.g., air corridors, air defense weapons free area(s)). Appendix C to FM 44-3 and appendix E to this manual present ACE display details.

(2) *Army aviation airspace operations.* The DACE performs airspace control services for multiple Army aircraft flights and designated single aircraft flights. (See paragraph 3-1a(2) for description of the normal DACE information-handling capability.) If coordination problems occur

in the planned use of airspace, the DACE, in conjunction with the tactical air support element (TASE), FSE, or any other element initiating the action, attempts to resolve the problem. Problems that cannot be resolved in accordance with command guidance, orders, and SOP are forwarded to the G3. Airspace control information will be disseminated to the initiator of the action and to appropriate external agencies as follows:

(a) From the DACE to the appropriate FOC/FCC or TTC.

(b) From the DACE to the brigade operations center via the division to brigade airspace net. The division communications-electronics officer may direct use of other nets.

(c) From the FOC/FCC and brigade operations center ((a) and (b) above) to all aviation elements concerned; e.g., aviation unit command posts, pathfinder elements, unit terminal guidance personnel, and forward helipad personnel. Both aviation and supported unit communications channels are employed as appropriate.

(3) *Other-Service airspace operations.* The TASE (or other action initiators) and DACE coordinate to preclude airspace problems between the Services. In general, other-Services may operate free of restrictions over the land battle area. Other-Service aircraft may remain under their area Service air traffic regulating agency or request assistance from Army agencies as appropriate. Recommended minimum risk routing will be provided on request. ADA fire units will be alerted to the flight.

(4) *Field artillery airspace operations.* The FSE, TASE, DACE, and brigade operations center coordinate to preclude airspace problems between field artillery and Army and other-Service air support operations. Coordination is as in (2) above, with the understanding that much of the quick response fire support activities cannot be so coordinated at the division level and must therefore be coordinated at lower levels (para 3-5b).

(5) *Army air defense operations.* This facet of airspace control is included in c below.

b. *The DACE assists the commander in supervising Army aviation operations.* The function is performed by the aviation section of the ACE which --

(1) Maintains continuous estimates of the aviation situation and represents the division aviation officer in recommending changes in the allocation and employment of aviation means. The aviation section provides information to other tactical operation center (TOC) elements on the aviation resources controlled by or available to the division. Reports from aviation units keep the DACE abreast of the aviation situation.

3-7. BRIGADE OPERATIONS CENTER

The brigade operations center is the commander's focal point for brigade airspace control. Activities are in compliance with higher headquarters directions and the commander's concepts. Coordination of airspace usage includes virtually all airspace activity and is subject only to time and information handling limitations. The brigade operations center:

a. Assists the commander (S3) in controlling the use of brigade airspace. This function is accomplished through the joint efforts of the S3, S3 Air, FSO, and liaison officers from supporting aviation and air defense units and the US Air Force. Activities are as follows:

(1) The operations center determines how airspace requirements can best be met, submits recommendations to the commander, and issues necessary instructions. The operations center also maintains airspace utilization displays which combine Army air defense, Army and Air Force air support, and available field artillery and mortar information. They display information regarding preplanned and ongoing air activities for those areas where they have airspace control responsibilities.

(2) The brigade operations center recommends appropriate routes for Army aircraft flights on request. Aviators and flight leaders coordinate with the operations center using the brigade air-to-ground net. Information on appropriate Army flights departing the brigade area is passed to the DACE, FCC, and adjacent brigades as necessary.

(3) The operations center coordinates to assist the DACE in order to preclude airspace control problems between the Services. The operations center monitors the CRP net and provides input to the DACE for minimum risk route recommendations.

b. The operations center receives and disseminates airspace control information. Typical information flow is as follows:

(1) Field artillery information (fire plans, battery locations, and restricted areas, as approved) is provided to the FSO at the operations center by the FDCs of artillery battalions located within the brigade area.

(2) Other-Service air support information is disseminated over the CRP net to the Air Force liaison party at the operations center. The Air Force liaison officer provides preplanned and immediate close air support information as missions are requested. On the way messages are monitored by the operations center on the CRP net. The operations center determines the best route through the brigade and passes it to the DACE on the division airspace control net.

(3) Army aircraft flights originating in or entering the brigade airspace requiring flight advisories and requesting alerting of ADA units will contact the operations center on the brigade air-to-ground net. The operations center will recommend appropriate routes based on the current tactical situation.

(4) Alert information regarding friendly air activity in the brigade airspace is disseminated to air defense fire units in the brigade area on the brigade alert net. Each brigade operations center is the NCS in its brigade alert net. This information supplements the aircraft identification capabilities of the air defense units.

3-8. AIRSPACE CONTROL PROBLEMS RESOLUTION PRECEPTS

a. Most control problems should be prevented during normal operational planning and execution; however, there will remain cases where problems must be resolved on the spot. The maneuver unit commander must establish priorities for the use of airspace. These serve as the guidelines for resolution of problems by the airspace coordinators. Initial priorities are published in the operations order with changes disseminated as necessary. If a problem cannot be resolved by established priorities, the commander will be advised. The commander's decision, which will vary with the mission, enemy capabilities, and support requirements, will then be passed to the elements concerned. When time or circumstances do not permit SOP or command resolution of the problem, situations presenting *immediate safety hazards* to friendly forces will be resolved by the coordinator or controller.

b. Commanders should insure that the following policies are incorporated in plans and SOPs --

(1) Use of the airspace in support of preplanned operations must be approved by the commander or his designated representative (G3/S3).

(2) Forward coordinators, maneuver unit commanders, air traffic controllers, forward observers, and forward air controllers must be given authority to make on-the-spot adjustments in airspace operations to preclude hazards to friendly forces.

(3) The FACs (or other personnel performing the function) will maintain communications with the maneuver unit commander, will direct other-Service close air attack of targets, and will respond to requests of the maneuver unit commander.

(4) Attack helicopters will establish communications with the maneuver unit commander or his designated representative prior to initiating the attack and will respond to the directives of the supported unit. Attack helicopters operating independently will coordinate with units that may be affected by their operations.

(5) When air cavalry operations are planned in conjunction with other forward ground elements, the air cavalry unit will normally dispatch a liaison officer to the controlling maneuver headquarters. This liaison officer, by coordinating the fire and maneuver of the air cavalry with the operations of the controlling maneuver unit, will reduce airspace problems.

(6) Adequate control rules and procedures, delineation of detailed responsibilities, and means for communication must be provided in SOP and plans and exercised in the field prior to hostilities. This manual provides points of departure for preparation of plans and SOP.

3-9. INDIVIDUAL RESPONSIBILITIES

Appendix D provides individual/agency responsibilities for airspace control with the understanding that the commander commands and controls, and the G3/S3 exercises overall staff supervision.

CHAPTER 4

CORPS AND FIELD ARMY AIRSPACE CONTROL

4-1. DIFFERENCES FROM DIVISION AIRSPACE CONTROL

The principles and organization for airspace control are the same for division, corps, and field armies. The types and densities of airspace user activities differ between the division area and the corps or field army rear areas, with potential impact as discussed below --

a. *Army Air Defense*. The dominant Army air defense weapons in the rear areas are Hawk and Nike Hercules. These are tied together by semi-automated control systems. Hawk and Nike Hercules can be employed under either centralized or decentralized (preferred) control, whereas the division air defense weapons *must* operate under decentralized control. Rules of engagement for Hawk and Nike Hercules are designed especially for application by radar-directed weapons and are therefore quite different from the rules applied to division air defense weapons. For example, rules for Hawk and Nike Hercules rely on use of electronic data link, electronic interrogation, and ADA unit ability to accurately measure aircraft speed, position, direction, and altitude.

b. *Army Air Support*. Army aviation activity is less dense in the rear areas and, for the most part, may be considered to be of a preplanned nature. Requirements for low-altitude flight to avoid enemy radars and missiles are less severe. Coordination with other aerial activity is mainly an enroute problem because combat operations are not usually occurring in the rear areas. On occasion air traffic density in the rear areas will increase substantially because of stability and counter-guerrilla operations. In any case, adequate control is required to preclude degradation of Army aviation combat operations originating from the rear or conducted in rear areas.

c. *Other-Service Air Support*. Considerations are similar to b above, except that "immediates" may originate in the rear areas and require priority handling. However, separation of this high speed traffic from the Army's low speed aviation is a lesser problem than in the division areas, because of reduced Army aviation density and urgency and more complete coverage by the other-Service's radar systems.

d. *Field Artillery and Mortars*. The potential for field artillery and mortar interference with aviation activities may be discounted in the rear areas. Field artillery missiles are not considered an airspace control problem as long as friendly aircraft routinely avoid direct overflight of missile firing positions.

e. *Summary*. The airspace control problem is less severe in the rear areas than in the division areas. Prior coordination through the corps and field Army airspace control elements and adherence to rules that are somewhat more restrictive than in the division area should eliminate most potential airspace conflicts. Army and other-Service aircraft on quick-response combat missions will, however, require handling with the same degree of urgency as in the division area.

4-2. RESPONSIBILITIES

As in the division areas, Army commanders are responsible for controlling their own aircraft and weapons and coordinating their operations with other airspace users. An exception may occur in the case of nondivisional Army air defense weapons, all or part of which may be placed under the operational control of the area (theater) air defense organization. This decreases ACE air defense management functions, although the ACE remains the focal point for coordinating "resident" Army air defense operations with ground force operations. The Army air traffic regulation system may be included in the overall area (theater) airspace control system, dependent upon the Army component commander's agreements with the airspace control authority. In that case the function of the ACE would be that of an overall coordinator with most airspace control functions becoming routine duties performed by the air traffic regulation system. Since the airspace volume involved is larger, traffic densities and conflicts are less likely to require ACE action.

4-3. ORGANIZATION

Overall organization is discussed in paragraph 2-4b.

4-4. RULES AND PROCEDURES

Rules and procedures will require close coordination with other-Service air activities.

CHAPTER 5

COMMUNICATIONS

5-1. REQUIREMENTS

Figure B-2 depicts the airspace control communications typically required to support the policies and procedures in chapters 3 and 4. Basic communications-electronics doctrine is contained in FM 11-50, FM 11-92, FM 11-125, FM 24-1, and FM 61-24. An airspace control communications requirement may be met by collocation, field wire, the multichannel communications systems typically available at echelons down to but not within the brigade, and organic tactical radios.

5-2. ADDITIONAL CONSIDERATIONS

Airspace control communications to support the policies and procedures in chapters 3 and 4 include four types of nets. These include:

a. *CRP to division net.* Provides a direct communications link from the CRP to the DACE. This net is used for the CRP to pass fragmentary orders and on the way notices to the DACE and for the DACE to provide recommended minimum risk routes for other-Service aircraft to the CRP. This net is monitored by the brigade operations center. Personnel and equipment to operate this net should be provided by the USAF.

b. *Division to brigade airspace net.* Provides for direct communications between the DACE, the FCC, and the brigade operations center by other than chain of command communications systems. This net is used for internal coordination of airspace within the division, to include recommendation of minimum risk routes for USAF flights to the DACE.

c. *Air defense alert nets.* Provide for alerting of air defense fire units in division rear and in each brigade, to supplement aircraft identification capabilities of the air defense units.

d. *Brigade air-to-ground nets.* Provide a direct communications link between Army aircraft transiting or operating in the brigade and the brigade operations center. This net is used for minute-by-minute airspace coordination with Army aircraft in the brigade airspace. The brigade operations center is the net control station (NCS) of this net.

(2) *Army aviation.*

(a) A system of flight operations centers (FOC), flight coordination centers (FCC), approach and departure control facilities, airfield control towers, and navigation aids are provided throughout the field army area for the control and coordination of Army aviation. The FOC/FCC provide air traffic regulation services to enroute air craft. The approach/departure control function may be located in an FSA, a radar facility, or a control tower. Approach/departure control provides air traffic service to aircraft arriving, departing, or overflying its area of responsibility. Contiguous approach/departure control facilities can provide enroute service between their areas of responsibility. The airfield control towers are part of the terminal traffic control (TTC) system and issue landing and takeoff clearances to control aircraft within the airport traffic control area.

(b) Army pathfinder units provide navigational assistance and aircraft control services as necessary during any phase of an operation that requires sustained employment of Army aircraft. Pathfinders are normally used to select, improve, mark, and control landing and drop zones. They may also operate at forward helipads. The pathfinder facility maintains communications with aircraft and fire support units as necessary for control and coordination in the landing and drop zone area. Unit terminal guidance personnel may perform similar functions.

(3) *Air Force.* The Air Force's radar-supported control and reporting centers and air traffic regulation center (CRC/ATRC), control and reporting posts (CRP), and forward air control posts (FACP) provide air surveillance and control of Air Force aircraft. The CRP in conjunction with the Division Airspace Control Element (DACE) and the Brigade Operations Center will determine minimum risk flight routes for Air Force flights through and within the division area. The CRC/ATRC is the control focal point, with the other elements being forward extension thereof. This system directs Air Force air defense intercepts and also control Air Force offensive missions until the aircraft are handed off to other systems or to forward air controllers. The Air Force also provides direct air support centers (DASC), tactical air control parties (TACP), and forward air controllers (FAC) to assist the Army in requesting and coordinating USAF tactical air support and to control such support as necessary. They work closely with the S2 and S3 Air or tactical air support element (TASE) in the Army command posts and tactical operations centers.

(4) *Field artillery and mortars.* Field artillery and mortar units maintain a system of fire direction centers (FDC) for internal fire control. Field artillery units provide the fire support element (FSE) at the various levels. Mortar units are directly controlled by the

maneuver unit commanders and are expected to continue to operate in the manual mode. The primary function of the FSE is to provide command coordination of supporting fires on surface targets. In some instances, mortar fires may be coordinated with field artillery fires.

(5) *Army air defense.* Army air defense operations are controlled by Army Air Defense Command Posts (AADCP). The AADCPs controlling the Hawk and Nike Hercules weapon systems are supported by local radars and semiautomatic control and coordination systems. The divisional air defense artillery (ADA) battalion and nondivisional Chaparral/Vulcan battalion AADCPs are manual and feature full decentralization of engagement control of the Chaparral and Vulcan air defense artillery weapons. The higher level semiautomated ADA control systems provide options for either centralized or decentralized engagement control of the all-weather weapons (Hawk, Nike Hercules). Control authority for Redeye and other organic weapons capable of engaging aircraft rests with the using unit, subject to compliance with established joint procedures and unit SOP. Air defense fire units will be alerted to US Air Force flights, selected single aircraft flights, and multiaircraft Army flights approaching their location.

(6) *Airspace control element (ACE).* Current doctrine provides for an ACE at division, corps, and field army level to serve as the commander's focal point for airspace control. The ACE is manned by personnel form organic, attached, and supporting ADA and Army aviation units. Recommended manning levels are listed in the tactical operations center appendix to FM 101-5.

(7) *Further details.* FM 1-60, FM 6-20 (when published), FM 6-140, FM 44-1, FM 44-3, FM 61-100, FM 100-26, and FM 101-5 provide further discussion.

APPENDIX A

REFERENCES

A-1. Department of the Army Regulations (AR)

310-25	Dictionary of United States Army Terms.
310-50	Authorized Abbreviations and Brevity Codes.

A-2. Department of the Army Field Manuals (FM)

1-60	Army Air Traffic Operations.
6-20-1	Field Artillery Tactics (When published).
6-20-2	Field Artillery Techniques.
6-140	Field Artillery Organizations.
11-50	Signal Battalion, Armored, Infantry, Infantry (Mechanized) and Airmobile Divisions.
11-92	Corps Signal Battalion and Airborne Corps Signal Battalion.
11-125	Field Army Signal Communications.
24-1	Tactical Communications Doctrine.
44-1	US Army Air Defense Artillery Employment.
44-3	Army Air Defense Artillery Employment, Chaparral/Vulcan.
61-24	Division Communications.
61-100	The Division.
100-26	The Air-Ground Operations System.
101-5	Staff Officers Field Manual: Staff Organization and Procedures.

A-3. Joint Chiefs of Staff Publications (JCS PUB)

JCS Pub 1	Dictionary of United States Military Terms for Joint Usage.
(FOUO) JCS PUB 8	Doctrine for Air Defense from Oversea Land Areas.

A-4. Miscellaneous

USACDC Study: Field Army Airspace Utilization Study II (FAAUS II).

APPENDIX B

AIRSPACE CONTROL IMPLEMENTING INSTRUCTIONS

B-1. Introduction.

a. The airspace control system (personnel, equipment, and procedures) has been designed to assist the commander in his conduct of the battle to the end of tactical mission accomplishment. This system requires the transmission of base information between elements of the division and also additional information from Air Force command and control facility. Some of this information is:

(1) Minimum risk route queries.

(2) Minimum risk route advisories.

(3) "On the way" notices.

(4) Air defense alerts.

b. The advisory service provided to the Air Force is intended in no way to usurp the prerogatives of the Air Force component commander but is analogous to a weather advisory. The pilot is advised of the hazards, and he must make the final decision to accept or reject the route.

c. Considering airspace control as an integral part of his planning and execution cycle is of value to the commander as it provides him another facet to complete his picture of the battle area and results in successful mission accomplishment.

B-2. Airspace Organization.

a. This system utilizes the already existing airspace control organization (the DACE), as prescribed in FM 101-5, Staff Officers Field Manual, Staff Organization and Procedures. It is augmented at division level and provides for augmentation at the maneuver brigade level with liaison officers from aviation, air defense, field artillery, and the US Air Force.

b. This organization, as shown in figure B-1, provides for the function of airspace control within the division.

B-3. Airspace System.

a. In addition to the DACE, this system envisions the augmentation of a brigade's operations center under the staff cognizance of the brigade S3 and is staffed by the liaison personnel shown in figure B-1.

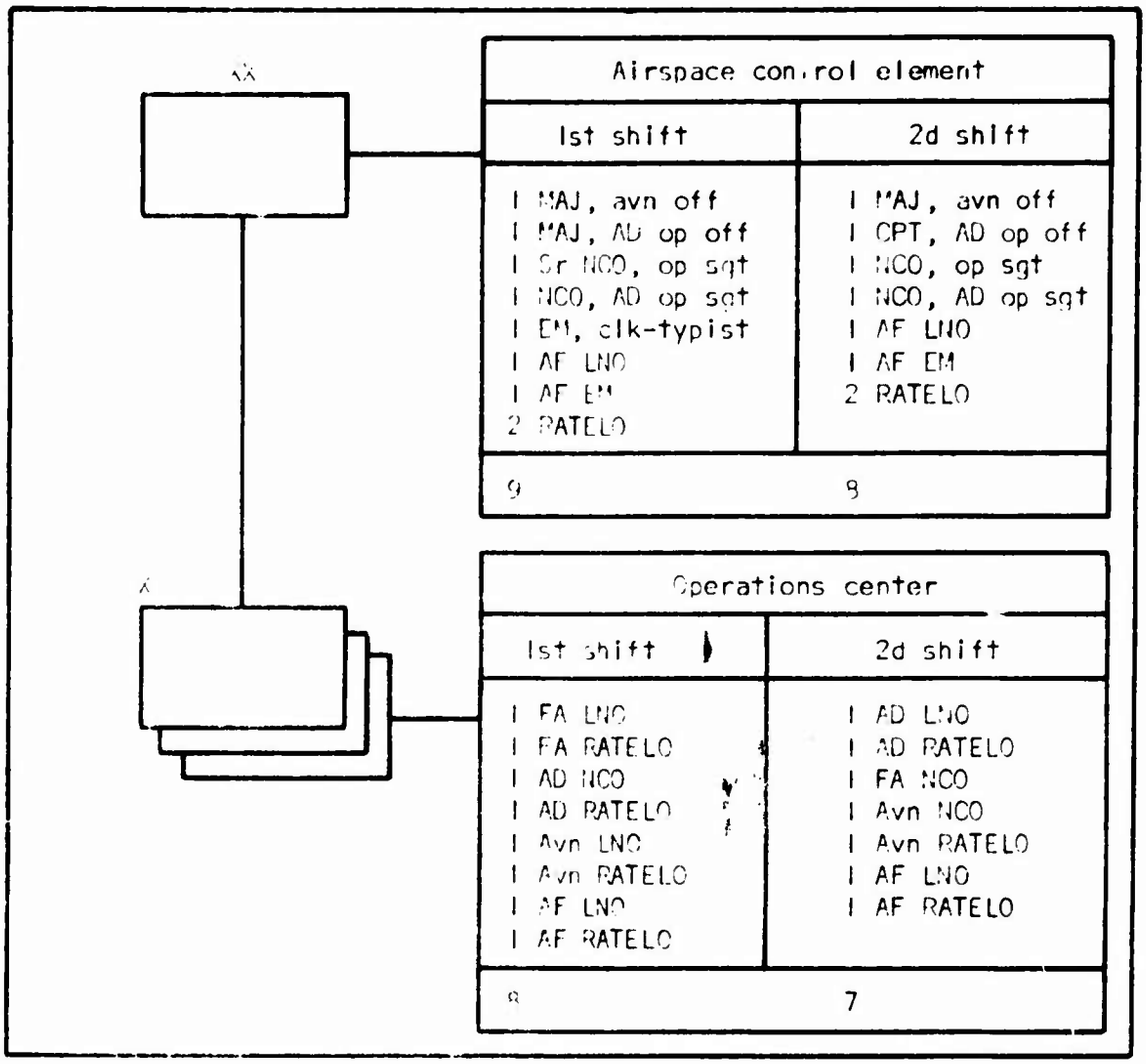


Figure B-1. Division Airspace Organization

b. The internal coordination required to assure the proper integration of the activities within the purview of the maneuver commander is accomplished by the personnel on a face-to-face basis with other members of the division and brigade staffs. Appendix D outlines the information necessary within these organizations to accomplish the airspace control function.

c. The DASE is the focal point for the functioning of this system. In addition to its original function as a preplanner of airspace activity, it now has the added function of an airspace operator. It is responsible for determining route advisories for AF and Army aviation flights through the division rear and for providing AD alerts for the fire units that are located in the division rear.

Para B-3, Airspace System (cont)

(1) This system requires the establishment of a long-range secure radio net which links the Air Force control facility and the divisions and brigades. This net is only monitored at brigade headquarters and is used as a cueing device to the possibility of a route requirement. It is also used to expedite "on the way" information for ADA alerting. AF aircraft passing into, through, or out of the division area will, upon request, receive a minimum risk route advisory from the DACE through their CRP/C. These advisories will be recommended by the brigade operations center based on their knowledge of activity within the brigade and the current tactical situation. The Air Force control facility will provide the division and brigades with the estimated time of arrival of the flight into the division area. The AD fire units (Chaparral/Vulcan) will be alerted by the DACE or brigade operations center over the AD alert net.

(2) To provide information to the AD fire units (Chaparral/Vulcan) on friendly aircraft, an air defense alert net (secure net) is required for the division. This net is composed of four separate parts, with each brigade being the net control station for the fire units located in its area. The division ACE provides the same information to the fire units located in the division rear area. This alert of friendly aircraft will apply to both AF and Army aviation.

(3) For internal airspace activities within the division, a division airspace FM radio net will be established. This net will be utilized for the division to request route advisories for USAF and Army aviation, for the brigades to advise each other of flights crossing over the adjacent brigade's boundaries, and for the interchange of information necessary to perform the airspace control function. The division FCC will also maintain a station in this net.

(4) The passage of Army aviation through the brigade areas requires the establishment of an air-to-ground net at brigade level. Initially, the aircraft will contact the Army air traffic control facility to request a recommended route advisory through the division. The Army air traffic control element will contact the division to obtain a recommended routing, if necessary. The division may in turn contact the brigade in which the aviation support is being provided in order to obtain a recommended route through or into the brigade. The routing advisory will be provided to the FCC, who will provide it to the aircraft. Upon crossing the division rear boundary and prior to crossing the brigade rear boundary, the aircraft should contact the brigade on the air-to-ground net to determine if there was a change to the routing advisory or if it is still current. Based upon the information of estimated arrival time provided by either the Army air traffic control facility or the pilot, the air defense fire units will be alerted to the flight.

Para B-3, Airspace System (cont)

(a) It may be advantageous to the division commander, based upon his analysis of the rotary-wing aircraft threat of the opposing force, to impose restrictive measures upon his air defense fire units with regard to rotary-wing aircraft flights. This will accomplish two objectives. It will decrease the number of alerts required to be given, and it will provide additional safeguards to aircraft operating in this manner.

(b) Army aircraft flights originating from within the brigades can obtain their advisories from unit operations or by contacting the brigade on the air-to-ground net.

(5) The control of divisional Redeye assets will be accomplished by dissemination of applicable information through the appropriate unit's command and control channels.

B-4. Communications. The communications requirement to support the airspace control system is shown in figure B-2 and described below:

a. Air Force routing net. This is a sole user, long-range, two-way, secure voice radio net which is only monitored at the brigade level. This net is used for minimum risk route queries, minimum risk route advisories, and "on the way" notices.

b. Division brigade airspace net. This is a sole user, two-way, secure voice radio net used for internal coordination of recommended route queries, recommended route advisories, and "on the way" notices for Army aviation. The Army air traffic control facility also has a station in this net.

c. Air defense artillery alerting net. This is a sole user, one-way, secure voice radio net used by either the division ACE or brigade operations center to alert air defense fire units to the presence of friendly aircraft.

d. Brigade air-to-ground net. This is a sole user, two-way, secure radio net used at the brigade operations center for coordination of Army aviation flights.

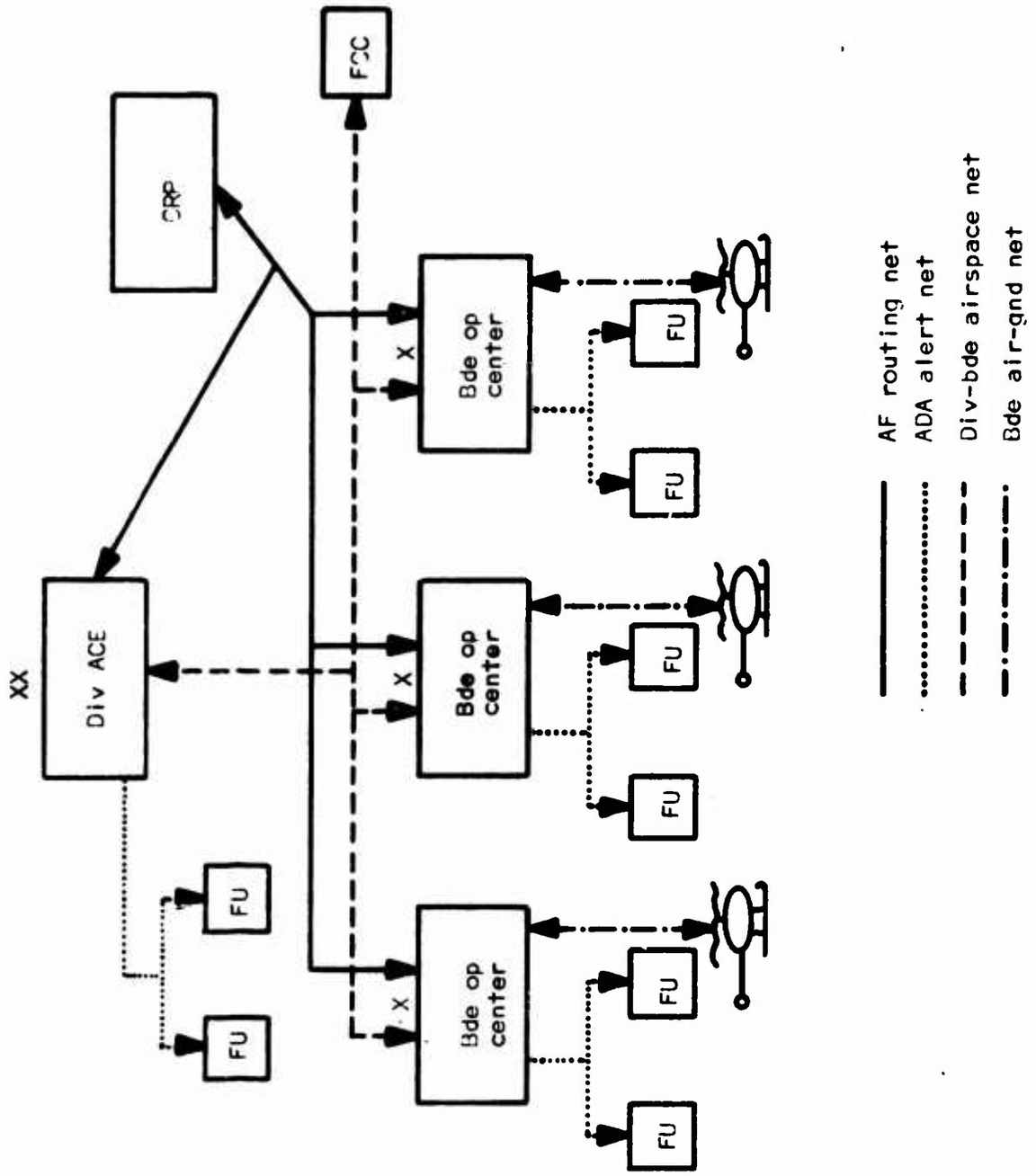


Figure B-2. Airspace Control Communications System

APPENDIX C

DEFINITION

This annex contains definitions peculiar to airspace control.

a. Minimum Risk Routes Query. A request from a US Air Force command and control facility or Army aviation element to a US Army division for a route which would present the minimum hazards to flight through a division area.

b. Minimum Risk Route Advisory. A route through the division area in response to the Air Force or Army query which has been developed by the DACE and/or brigade operations center and presents the minimum hazards to flights.

APPENDIX D

INFORMATION REQUIREMENTS

D-1. Purpose. This appendix defines the information requirements necessary to support the Army Airspace Control System.

D-2. Introduction. Airspace control, like any other tactical function, requires certain information to serve as the basis for decisions. Most of the information used by the commander and his staff to formulate courses of action and selected the optimum course of action also relates to the airspace control functions. Therefore, the information requirements discussed in this chapter are for the most part currently reported to the command post or operations center. The information requirements are presented here to emphasize their role in the airspace control function. This information is related to an individual or section who collects, correlates, presents, and disseminates that information. The reader must also not let the list be an all-inclusive or a limiting force. The operator must continuously reevaluate his and the command post's or operation center's requirements for information. Where voids or deficiencies in information occur, actions will be initiated to fulfill that requirement.

D-3. Information Requirements. The duties and information provided by the individuals or sections which are listed below relate to airspace control and in no sense of the word modify the individual's or section's other requirements.

a. Commander. The commander must insure that his planning guidance, selection of concepts of operation, selection of courses of action, and other decisions have considered the impact on airspace control. He must also insure that he and the members of his staff advise the DACE and brigade operations center airspace control operators as to which of their actions affect control of airspace.

b. Operations section (G3 and S3). As the staff focal point of the overall command operation the G3 and S3 must insure that the DACE and brigade operations center airspace control operators are fully informed. Some of the specific information is:

(1) Overall tactical situation.

(2) Unit positions.

(3) Areas of active ground combat.

(4) Aerial tactical operations.

Para D-3, Information Requirements (cont)

(a) Air cavalry operations.

(b) Airmobile operations.

(c) Attack helicopter operations.

(5) Redeye status.

(6) Command and control aircraft allocations.

(7) Air traffic control measures.

(8) Airborne-paradrop operations.

c. Intelligence section (S2 and G2). Since the enemy is one of the significant users of airsapce, the intelligence officer's input of the current enemy situations and ongoing activities to the airspace control operators is of prime importance. This requirement must not be construed to mean that detailed round-by-round or minute-by-minute flight information is required or desired. Some examples of the specific information required are:

(1) Enemy situation and current activity.

(2) Enemy ADA positioning and capabilities.

(3) Information that satisfied any of the EEI or OIR of airspace users.

(4) Army aerial reconnaissance and surveillance plans.

(5) USAF reconnaissance support planned and requested.

d. Logistics section (G4 and S4). Any logistical effort that uses airspace must be reported to the DACE-brigade operations center. The logistics officer must keep the DACE-brigade operations center aware of the logistical system and situation to allow maximum leadtime if an air line of communication is necessary to support the situation.

e. Fire support section (FSCC-FSE). The field artillery officer and his section are part of the brigade operations center and are the nucleus of the FSE at division level. In either case these sections become primary participants in the airspace control function. Some of the specific information they provide is:

Para D-3, Information Requirements (cont)

(1) Field artillery positions and activities.

(2) Priorities of fires as directed by force commander.

(3) Naval gunfire activity current and planned.

(4) Enemy artillery positions and activities.

(5) Artillery fire plans and schedules of fires.

(6) Non-troop-support fires.

(7) Aerial field artillery activities.

(8) Flak suppression capabilities and program.

e. Aviation section. This section is part of the DACE or brigade operations center. It is a primary operator in the airspace control function. Some of the specific information provided by this section is:

(1) Status and major activity of aviation units under division-brigade control or in their support.

(2) Army IFR and VFR airway system data.

(3) Airfield-heliport terminal area location.

(4) Air traffic controls in effect.

(5) Aviator support requirements planned and requested.

(6) Enemy air (rotary-wing) capability and current activity.

(7) Medical evacuation activities.

(8) Aviation IFF status.

f. Air defense artillery section. This section is part of both the DACE and the brigade operations center. It is a primary operator in the airspace control function. Since ADA and all arms AD weapons are the greatest potential hazard to manned aircraft, their participation is significant. The air defense artillery section must provide information on the air defense of the command. Some of the information provided by the air defense artillery section is as follows:

Para D-3, Information Requirements (cont)

(1) ADA weapon locations.

(2) ADA weapon status.

(3) Redeye and all arms AD weapons status.

(4) DEFCON and DEFREP.

(5) FAAR position and TADDS frequency.

(6) AD warning.

(7) Enemy AD capabilities and position.

(8) ADA IFF capabilities.

(9) Adjacent unit ADA information. Enemy aerial activity information.

c. US Air Force liaison section. This section provides Air Force participation in the decision process of minimum risk route selection for AF aircraft. They work in the DACE and brigade operations centers but are under the operational control of the AF command and control facility. The information contributing to the DACE-brigade operations center includes:

(1) Air Force flight information.

(2) Air Force flight restrictions and traffic controls.

(3) Enemy air activity.

(4) Restrictions and prohibited zones.

(5) USAF planned air activities.

(6) Other Air Force information.

APPENDIX E

DISPLAYS, TECHNIQUES, AND SYMBOLOGY

E-1. Introduction. The information in annex D which is reported to the DACE and the brigade operations center must be converted into graphic displays. The displays allow the operators to envision the relationships of the various airspace users to the tactical situation. It also allows the viewer to predict and plan to avoid or prevent potential hazards to airspace users. Since the reported information is being used for airspace control decisions, some new techniques are associated with these decisions. Current map symbols are not adequate to portray some of the actions of the airspace users; therefore, a few airspace control special map symbols are required. The additional displays, techniques, and symbols are held to a minimum, and maximum use of existing ones is encouraged.

E-2. Displays.

a. Displays used by the DACE will be shared by both the air defense artillery section and the aviation section. Since the DACE is collocated with or adjacent to the G2 or G3 element of the TOC and the FSE, the current displays of these elements can be used by the DACE for periodic updates and long term planning. There is a requirement for two displays in the DACE. One must be of the same scale as the other displays in the TOC and be able to accept overlays from those maps. Normally, this is the FAM and tactical situation display. The other may be a battle map like the first or can be a plain, white grid sheet. The plain sheet allows the posted data to be viewed without the background clutter. Information pertaining to air defense, air defense artillery, and air traffic is often not too dependent on terrain considerations. This option has merit in this case. Both displays should have basic tactical control (boundaries, etc.) and air traffic control information (air control references system; i.e., TACAN radials) posted on the base sheet or base overlay.

(1) One map or grid sheet display should have all the air defense information passed on it. Restricted and prohibited zones, weapons free areas, aircraft identification zones, air traffic control lines, etc. should also be included. Enemy AD information must be included on this display.

(2) The second display must be a battle map of the scale used by the G2 or G3 element for the current situation, normally 1:50,000. This map has the FAM information posted on it. Aerial maneuver forces and air cavalry operations must be posted on this map. Air or aerial fire support activities must be portrayed on this display.

b. At brigade headquarters, the FSCC is part of the operations center. This allows the operations center the use of the current FSCC FAM displays under some tactical conditions. In other cases an additional FAM display will be required. Other than this consideration, the displays required by the operations center are the same as the DACE.

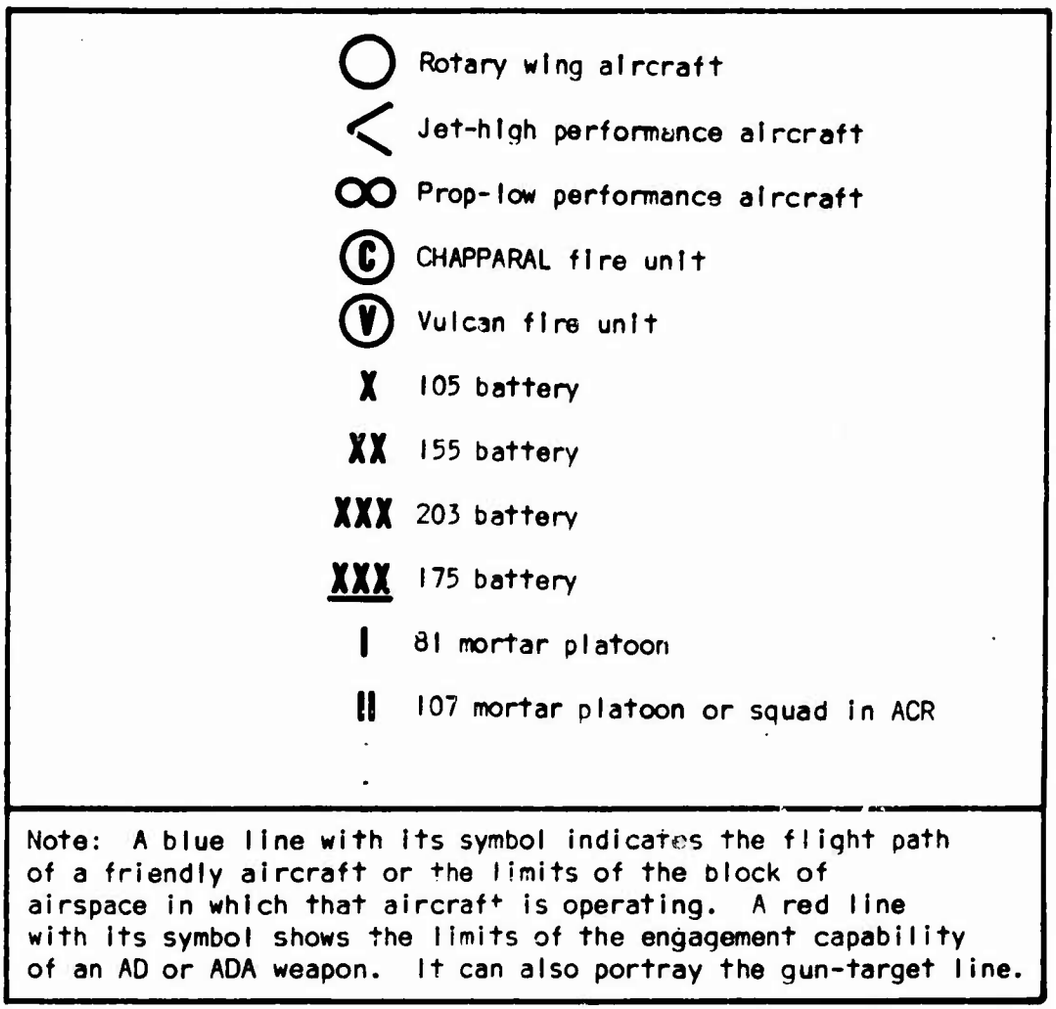
E-3. Techniques. The techniques described here and in appendix B are designed to give the operator a general basis from which he can depart to satisfy the needs of the specific situation. This technique is best described as a process of analyzing the hazards to a manned flight and deducing those steps that can be taken to avoid or neutralize those hazards and not degrade mission accomplishment. Basically, the operator receives an airspace action involving a manned aircraft. He then plots the flight on the AD map or display. He determines those areas that require air defense alerting and considers the enemy AD threat. The enemy threat can be avoided by rerouting or using countermeasures to neutralize it. With the potentially greatest threat or hazard minimized, he now plots the flight on the FAM battle map display. He attempts to pick a route to avoid high activity areas and air operations areas. Deviation must be within the limitation of the mission requirements. All routing recommendations are developed in concert with the representatives on the agency who is doing the flying. This representative may accept, reject, or modify these recommendations. He also passes alerting information to those agencies which need to be advised. This technique only attempts to aid the manned aircraft in minimizing the risk but does not eliminate it.

E-4. Symbols.

a. FM 23-5, Military Symbols, will be used to the extent possible on airspace displays. Plotting of FAM fire units (batteries, ADA fire units (weapons), and aircraft flights) is impractical with current symbology; therefore, symbols shown in E-1 will be used for airspace control displays.

b. Examples of airspace control symbology are shown in figure E-2. Annotations will be made on these lines using the symbols presented in figure E-1 to designate the type of aircraft or weapon related to that line. Aircraft lines should have the identification number posted on them and, when available, should have the flight altitude posted in thousands of feet above sea level. In cases where the aircraft is flying a nap-of-the earth profile, an N will indicate that profile. In those cases where the duration of an airspace block is known, the ending time can be posted on the line delineating that block.

Para E-4, Symbols (cont)



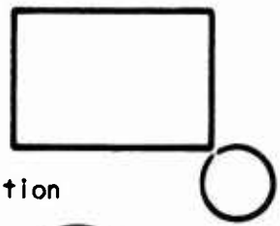
Note: A blue line with its symbol indicates the flight path of a friendly aircraft or the limits of the block of airspace in which that aircraft is operating. A red line with its symbol shows the limits of the engagement capability of an AD or ADA weapon. It can also portray the gun-target line.

Figure E-1. Airspace Control Symbology

Para E-4, Symbols (cont)

Jet aircraft flight path

Rotary wing airspace block, three aircraft



Vulcan fire unit position

155-mm battery firing on a non-troop-support target, registration

Figure E-2. Examples of Airspace Control Symbology

APPENDIX F

FUNCTIONS AND PROCEDURES CHARTS

Purpose. This appendix describes the functions and procedures to be used by the personnel operating within the airspace control system.

Steps	Battalion size units	Brigade size units	Division size units	Army air traffic control element	USAF air traffic control element
Request.	Initiates request on air request net.	Monitors request on air request net. Staff evaluation. Concurrence or non-concurrence on air request.	Monitors request on air request net. Staff evaluation. Concurrence or non-concurrence on air request.	No action.	No action.
Mission approval.	Advised of approval on air request net.	Advised of approval on air request net.	Advised of approval on air request net.	No action.	No action.
Minimum risk route queries (Recurring and USAF-initiated missions may start at this step.)	No action.	Monitors request on CRP-div net.	Receives request on CRP-div net.		Initiates route request on CRP-div net.
		Receives div request for MRR on div-bde airspace net.	Contacts brigade on div-bde airspace net.	Monitors div request for MRR on div-bde airspace net. Advises DACE of Army activity.	
		Determines route thru internal coordination and advice of AF LNO (fig F-3).			
		Advise div of selected MRR on div-bde airspace net.	Receives bde MRR on div-bde airspace net. Concurs in route or changes thru internal coordination and advice of AF LNO.	Monitors bde MRR div-bde airspace net.	

Figure F-1. Functions and Procedures Air Force Missions

Steps	Battalion size units	Brigade size units	Division size units	Army air traffic control element	USAF air traffic control element
Minimum risk route advisory to CRP.	No action.	Monitors route passed to CRP on CRP-div net.	Transmits route to CRP on CRP-div net.	No action.	Receives route on on CRP-div net. Directs aircraft on MRR or other route as desired.
"On the way" (OTW) notice.	No action.	Monitors OTW notice on CRP-div net. Transmit OTW to ADA fire units on AD alert net (fig F-4). Advise adjacent bde of flight near their boundaries or crossing over the boundaries. The adjacent div-bde airspace net is used.	Monitors OTW notice on CRP-div net. Transmit OTW to ADA fire units on AD alert net. Advise adjacent div of flight near their boundary or crossing over the boundaries on that division's div-bde airspace net.	Provide advisory to Army aircraft on USAF flight (if required).	Initiates OTW notice.

Figure F-1 (cont). Functions and Procedures Air Force Missions

Steps	Battalion size units	Brigade size units	Division size units	Army air traffic control element	USAF air traffic control element
Request.	Initiates request on higher headquarters designated net.	Receives battalion request on designated net or initiates own request. Staff evaluation. Concurrence or non-concurrence on request. Fills request from own assets or forwards request to higher headquarters on designated net.	Receives request on designated net. Staff evaluation. Concurrence or non-concurrence on request. Fills request from own assets or forwards request to higher headquarters on designated net.	No action.	No action.
Mission approval.	Advised of approval on on designated net.	Approves mission or is advised of approval on designated net.	Approves mission or advised of approval on designated net.	No action.	No action.
Minimum risk route queries. (Due to the tactical situation, mission may start at this point.) (See note 1 and 2.)	No action.	Receives division minimum risk request for route on div-bde airspace net. Determines route thru internal coordination and advice of avn LNO (fig F-3). Advise division of selected minimum risk route on div-bde airspace net.	Receives queries from FCC on division-brigade airspace net. Determines route thru internal coordination and advice of avn LNO (fig F-3). Receives bde minimum risk route on div-bde airspace net.	Initiates query to division on div-bde airspace net or receives aircraft request. Receives bde or div minimum risk route on div-bde airspace net.	Initiates request to FCC on designated net or contacts bde on air-ground net.

Figure F-2. Functions and Procedures Army Aviation Missions

Steps	Battalion size units	Brigade size units	Division size units	Army air traffic control element	USAF air traffic control element
Minimum risk route to aircraft or FCC. (See note 1 and 2.)	No action.	Passes route to aircraft on bde air-ground net. Passes route to div on div-bde airspace net.	Passes route to FCC on div-bde airspace net.	Passes route to FCC on designated net if required. Passes route to aircraft.	Receives route from FCC or bde.
"On the way" (OTW) notice.	No action.	Monitors OTW notice on division-dbe airspace net or receives it from the aircraft on the bde air-ground Transmits OTW to ADA fire units on AD alert net (fig F-4). Advise adjacent bde of flights near their boundaries or crossing boundaries on the div-bde airspace net.	Monitors "on the way" notice on div-bde airspace net. Transmit OTW to ADA fire units on AD alert net (fig F-4). Advise adjacent div of flights near their boundaries or crossing boundaries on the adjacent div airspace net.	Passes "on the way" notice to div and bde on the div-bde airspace net.	Initiates OTW notice to FCC on designated net or to bde on the air-ground net.

Note 1: Consideration for aerial maneuver and air cavalry elements. Those maneuver or cavalry elements who are mounted in aircraft have their flights through the division and brigade airspace controlled in the same manner as command support aviation mission. The only difference occurs once they arrive in their area of operation. There, the aerial force commander may be given his own area of operation and becomes his own airspace coordinator, or he is working for another maneuver commander who performs the airspace control function. The degree of the coordination problem is also reduced in the near forward area situation since these aircraft will be flying at a very low level.

Note 2: Special considerations for aerial fire support elements. Aerial fire support means are handled in the transit phase in the same manner as command supported aviation missions. In the target area the unit commander or forward observer provides the local target area airspace control.

Figure F-2 (cont). Functions and Procedures Army Aviation Missions

Requirement	Supporting information	Communication channel	Actions required
Routing advisory.	ADA weapon positions and control status.	ADA liaison party.	Evaluation air mission route request. Where is the aircraft? Where does it need to go? Can it accept a time change? What are the altitude restrictions?
	Redeye and unit weapons control status.	S3-G3 channels, OPORD's, requests for air-aviation support.	Are ADA weapons, Redeyes, and unit weapons alerted or on weapons hold? If not avoid these areas or alert these areas.
	Field artillery firing unit positions.	Fire support coordination centers and fire support elements.	Where is the concentration of FAM fire units? Avoid overflight of these areas.
	Heavy mortar positions.	Bn G3 into fire support channels.	Are these fire units firing? If so, where? Avoid these areas.
	Firing programs that are scheduled.	Schedules are passed through FA command fire channels to direct support battalion level with the FSE's, and FSCC's advised by their unit FDC's.	Where are the other aircraft working that are not under positive radar traffic control? Avoid penetration or insure that the penetrating aircraft are working for the commander who has the other aircraft in the area.
	Non-troop-support fires.	Schedules are passed through FA command and fire channels to direct support battalion level with the FSE's and FSCC's advised by their unit FDC's. Plus all field artillery units will establish communication with the direct support battalion supporting the brigade in whose zone they are positioned.	Analyse the similar enemy potential conflicts. Avoid if possible. Consider suppression if needed.
	Areas where aircraft are operating and not under an air traffic control system.	S3-G3 channels provide information on aviation tactical operations. Aviation unit liaison provides information on other aviation activities. TACP's provide information on close air support strikes in progress.	What are the other tactical situation considerations?
	Enemy ADA, FA, and mortar positioning and activities.	S2-G2 channels.	Recommend to the USAF-avn rep that route when allows the mission accomplishment and the least risk. In the absence of a USAF-avn rep, recommend to requesting agency.

Figure F-3. Routing Advisory

Requirement	Supporting information	Communication channel	Actions required
Air defense artillery alerting. (Normally, forward area weapons *only*.)	ADA weapons control status. Redeye and unit weapons control status. USAF, other air forces flight information. US Army aviation flight information	ADA liaison party. S3-S3 channels, OPORDS, requests for air and avn support. USAF flight information will be received over the Air Force CRP net from the controlling USAF facility. US Army aviation flight information will be received from the FCC, S3-S3 channels, or from the aviators over the bde air to ground net or other designated net.	Determine if the ADA weapons are in a weapons hold status. If so, no alerting is required. Determine if the Redeye and unit weapons are at weapons hold status. If so no action is required. If ADA weapons or all service antiaircraft weapons are other than weapons hold, the aircraft route must be visualized on the situation display. Does the aircraft pass through the zone of effects of your ADA weapons or through your unit's air space? Broadcast an alert to all ADA fire units in your area, including other weapons if your commander desires, over the ADA alert net. The alert should include effective time period, direction of flight, number and type of aircraft, and speed and altitude. If flight is in range of adjacent AD weapons, the adjacent brigades operations section must be contacted and they will alert the weapons in their zone.

Figure F-4. Air Defense Artillery Alerting

APPENDIX 2

MAJOR ITEMS INCLUDED IN BOTH FM 44-10 AND THE REVISIONS RECOMMENDED BY MASSTER

The following major items are included in both FM 44-10 and the revisions recommended by MASSTER.

a. Chapter 1.

(1) Purpose and Scope.

(2) Background.

b. Chapter 2.

(1) Principles.

(2) Airspace Users.

(3) Command Responsibilities.

(4) Organization.

c. Chapter 3.

(1) Control Levels.

(2) Airspace Conflict Resolution Precepts.

d. Chapter 4.

(1) Differences From Division Arispace Control.

(2) Responsibilities.

APPENDIX 3

MAJOR ITEMS IN FM 44-10 BUT OMITTED FROM THE MASSTER RECOMMENDATIONS

This appendix lists the major items in FM 44-10 which are omitted in the MASSTER-recommended revisions. The appendix includes references to the FM 44-10 paragraph locations of the information, short paraphrases of the information, and explanation for omissions.

a. Reference: Paragraph 2-1a.

(1) Information. The principle of a vertical boundary (coordination altitude) for controlling airspace is interjected.

(2) Explanation. The concept of a coordination altitude will impose unnecessary restrictions on the maneuver commander. It will also impose a requirement for a great deal of communication between maneuver elements and other Services. A coordination altitude would require clearance for firing artillery, mortars, and air defense. It would also require clearance for high-flying Army aircraft. In certain situations special control procedures such as coordination altitude or flight corridors are appropriate. In other circumstances, for exapmle trying to impose a coordination altitude in mountainous terrain, the procedures would be unworkable.

b. Reference: Paragraph 2-4b(6)(b).

(1) Information. There is a tentative doctrinal requirement for a full-time brigade airspace control element.

(2) Explanation. The possible requirement to establish a brigade airspace control element (BACE) was discussed in detail during the general officers airspace control conference (reference paragraph C-4c basic report). At this conference it was agreed that the control of airspace is an integral function of normal staff procedures and that no separate staff organization is necessary to perform the airspace control function at the brigade level. Airspace control functions under this system would be supervised by the operations officer in the brigade operations center. The operations officer would be assisted by combat support staff officers, staff officers, commanders and liaison officers from field artillery, air defense artillery, Army aviation, and Air Force when this type of support is being provided to the brigade.

c. Reference: Paragraph 3-2b(1)(a).

(1) Information. The normal weapons control status for division air defense weapons should be weapons tight.

(2) Explanation. While no change was found to be necessary in the normal division ADA weapons control status for CHAPARRAL-Vulcan fire units, it was found that it may be necessary to modify the normal weapons control status for Redeye (reference paragraph C-4c(2), basic report). In order to reduce the misidentification rate among CHAPARRAL-Vulcan fire units, air defense artillery alert nets were created to alert these firing units to the passage of friendly aircraft. Redeye firing units, on the other hand, are not under centralized control. A majority of the general officer airspace control conferees agreed that it would be costly for the ADA alert net to include Redeye firing units. Thus, in order to reduce the hazard to friendly aircraft, it may be necessary to consider weapons hold as the more normal air defense alert status for Redeye fire units.

d. Reference: Paragraph 3-3b(4)(c).

(1) Information. Army aircraft should obtain field artillery advisories before entering the airspace between any firing battery and the forwardedge of the battle area (FEBA).

(2) Explanation. The MASSTER-recommended system eliminates all fire warning nets and does not contain a BACE. Pilots may contact the flight coordination center (FCC) or the appropriate brigade operations center over the air-to-ground net and receive a minimum risk route if desired.

e. Reference: Paragraph 3-4a(2).

(1) Information. The ACE should be kept informed throughout the planning and execution phases of instrument flights.

(2) Explanation. The ACE does not need this information for the airspace control system recommended by MASSTER. The FCC, FOC, CRP, and CRC are the agencies monitoring instrument flights.

f. Reference: Paragraph 3-4b(1).

(1) Information. High-performance aircraft will commonly use low-altitude airspace during limited and general war.

(2) Explanation. This statement seems to define Air Force tactical doctrine. Our investigations reveal that the statement may not be true.

g. Reference: Paragraph 3-4b(2).

(1) Information. Various elements of airspace are controlled by different component commanders.

(2) Explanation. This statement was deleted as it outlined procedures which are more restrictive than the airspace control procedures recommended by MASSTER.

h. Reference: Paragraphs 3-5 and 3-5b.

(1) Information. Field artillery units are responsible for disseminating hazard to flight information. Aviators are responsible for monitoring field artillery fire warning nets.

(2) Explanation. The airspace control system recommended by MASSTER deletes all fire warning nets. Field artillery fire units are responsible for passing firing data to the brigade operations center and or the division airspace control element (DACE).

i. Reference: Paragraph 3-5b(1).

(1) Information. Field artillery firing data will be forwarded to the division FCC. The FCC will use the information in the routing of aircraft.

(2) Explanation. Under the airspace control system recommended by MASSTER, artillery firing data are passed to the brigade operations centers and the DACE but not to the FCC. The FCC passes minimum risk routes (MRR's) to aircraft based on the route received from the DACE.

j. Reference: Paragraph 3-5b(2).

(1) Information. A BACE can be formed to coordinate artillery fire mission information with other airspace control activities.

(2) Explanation. The airspace control system recommended by MASSTER does not contain a BACE (reference paragraph C-4e, basic report).

k. Reference: Paragraph 3-5c.

(1) Information. The Army has the responsibility for informing Air Force elements of field artillery and heavy mortar locations and operations.

(2) Explanation. In the airspace control system proposed by MASSTER, there is no requirement to inform the Air Force of field artillery data. The Air Force is given MRR's which avoid field artillery fires as whenever practical. In order to further eliminate field artillery-mortar (FAM) and Air Force incidents, the field artillery reschedules non-troop-support fires based on Air Force flight "on the way" data passed from the Air Force control facility to the DACE.

l. Reference: Paragraph 3-5d.

(1) Information. Helicopters will receive field artillery and mortar fire warning advisories.

(2) Explanation. The airspace control system recommended by MASSTER deletes all fire warning nets. Rotary-wing flights may contact the brigade operations center (BOC) if in a brigade area or the FCC if in the division rear in order to obtain MRR. These MRR's avoid field artillery and mortar fires whenever practical.

m. Reference: Paragraph 3-6a(3).

(1) Information. A coordination altitude is used in the coordination and air traffic regulation of operation over the battlefield.

(2) Explanation. The use of a coordination altitude is just one technique which may be used in regulating airspace. This is discussed briefly in paragraph 3-4b(4), annex G.

n. Reference: Paragraph 3-6b(2).

(1) Information: The airspace control element (ACE) regulates Army air traffic.

(2) Explanation. This paragraph was rewritten to clarify the role of the DACE and its relation with the FCC while performing airspace control functions.

o. Reference: Paragraph 3-7a(1), (2), (3), (4), (5), (6), and (7).

(1) Information. The manual includes examples of actions to be taken for emergency on-the-spot conflict resolution.

(2) Explanation. These examples of actions taken to prevent conflicts are not necessary as a part of this FM. They should, however, be included in unit SOP's.

p. Reference: Table 3-1.

(1) Information. This table summarizes individual and agency primary responsobilities for airspace control.

(2) Explanation. This table was deleted, as the responsibilities of airspace control agencies changed under the airspace control system recommended by MASSTER.

q. Reference: Chapter 5.

(1) Information. The chapter and the associated charts depict the communications typically required to support the airspce control system.

(2) Explanation. These charts were deleted because they did not depict the airspace control system recommended by MASSTER.

APPENDIX 4

MAJOR ITEMS IN MASSTER RECOMMENDED REVISIONS BUT EXCLUDED FROM FM 44-10

This appendix lists the major items in the MASSTER recommended revisions which are excluded from FM 44-10. This appendix includes references to the MASSTER-recommended revision, paragraph locations of the information, short paraphrases of the information, and explanations for the inclusions.

a. Reference: Paragraph 3 of the preface, page G-1-1.

(1) Information. The overwhelming majority of Army aviation operations are controlled through the chain of command under Army visual flight rules. There will be requirements for limited numbers of operations under instrument flight rules (IFR) for limited periods of time when commanders are assisted by air traffic regulating agencies.

(2) Explanation. It should be emphasized that almost all Army aircraft will operate at low level under visual flight rules. Consequently, Army aircraft can operate with a minimal amount of regulation by air traffic agencies.

b. Reference: Paragraph 2-4b(3).

(1) Information. Recommended minimum risk routes will be furnished to the Air Force for flights through and within the division area.

(2) Explanation. Current procedures attempt to pass a maximum amount of information to Air Force elements outside the division. These elements then route Air Force aircraft. Because of the volume of artillery and mortar fires and the nature of these fires and Army aircraft flights, it is almost impossible to transmit all current information up the channels to the Air Force air traffic control agencies. Consequently, the MASSTER-recommended revision provides for development of a minimum risk route at brigade and division headquarters. This route would be developed in conjunction with the Air Force personnel at brigade and division. It would be based on the division and brigade personnel's knowledge of the tactical situation and would have the objective of reducing hazards to aircraft flying in or transiting the division area. The Air Force would then decide whether or not to fly the recommended route or select another route. This procedure would permit more freedom of movement over the battlefield.

c. Reference: Paragraph 2-4b(5).

(1) Information. Friendly air defense units will be alerted to friendly aircraft flights.

(2) Explanation. MASSTER-recommended revisions include the requirement to notify (alert) friendly air defense artillery (ADA) units of the flights of friendly aircraft. It has been shown that alerting friendly ADA units reduces the probability of misidentifying and engaging friendly aircraft.

d. Reference: Paragraph 3-1a(2)(b).

(1) Information. Airspace control functions at brigade will be performed by a group of liaison personnel under the staff supervision of the brigade S3.

(2) Explanation. Airspace control functions at brigade are an integral function of normal staff procedures in the brigade operations center. For this reason, there is no requirement for a separate staff organization for airspace control. The S3, assisted by liaison officers from field artillery, air defense artillery, Army aviation, and the Air Force as they are required, will provide airspace control.

e. Reference: Paragraph 3-2b(1)(a) and (c).

(1) Information. The normal weapons control status for Redeye should be weapons hold. The normal status for all other division air defense weapons should be weapons tight for high performance aircraft and weapons hold for rotary-wing aircraft.

(2) Explanation. Friendly air defense (ADA) units misidentifying and engaging friendly aircraft create a problem area. The misidentification rate can be reduced by alerting friendly ADA units or by using a weapons hold weapons control status. Chaparral/Vulcan units can operate in a weapons tight weapons control status and reduce their misidentification rate with a radio alerting system. The Redeye units are numerous and widely dispersed. Because of the number of Redeye units, their method of employment, and the costs involved, it is not practical to use a radio alerting system for Redeyes. This leads to the recommendation that the normal weapons control status for Redeye should be weapons hold.

f. Reference: Paragraph 3-3.

(1) Information. Army aircraft will be provided minimum risk routes to minimize hazards during flight from friendly activities.

(2) Explanation. The division airspace control element (DACE) and brigade operations centers will develop minimum risk routes based on their knowledge of the tactical situation. These routes, which will minimize hazards to the aircraft from friendly activities, will be recommended to the aviator. The aviator, in accordance with his unit SOP, will decide

whether or not to fly the recommended route. This procedure will allow more freedom of movement over the battlefield.

g. Reference: Paragraph 3-4b(3).

(1) Information. Air Force aircraft will be provided minimum risk routes upon request.

(2) Explanation. This concept is discussed in comment f(2), above.

h. Reference: Paragraph 3-5a.

(1) Information. Artillery fire direction centers (FDC's) and maneuver battalions will provide firing position locations and firing information to the brigade operations center.

(2) Explanation. Because of the volume of artillery fire, information concerning the fires will be passed only as far as the brigade. The brigade operations center will use this along with other information to develop minimum risk routes for aircraft.

i. Reference: Paragraph 3-6, a, 1 (c).

(1) Information. In general, other Service can operate free of restrictions over the land battle area.

(2) Explanation. The Army recommends minimum risk routes based on its knowledge of the tactical situation. The other Services make the final decision on what route will be flown.

j. Reference: Paragraph 3-6a(4)(d) and b (1) (c).

(1) Information. Frag orders and "on the way" messages are passed from the CRP to the DACE. The DACE provides recommended minimum risk flight routes to the control and reporting post (CRP) on request.

(2) Explanation. The frag orders and "on the way" messages assist the Army in development of minimum risk routes for Air Force aircraft. The minimum risk route concept is discussed in comment f(2), above.

k. Reference: Paragraph 3-6a (4) (f) and b (1) (d).

(1) Information. Friendly air defense artillery units will be informed of the flights of friendly aircraft.

(2) Explanation. The MASSTER recommendation includes a requirement to implement a radio ADA alert net. This net will be used to inform

ADA units of friendly aircraft flights. The purpose of this alert is to reduce the rate of misidentification of friendly aircraft.

l. Reference: Paragraph 3-6b.

(1) Information. This section explains the functions of the brigade operations center which serves as the commander's focal point for brigade airspace control.

(2) Explanation. The concept of the brigade operations center was previously discussed in comment appendix 3. Paragraph 3b(2) gives details concerning the brigade operations center.

m. Reference: Paragraph 5-2.

(1) Information. The four types of communications nets required to support the airspace control system are the CRP to division net, the division to brigade airspace net, the air defense alert nets, and the brigade air-to-ground nets.

(2) Explanation. This section describes the communications nets which are required to operate the airspace control system outlined in the MASSTER-recommended revisions.

n. Reference: Appendix B.

(1) Information. Detailed airspace control implementing instructions.

(2) Explanation. This section was added for clarity.

o. Reference: Appendix D.

(1) Information. An explanation of the information requirements necessary to support the recommended airspace control system.

(2) Explanation. This section was added for clarity.

p. Reference: Appendix E.

(1) Information. A discussion with examples of displays, techniques, and symbology used in the recommended airspace control system.

(2) Explanation. This section was added to assist the implementors of the airspace control system.

q. Reference: Appendix F.

(1) Information. Charts which delineate the functions and procedures to be used by personnel operating within the airspace control system.

(2) Explanation. This provides a quick reference for instruction in the use of this system.

ANNEX H

RECOMMENDED CHANGES TO FM 100-26

Recommended Change. The initial draft manuscript of FM 100-26, The Air-Ground Operations System, was reviewed for consistency with the Army airspace control system which is recommended in paragraph 8c of this report. Recommend that paragraph 3-13, FM 100-26 be changed to read as follows:

3-13. Airspace Control.

a. All airspace in the theater, particularly over the combat zone, is subject to use by all friendly forces. Theater policies for the use of this airspace are based on the necessity for permitting each participating force to utilize and exploit its air capabilities with minimum interference with other friendly forces.

b. Within the theater, the combined or joint force commander establishes the boundaries within which airspace control is to be exercised; provides the general priorities and restraints to be applied with regard for the requirements of all users of the airspace; and resolves differences that cannot otherwise be resolved by the component commanders concerned. He establishes the broad guidance necessary to insure coordination of airspace operations of participating services or national components. The combined or joint force commander normally will designate a single service or national component commander as airspace control authority for the supervision of these functions throughout the theater. When authority is so delegated, the combined or joint force commander normally retains approval authority for control measures of airspace utilization and air traffic control.

c. The Air Force component commander (AFCC) normally is designated as the airspace control authority for the theater and has the responsibility for coordinating the establishment of an air traffic control system for use throughout the theater. In this effort, he coordinates with the Army component commander (ACC) and other component commanders to establish procedures for air traffic control in and over the field Army area. He will insure that the maneuver force has maximum possible freedom of action in airspace over the combat zone.

d. The ACC is delegated the authority necessary to employ his organic aircraft, air defense, and surface-to-surface fire support on an immediately responsive basis in the airspace over those land areas under his control. This delegation of authority normally is accomplished by the joint force commander though the airspace coordinating authority.

e. Airspace control affects all operations and is, therefore, a command function. While all airspace users have requirements for airspace use in support of the command mission, airspace requirements frequently conflict. The overall system established for airspace control must provide timely and effective means to minimize and resolve these conflicts in accordance with the joint force commander's priorities. Ideally, the airspace control rules and procedures must be developed and exercised before hostilities begin. Army airspace doctrine and techniques are provided in FM 44-10 (Test).

ANNEX X

DOCUMENT CONTROL DATA - P&D

This annex is comprised of DD Form 1473, Document Control Data - R&D.