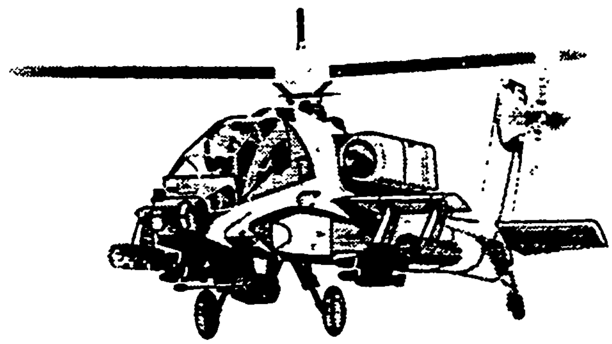
Technical Report TRAC-TR-0993
October 1993

Aviation Attack Battalion Study



Final Report

U.S. Army
TRADOC Analysis Center-Operations Analysis Center
Production Analysis Directorate
Fort Leavenworth, Kansas 66027-5200

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AVIATION ATTACK BATTALION STUDY

FINAL REPORT

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1993	Technical report

4. TITLE AND SUBTITLE
Aviation Attack Battalion Study Final Report

5. FUNDING NUMBERS

6. AUTHOR(S) Mrs. Laurie Hable, MAJ Robert Raichle, MAJ Richard Segres, CPT Michael Weaver, Mrs. Pat Doherty, Mr. Derek Konczal, Mr. Bill Palmer, Mrs. Sharon Wagner

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8. PERFORMING ORGANIZATION REPORT NUMBER
TRAC-TR-0993

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
HQ TRADOC
Deputy Chief of Staff for Analysis
ATTN: ATAN-AP
Fort Monroe, Virginia 23651-5151

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release;
Distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Aviation Attack Battalion Study (AABS) was conducted by the Production Analysis Directorate of the Training and Doctrine Command (TRADOC) Analysis Center (TRAC). This document is the final report for the AABS. The study began with a tasking from the Training and Doctrine Command to identify the benefits and liabilities involved in replacing the OH-58C with the AH-64A as the scout helicopter in the heavy division attack helicopter battalion. TRAC was directed to conduct a study using force-on-force simulations to examine the impact of the proposed Aviation Restructure Initiative design of the attack helicopter battalion while considering the Army modernization objectives. The Aviation Restructure Initiative focuses on providing an aviation force that will support the new National Military Strategy for a continental United States-based force projection Army.

14. SUBJECT TERMS
AH-64A, OH-58C, helicopter, attack battalion, Aviation Restructure Initiative, ARI

15. NUMBER OF PAGES
124

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unclassified

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std Z39-18
298-102

CONTENTS

* Published under separate cover

Figures

Tables

ABSTRACT

The Aviation Attack Battalion Study (AABS) was conducted by the Production Analysis Directorate of the Training and Doctrine Command (TRADOC) Analysis Center (TRAC). This document is the final report for the AABS.

The study began with a tasking from the Training and Doctrine Command to identify the benefits and liabilities involved in replacing the OH-58C with the AH-64A as the scout helicopter in the heavy division attack helicopter battalion. TRAC was directed to conduct a study using force-on-force simulations to examine the impact of the proposed Aviation Restructure Initiative design of the attack helicopter battalion while considering the Army modernization objectives. The Aviation Restructure Initiative focuses on providing an aviation force that will support the new National Military Strategy for a continental United States-based force projection Army.

AVIATION ATTACK BATTALION STUDY

EXECUTIVE SUMMARY

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1. Purpose. The Aviation Attack Battalion Study (AABS) identifies the benefits and liabilities involved in replacing the OH-58C (Kiowa) with the AH-64A (Apache) as the scout helicopter in the heavy division attack helicopter battalion.

2. Introduction.

a. During the Winter 93 Force Design Update held on 3 February 1993, the Chief of Staff, U.S. Army (CSA) approved the Aviation Restructure Initiative (ARI). ARI focuses on providing an aviation force that will support the new National Military Strategy (NMS) for a continental United States (CONUS)-based force projection Army. The military strategy changed from reliance on large, forward-deployed forces to a force projection Army designed to protect national interests. The redesign of aviation focused on fixing the long standing Army of Excellence (AOE) deficiencies which detract from aviation's ability to field a fightable, sustainable force. The AH-64A in the scout role is an interim solution until the Comanche is available.

b. The CSA tasked the Combined Arms Command (CAC) to provide analytical support for the decision to replace the OH-58C with the AH-64A as the scout helicopter in the heavy division attack helicopter battalion. The 9 March 1993 U.S. Army Training and Doctrine Command (TRADOC) study tasker (see appendix A) requested that TRADOC Analysis Center (TRAC) conduct a study using force-on-force simulations to examine the impact of the proposed ARI design of the attack helicopter battalion considering the Army modernization objectives.

3. Alternatives. The following are the alternatives gamed in the effectiveness analysis and compared in the sustainability analysis.

a. *Basecase.* The basecase included a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60L helicopters. There were three companies per battalion. Each company had an aircraft availability rate of 75 percent and operated with three OH-58C scout helicopters and five AH-64A attack helicopters. There were two attack battalions in each division.

b. *ARI case.* The ARI case included a battalion of 24 AH-64A helicopters (9 scout and 15 attack) with the same operational availability of three companies per battalion. Each company had an aircraft availability rate of 75 percent and operated with six AH-64A helicopters. Two of the AH-64A helicopters had a scout mission and four had an attack mission. There were two attack battalions in each division.

4. **Discussion.**

a. *Performance analysis.* The purpose of the performance analysis was to evaluate specific capabilities of the OH-58C and the AH-64A that were not looked at during the combat modeling. Static comparisons were used to evaluate the aircraft.

(1) Mission equipment. The AH-64A scout is configured with communications, navigation, pilotage, and target acquisition equipment that is a vast improvement over the OH-58C. The AH-64A is provided with navigation information electronically from ground level to 10,000 feet while the OH-58C pilot uses a paper map. The AH-64A pilot is able to fly at night using the forward looking infrared sensor. The target acquisition sight provides enhanced acquisition capability over the eyes of the OH-58C pilot.

(2) Weapons load. In the combat modeling conducted during this study, the OH-58C carried four air-to-air Stinger weapons. The AH-64A carried four Stingers, 325 rounds of 30mm ammunition, four Hellfire missiles, and 19 2.75-inch rockets.

(3) Aircraft survivability equipment (ASE). The AH-64A is a more survivable aircraft, in part because of the additional ASE equipment it carries. The AH-64A is able to jam radar and infrared (IR) instead of simply receiving a warning signal as the OH-58C does.

b. *Effectiveness analysis.* The purpose of the effectiveness analysis was to evaluate the basecase and ARI case force structures in force-on-force combat simulations. The attack battalions were employed in NEA and SWA environments and were evaluated in high- and low-resolution combat simulations.

(1) High-resolution gaming.

(a) The high-resolution gaming was conducted in SWA and NEA to show the differences in tactics, techniques, and procedures executed by the scout helicopters.

(b) The OH-58C detections always came at a close range, so that while the AH-64A attack aircraft were moving forward, the OH-58C scouts had to move out of direct fire range as quickly as possible. The AH-64A scouts made their first detections at a much greater distance. This allowed the AH-64A scouts to remain out of range, call the attack aircraft forward to handle the threat, and then to continue toward their battle positions.

(c) In the basecase, the OH-58Cs detected very little. This forced the AH-64As to move well forward in the battle position and find their own targets, while the OH-58Cs withdrew to provide rear and flank security. In the ARI case, the AH-64A scouts were able to find the threat and, in many cases, designate targets for the attack helicopters. Because the AH-64A scouts were able to perform their mission, fewer of the attack AH-64As were within direct fire range of the enemy.

(d) The enhanced detection capabilities of the AH-64A allowed it to detect targets much earlier than the OH-58C. Therefore, the ARI case battalion had more time to react to and destroy the threat before getting within direct fire range.

(e) The AH-64As in the basecase performed the duties of the scout helicopter at the expense of the attack mission.

(f) The SWA ARI case LER (17.7) was much better than the basecase LER (7.5). The total kills of the threat by the Blue helicopters did not change significantly (2 percent) but the total losses of Blue helicopters dropped considerably (58 percent). The LER improved in the ARI case by approximately two and one-third times the basecase. The NEA ARI case LER also went up (from 7.1 to 7.9). In NEA, the total kills of the threat went up by 15 percent and helicopter losses went up by 4 percent. The result is an LER that is 11 percent better than the basecase.

(2) Low-resolution gaming.

(a) The low-resolution gaming was conducted in SWA to show the effectiveness of the battalion within a division-level exercise. Results were similar to those seen in the Janus gaming.

(b) During the deep attack hand-off from the OH-58C scouts to the AH-64A attack helicopters in the basecase, eight of the nine scout helicopters were shot down by threat tanks or armored fighting vehicles (AFV). In the ARI case, only two of the six scout helicopters were shot down by ADA. The AH-64A scouts in the ARI case were able to conduct armed security during the entire deep attack. They focused primarily on ADA systems.

(c) During the close attack the mission of the scouts was to conduct security. Again, in the basecase, eight of the nine scout helicopters were shot down by threat tanks or AFVs. In the ARI case, no scout helicopters were shot down. Therefore, the scouts in the ARI case were able to conduct armed security successfully.

(d) Because of the losses to the scout helicopters in the basecase, the commander lost his capability to use his scouts very early in the battle. In the ARI case, the scout helicopter's survivability remained better than 80 percent. The commander was able to maintain his reconnaissance and security capability throughout both of the ARI battles.

c. *Sustainability analysis*. The purpose of the sustainability analysis was to evaluate the logistics impacts of changing the attack battalion to the ARI configuration. The impact on deployment requirements was also taken into account.

(1) Manpower analysis.

(a) The basecase is constrained by the AOE force structure ceiling and does not have all the manpower required to support the mission. The basecase headquarters and headquarters company (HHC) is understaffed by 16 personnel and aviation unit maintenance (AVUM) personnel levels are set at 69 percent of the MARC requirement. This recognized shortfall results in the inability of AVUM mechanics to cope with their workload. The excess workload is passed back to the aviation intermediate maintenance (AVIM) level.

(b) The ARI design is staffed to meet the full ground and aviation MARC manpower requirement. Even though the full requirement is met, there is only a net increase of three personnel in the battalion.

(2) Maintenance analysis.

(a) The AH-64A is less reliable and more difficult to maintain.

(b) Under the ARI design, mechanics will devote a greater portion of their time to maintaining the aircraft.

(3) Supply analysis.

(a) Daily supply requirements show some minor differences in specific areas.

(b) The exchange of the OH-58Cs for 6 additional AH-64As in the battalion resulted in a 20 percent increase in attack and scout fuel requirements. The realignment of the UH-60Ls into the brigade shifted the UH-60L's fuel requirements to the brigade. The tradeoff of increased attack and scout fuel with the shifting of UH-60L fuel to the brigade resulted in only a one percent change in the fuel requirements at the battalion level.

(4) Deployment analysis. There was very little difference in the airlift and sealift requirements to deploy the basecase and ARI case attack battalion. The AH-64A has the capability to self-deploy (800 to 1000 nautical miles when loaded with four auxiliary fuel tanks). Since the ARI battalion does not have any OH-58Cs, the unit would be able to self-deploy together in support of a contingency operation.

5. Findings.

a. There was a decrease in the total number of helicopters lost in the ARI case over the basecase in both the SWA low-resolution and high-resolution gaming.

b. Lack of detections by the OH-58C forced the AH-64As to get within direct fire range of threat systems in the basecase.

c. Use of the AH-64A scouts to designate targets for the attack helicopters allowed greater survivability for the battalion.

d. The AH-64As in the basecase performed the duties of the scout (detections, target handover), at the expense of attack missions. The OH-58C could not perform the scout duties adequately.

e. The AH-64A provides enhanced communications, navigation, pilotage, target acquisition, and weapons capabilities over the OH-58C.

f. The ARI battalion provides the possibility of increased combat power.

g. The ARI battalion provided the commander with additional unit flexibility.

h. Daily sustainment requirements were about the same.

i. The ARI case personnel requirements are as supportable as the basecase requirements while being staffed at its full MARC requirement.

j. Maintenance requirements for AH-64A are considerably higher than for the OH-58C.

k. The new AVIM structure should facilitate task organization and deployment.

l. The ARI attack battalion corrects previously identified shortcomings in aviation maintenance.

m. The ARI battalion supports the National Military Strategy. The ARI battalion is a power projection force designed to protect national interests

6. Conclusion. The ARI battalion met or exceeded the capabilities of the basecase battalion in the areas of performance, combat effectiveness, and sustainability.

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AVIATION ATTACK BATTALION STUDY

CHAPTER 1

INTRODUCTION

1-1. Purpose. The Aviation Attack Battalion Study (AABS) identifies the benefits and liabilities involved in replacing the OH-58C (Kiowa) with the AH-64A (Apache) as the scout helicopter in the heavy division attack helicopter battalion.

1-2. Problem statement.

a. During the Winter 93 Force Design Update held on 3 February 1993, the Chief of Staff, U.S. Army (CSA) approved the Aviation Restructure Initiative (ARI). ARI focuses on providing an aviation force that will support the new National Military Strategy (NMS) for a continental United States (CONUS)-based force projection Army. The military strategy changed from reliance on large, forward-deployed forces to a force projection Army designed to protect national interests. The redesign of aviation focused on fixing the long standing Army of Excellence (AOE) deficiencies which detract from aviation's ability to field a fightable, sustainable force. The AH-64A in the scout role is an interim solution until the Comanche is available.

b. The CSA tasked the Combined Arms Command (CAC) to provide analytical support for the decision to replace the OH-58C with the AH-64A as the scout helicopter in the heavy division attack helicopter battalion. The 9 March 1993 U.S. Army Training and Doctrine Command (TRADOC) study tasker (see appendix A) requested that TRADOC Analysis Center (TRAC) conduct a study using force-on-force simulations to examine the impact of the proposed ARI design of the attack helicopter battalion considering the Army modernization objectives.

1-3. Related studies.

a. "(U) Light Helicopter (LH) Program Cost and Operational Effectiveness Study (S/NF/WNINTEL)," March 1991, TRAC, Fort Leavenworth, Kansas.

(1) This study focused on determining the most cost effective solution to meet the future helicopter requirements.

(2) This study evaluated the LH, the AH-64A, the OH-58D, the LH with Longbow, and the AH-64A with Longbow. The study used the Combined Arms and Support Task Force Evaluation Model (CASTFOREM) high-resolution model to evaluate performance in a corps attack helicopter battalion and the Vector-in-Commander (VIC) low-resolution model to evaluate attack battalion performance in a corps attack.

(3) This study concluded the following:

(a) The basecase light fleet was seriously deficient in its capability to conduct operations across the spectrum of worldwide conflicts and environments.

(b) The LH had the best capability for correcting the light fleet deficiencies.

(c) The LH equipped with Longbow was the most combat effective alternative, followed closely by the AH-64 equipped with Longbow.

(d) The cost and manpower analyses showed the LH to be the least costly of the alternatives that were capable of meeting, fighting, and defeating the "cold war " worldwide threat.

(e) LH had the most versatility in deployment. During a self-deployment, the LH would arrive faster and with fewer mechanical failures. The LH required fewer C-5 aircraft to deploy it.

b. "(U) Scout/Attack Mix Study (S) ," August 1991, United States Army Aviation Center (USAAVNC), Fort Rucker, Alabama.

(1) This study was conducted by USAAVNC but, was never certified or approved. The purpose of the study was to determine the most effective combination of scout and attack helicopters in heavy attack helicopter units for the 1999 time-frame and beyond.

(2) Lethality and survivability of the attack helicopter battalions was examined through the use of the Janus and CASTFOREM high-resolution combat simulations. The number of operationally available scout helicopters varied from one to four and the number of operationally available attack helicopters varied from four to nine.

(3) This study made the following conclusions:

(a) There were two alternatives that provided the most tactically effective mix of attack and scout helicopters. Units with AH-64 attack helicopters were most effective when used with the RAH-66 (Comanche) Longbow scout helicopters. Units with AH-64 Longbow attack helicopters were most effective when used with RAH-66 scout helicopters.

(b) Improving lethality or survivability created a synergistic effect whereby improved lethality increased unit survivability and improved helicopter survivability improved unit lethality.

1-4. Assumptions.

a. The scenarios used in the study are representative of likely situations for employment of attack helicopter battalions.

b. Threat doctrine and equipment projections are accurate.

c. Surrogate data substituted for identified data deficiencies accurately represented the systems involved.

d. Classes of supply planning factor data adequately reflected supply requirements.

e. Maintenance requirements based on Army Regulation (AR) 570-2 (Army Manpower Authorization Requirements Criteria (MARC)) and the annual maintenance man-hour data base adequately represented maintenance requirements.

1-5. Scope.

a. *Limitations.*

(1) Eagle. Analysis was conducted using the Eagle model. Eagle is a prototype model developed by TRAC-Operations Analysis Center (TRAC-OAC) but it has not been verified, validated, and accredited (VV&A). Eagle was used on the Reconnaissance and Security Study conducted by TRAC-OAC and was benchmarked against the VIC model. The USAAVNC provided subject-matter experts (SMEs) to oversee the tactics, techniques, and procedures (TTP) employed by helicopters in the model and supported use of Eagle in the study.

(2) Reconnaissance. The effectiveness analysis focused on evaluating the attack battalion in its primary role - attack. The study did not attempt to measure the value of reconnaissance.

b. *Constraints.*

(1) Low-resolution scenario (LRS). No certified southwest Asia (SWA) scenario existed for use in the Eagle model. A LRS was developed for use in this study from the SWA 4.0 TRADOC standard scenario. It was used to evaluate an attack helicopter battalion performing a deep and close attack in the context of an armored division advance toward an airfield. This scenario has been approved for use in this study by the TRAC-Scenario and Wargaming Center (TRAC-SWC). The scenario name is SWA 4.0.1.

(2) High-resolution scenarios (HRS). No certified scenario initially existed for evaluating an attack helicopter battalion in northeast Asia (NEA). The USAAVNC had developed an excursion off of the TRADOC standard scenario HRS 31 in which an air assault mission which had only been scripted into the standard scenario was gamed using Janus. This scenario was reviewed by TRAC-SWC and certified. The previously certified scenario, HRS 24.AABS, was also used in this study.

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AVIATION ATTACK BATTALION STUDY

CHAPTER 2

METHODOLOGY

2-1. Study methodology. Figure 2-1 depicts the study approach. The essential elements of analysis (EEA) are grouped by the type of analysis that was being performed in evaluating each EEA. The analytical tools used in evaluating the EEA included static comparisons, combat modeling, spreadsheet analysis for sustainment issues and deployment modeling. Each analytical tool focused on providing specific measures of effectiveness (MOE) and measures of performance (MOP) which, could provide insights into the effectiveness of the basecase and ARI case.

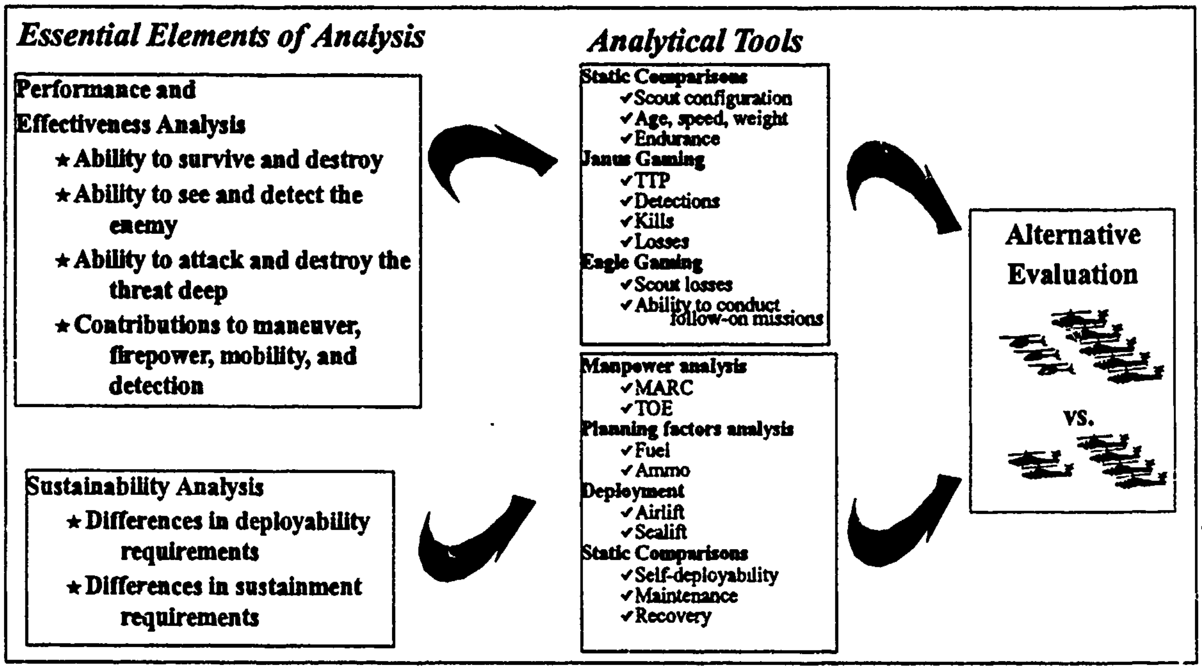

Figure 2-1. Study approach

a. *Study plan.* The study methodology was detailed in the Aviation Attack Battalion Study Plan (see appendix B). This plan describes the EEA and the associated MOEs and MOPs. A mapping of the MOE and MOP to the EEA can be found in the study plan, in addition to a run matrix. The study plan was certified by the Director, TRAC and approved by the Deputy Chief of Staff for Combat Developments (DCSCD), TRADOC. During the course of the study, the EEA were modified to remove the overlap in study issues between the EEA.

b. *Study team.* The study team charged with evaluating the study alternatives included TRAC elements from Fort Leavenworth, Kansas and Fort Lee, Virginia, as well as representatives from the USAAVNC. The participants were responsible for reviewing and providing input to the development of MOE and MOP. The USAAVNC was responsible for developing the TTP appropriate for the alternatives and ensuring that the analysis accurately reflected helicopter capabilities.

c. *Literature search.* The documents summarized in chapter 1, paragraphs 1-3.a. and 1-3.b. were reviewed prior to the execution of the study to gain insights on attack and scout helicopters. Several manuals were also used to reference helicopter capabilities and TTP: TM-55-1520-288-10, Operator's Manual for Army OH-58C; TM-55-1520-238-10, Operator's Manual for Army AH-64A; FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion; and Jane's world aircraft recognition handbook.

d. *Analytic tools.* The major analytic tools used in this study were computer models and the analysis of results obtained from the operational scenarios as depicted in the models. Effectiveness analysis was conducted using both Janus and Eagle computer simulations. Sustainability analysis consisted of manpower and planning factors analysis using spreadsheets and data bases and modeling of deployment capabilities with the Transportability Analysis Reports Generator (TARGET) and Rapid Intertheater Deployment Simulation (RAPIDSIM) models. Static comparisons used for the performance, effectiveness, and sustainability analysis focused on off-line evaluation of the two helicopters under study, the AH-64A and OH-58C.

e. *Performance analysis.* The performance analysis focused on looking at the specific characteristics of the helicopters. These capabilities were evaluated through static comparisons. The mission equipment, weapons load, fuel capacity, aircraft survivability equipment (ASE), average age, cruise speed, weight capacity, and endurance of the aircraft were examined.

f. *Effectiveness analysis.* The LRS SWA 4.0.1 scenario was represented in the Eagle division-level model, with one attack battalion employed against a separate armored brigade located deep and one attack battalion employed against an attacking brigade in battle hand-off from the division cavalry. In this scenario, we focused on the survivability of the helicopters and on the ability of the attack helicopter battalion to conduct follow-on missions. HRS 24.AABS and HRS 31.AABS were gamed in the Janus model. HRS 24.AABS represented an attack battalion in a deep attack against a threat armored brigade in SWA. HRS 31.AABS represented an attack battalion preparing the battlefield in NEA for an air assault. In the HRS gaming, we focused on an evaluation of the contributions of the scout helicopter in each alternative and quantified the helicopter detections, kills, and losses.

g. *Sustainability analysis.* The sustainability analysis determined logistics impacts in manpower, maintenance, and supply. It also looked at the deployment requirements and capabilities for the force structure. Two tables of organization and equipment (TOE) unit designs were considered for this study: the basecase L-series constrained TOE with an equipment date of fiscal year (FY)94 and the ARI case A-series TOE with an equipment date of FY00. The manpower analysis was based on these TOEs. The maintenance analysis was based primarily on results produced by the U.S. Army Aviation Logistics School (USAALS) and USAAVNC using automated spreadsheets. The Aviation MARC was used to compare both alternatives. MARC computes the number of required maintainers given aircraft density and the Department of the Army (DA) flying hours program. The Combined Arms Support Command (CASCOM) developed daily supply requirements for each alternative using a spreadsheet aggregation of supply planning factor data from their Logistics Data Base (LDB). Requirements were developed for supply classes I through IX.

2-2. Alternatives. The following are the alternatives gamed in the effectiveness analysis and compared in the sustainability analysis.

a. *Basecase.* The basecase included a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60L helicopters. There were three companies per battalion. Each company had an aircraft availability rate of 75 percent and operated with three OH-58C scout helicopters and five AH-64A attack helicopters. There were two attack battalions in each division.

b. *ARI case.* The ARI case included a battalion of 24 AH-64A helicopters (9 scout and 15 attack) with the same operational availability of three companies per battalion. Each company had an aircraft availability rate of 75 percent and operated with six AH-64A helicopters. Two of the AH-64A helicopters had a scout mission and four had an attack mission. There were two attack battalions in each division.

2-3. EEA. The EEA and their associated MOE and MOP are listed below. Chapter 3 of this report discusses the results of the performance, effectiveness, and sustainment analyses and appendix C specifically answers each EEA.

a. *EEA 1a.* What are the deployability requirements (airlift, sealift, and self-deployment) for an aviation battalion structured with each alternative?

(1) MOE 1. Number of transportation assets required (ships and aircraft).

(2) MOE 2. Time required to deploy Army forces.

(3) MOE 3. Number of miles aircraft can self-deploy (and speed at which it flies).

b. *EEA 1b.* How do the alternatives differ in sustainment requirements?

(1) MOP 1. MARC requirement for the basecase and ARI case.

(2) MOP 2. Mechanic manpower available in each TOE by military occupation specialty (MOS) for the basecase and ARI case.

(3) MOP 3. Maintenance requirements for each alternative?

(4) MOP 4. Supply requirements for the basecase and ARI case at the battalion level?

(5) MOP 5. Ability to recover downed aircraft in each alternative.

c. *EEA 2*. How do the alternatives differ in ability to survive and destroy?

(1) MOE 4. Blue helicopter losses.

(2) MOE 5. Blue helicopter kills of threat systems.

(3) MOP 6. Helicopter system capabilities.

d. *EEA 3*. How do the alternatives differ in ability to see and detect the enemy?

(1) MOP 6. Helicopter system capabilities.

(2) MOP 7. Number of detections made by the scout and attack helicopters.

(3) MOP 8. Distance at which threat units are detected by the scout.

e. *EEA 4*. How do the alternatives differ in the ability to attack and destroy the threat deep?

(1) MOE 6. Blue helicopter kills against a deep threat.

(2) MOP 6. Helicopter system capabilities.

f. *EEA 5*. What are the differences in contributions of each alternative to maneuver, firepower, mobility, and the ability to detect the enemy on the battlefield?

(1) MOE 4. Blue helicopter losses.

(2) MOE 5. Blue helicopter kills of threat systems.

(3) MOE 7. System exchange ratio (SER).

(4) MOE 8. Loss exchange ratio (LER).

(5) MOP 6. Helicopter system capabilities.

(6) MOP 7. Number of detections made by the scout and attack helicopters.

(7) MOP 8. Distance at which threat units are detected by the scout.

(8) MOP 9. Changes in battle flow and time events occur.

(9) MOP 10. Successfully complete mission.

2-4. Models.

a. *Janus.* The Janus model is an interactive, high resolution, force-on-force, brigade-level, stochastic combat simulation. The principal focus of Janus is on ground maneuver and artillery units, but Janus also models rotary and fixed wing aircraft, engineer support, minefield employment and breaching, resupply, weather and its effects, and day and night visibility.

b. *Eagle.* Eagle is a corps-level, deterministic combat model with resolution at the maneuver battalion. This means that the force being modeled on each side is typically corps, and that units smaller than battalions are normally not represented explicitly. The effects of companies, platoons, squads, and vehicle crews are aggregated within a battalion. The model is time-stepped in 5-minute increments. During each time step, each military headquarters and resolution unit is triggered to do the four main actions of shoot, move, look, and decide. The model architecture allows for any number of sides, although it is normally run with a Blue side representing U.S. doctrine and equipment and a red side representing several threat forces.

c. *TARGET.* The TARGET model provides an automated way to merge unit equipment authorization data from TRADOC's TOE Master File with the equipment item data from the Forces Command Computerized Movement Planning and Status System Equipment Characteristics File. The TARGET programs can determine the unit deployment data required for strategic mobility planning. TARGET generates unit deployment data (vehicle quantity, square feet, short ton (STON)) and sortie requirements.

d. *RAPIDSIM.* RAPIDSIM models the deployment of cargo and troops from ports of embarkation (POEs) to ports of debarkation (PODs) by air and sea. RAPIDSIM requires user-supplied scenario and movement requirement files. The scenario file defines the Defense Transportation System from CONUS origins to the destination theater, including the inventories and capabilities of aircraft and ships, and the location of POEs and PODs. The movement requirements file defines units and supplies to be deployed (i.e. equipment, resupply, ammo, etc.) and appropriate timelines and deployment priorities. RAPIDSIM provides unit closure profiles within a joint service movement and summarizes utilization of the strategic lift assets.

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AVIATION ATTACK BATTALION STUDY

CHAPTER 3

ANALYSIS

3-1. Performance Analysis. The purpose of the performance analysis was to evaluate specific capabilities of the OH-58C and the AH-64A that were not looked at during the combat modeling. Static comparisons were used to evaluate the aircraft.

a. *Scout configuration.* The standard AH-64A scout configuration as recommended by the Aviation Restructure Initiative (ARI) is shown in figure 3-1. The goal of ARI in selecting the AH-64A as the interim scout was to increase endurance, provide enhanced communication, improve air-to-air capability, and improve optics through night vision systems. Alternative configurations for the AH-64A scout can be used depending on the situation and mission requirements. Based on the conditions within the scenarios gamed, it was decided that an extra fuel tank was not necessary to accomplish the mission. Additional firepower was loaded on the AH-64A scout helicopter in the form of 19 2.75-inch rockets. The AH-64A scout configuration studied is as follows: 4 Stingers, 325 rounds of 30mm, 4 semi-active laser (SAL) Hellfire, and 19 2.75-inch rockets.

	OH-58C	AH-64A Scout
		
Mission Equipment		
Secure/Jam resistance comms	VHF-FM	VHF-FM & UHF-AM
Navigation	Paper map	Doppler
Pilotage	NVG	FLIR/ Image Intensification
Target acquistion	Eyes	TV/FLIR/DVO
Weapons Load		
ATAM	4 Stinger	4 Stinger
Gun		1200 rds 30mm
ATGM		4 SAL Hellfire OR
Rockets		19 2.75 in rockets
Fuel Capacity	71.5 gals	600 gals (one auxillary fuel tank)

Figure 3-1. Scout configuration

b. *Mission equipment.* The following paragraphs discuss the mission equipment listed in figure 3-1.

(1) Communication. The AH-64A has a target handover system which allows it to digitally pass information over selected radio frequencies, eliminating the lengthy call and response times associated with voice communications necessary with the OH-58C.

(2) Navigation. The Doppler navigation set provides present position or destination navigation information to the pilot. Used in concert with the heading and altitude reference set, it can provide velocity, position, and navigation information from ground level to 10,000 feet.

(3) Pilotage. The night vision goggles (NVG) use ambient light to provide night sight out to 500 meters. At night, the OH-58C is forced to rely on NVG for target acquisition. This severely limits the mission capability of the OH-58C. The forward looking infrared (FLIR) sensor is mounted in the nose of the AH-64A. The FLIR transmits a thermal image to the helmet display which is identical in scale and directly superimposed over the external view.

(4) Target Acquisition. The target acquisition designation sight (TADS) provides infrared television (TV) (smoke and haze penetration), direct view optics (DVO) (widest field of view for detection), laser designator/rangefinder, laser tracker, and FLIR (night and poor weather acquisition). At night or in low-visibility conditions, the AH-64A TADS provides a considerable enhancement over the OH-58C. While the AH-64A is able to operate autonomously or allow another helicopter to laser designate targets for it, the OH-58C is unable is laser designate for the Hellfire missile or other compatible artillery munitions such as Copperhead.

c. *Weapons load.* The following paragraphs discuss the weapons listed in figure 3-1.

(1) Stinger. The Stinger is an infrared homing missile system which homes in on the heat emitted by either fixed wing aircraft or helicopters. The minimum range is approximately 600 meters and the maximum range is approximately 6,000 meters. The time of flight of the missile is approximately 2.0 seconds to the minimum range and 13.5 seconds to the maximum range. While an air-to-air capability on the AH-64A is required, it is not currently funded in the Program Objective Memorandum.

(2) 30mm gun system. The system was designed as an area fire weapon to engage and defeat ground vehicles and personnel. The 30mm gun system is mounted under the nose of the aircraft leaving all the weapon pylons available for either missiles and/or rockets.

(3) SAL Hellfire. The Hellfire missile is guided by reflective laser energy from the target and requires a SAL designator. The Hellfire missile can be fired in either the direct or indirect mode. The direct fire mode (autonomous operation) requires the launch/designation aircraft to be exposed to the target during a direct fire engagement. In the indirect fire mode, the missile is launched for a remote laser designator. The AH-64A is capable of carrying as many as 16 Hellfire (4 on each pylon).

(4) 2.75-inch rocket. The rocket consists of a rocket motor, a submunition warhead made up of nine high explosive submunition grenades, and the airburst fuze which is remotely set from the aircraft with time to the target. The maximum range of the rocket is approximately 8,800 meters and the minimum range is approximately 500 meters.

d. *ASE*. Figure 3-2 shows the ASE available with the two aircraft. A plus sign means the ASE equipment is available on the aircraft, while a minus sign means that it is not available. The AH-64A is a more survivable aircraft, in part because of the additional ASE equipment. The AH-64A is able to jam radar and infrared (IR) instead of simply receiving a warning signal as the OH-58C does.

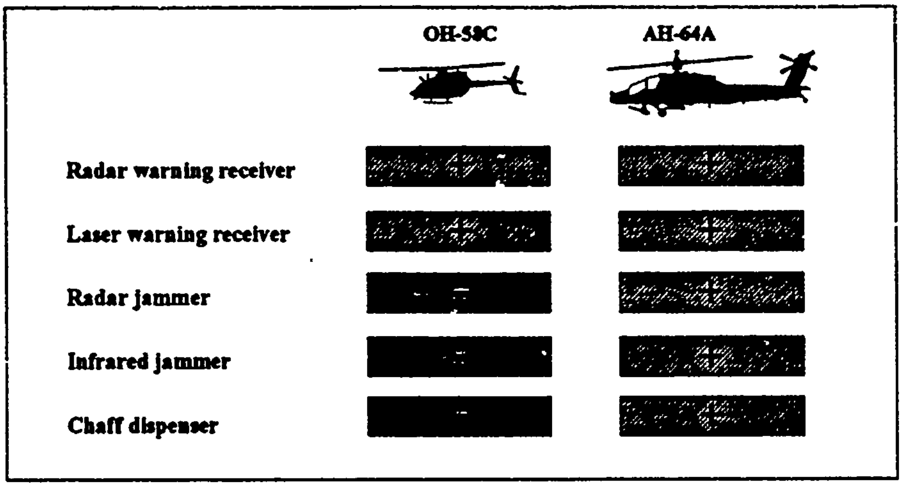


Figure 3-2. ASE

(1) Radar warning. A radar warning receiver will provide warning that the aircraft is being illuminated by a radar and will detect missile guidance signals to provide missile alert warning to the pilot.

(2) Laser warning. A laser warning receiver is designed to provide warning of laser directed weapon systems targeting the aircraft.

(3) Radar jammer. The radar jammer uses angle and range deception techniques to jam air defense systems. This system provides automatic jamming of received pulsed radar directed threats and provides the pilot a visual indication of jamming.

(4) Infrared jammer. The IR jammer is targeted toward heat seeking air-to-air and surface-to-air missiles. It uses a cylindrical ceramic block heated electrically as the source of IR energy. This is surrounded by a modulation system which causes the IR energy to vary in pattern so as to confuse missile seekers by creating false error signals.

(5) Chaff dispenser. The chaff dispenser is designed primarily to release M-1 chaff cartridges which can be used in conjunction with a radar warning receiver to counter radar-guided/directed antiaircraft artillery (AAA).

e. *Helicopter characteristics.*

(1) Age, speed, and weight. Table 3-1 compares the two helicopters in the area of age, speed, and weight. The OH-58C is a very small, maneuverable helicopter with a very low target signature. The OH-58C's maximum gross weight is 3,200 pounds. The weight of the OH-58C studied in the combat modeling was 2,741 pounds. The AH-64A has the advantage of being a younger, faster aircraft. The AH-64A was also designed to be survivable. Approximately 2,500 pounds of airframe weight is for ballistic protection (armor fittings or oversized components). The drive shaft is able to take a 12.7mm strike and keep functioning and the cockpit can withstand a 23mm projectile. The AH-64A can carry as many as 16 Hellfire antitank missiles. It's maximum gross weight is 17,650 pounds. The weight of the AH-64A scout studied in the combat modeling was 16,016 pounds. The AH-64A scout would weigh 17,511 pounds if it carried an auxiliary fuel tank.

Table 3-1. Helicopter age, speed, and weight

	OH-58C	AH-64A
Average Age (yrs)	**23**	**7**
Cruise Speed (kt/hr)	**90**	**130**
Weight (lbs)		
Basic	2,629	14,745
325 30mm rnds		250
4 ATAS	112	112
4 Hellfire		394
19 2.75 in rockets		515
Total	**2,741**	**16,016**
Auxilary fuel not played. Would add 1495 lbs.		

(2) Endurance. Figures 3-3 and 3-4 detail how long each helicopter could fly at a pressure altitude of 4,000 feet and a free air temperature (FAT) of 0 and 30 degrees celcius. Endurance was calculated by using TM-55-1520-288-10, Operator's Manual for Army OH-58C and TM-55-1520-238-10, Operator's Manual for Army AH-64A. This comparison shows the relationship between endurance of the OH-58C and the AH-64A. Comparisons at other pressure altitudes and FATs would be proportionally the same. Each helicopter is loaded with the scout configuration used for gaming in this study. The extension on the bar chart for the AH-64A shows endurance capabilities if the scout was loaded with an additional fuel tank. This would put the AH-64A at its maximum gross weight and would increase the speed of the aircraft to 77 knots in NEA and SWA. As is evident, the AH-64A scout has a much greater endurance capability with the addition of the fuel tank.

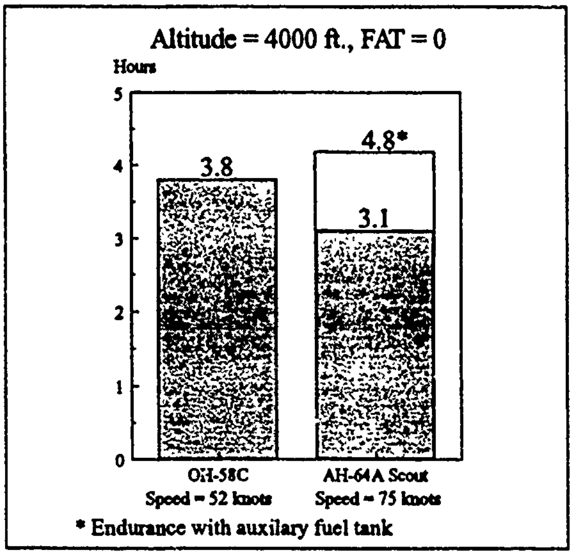


Figure 3-3. Endurance in NEA environment

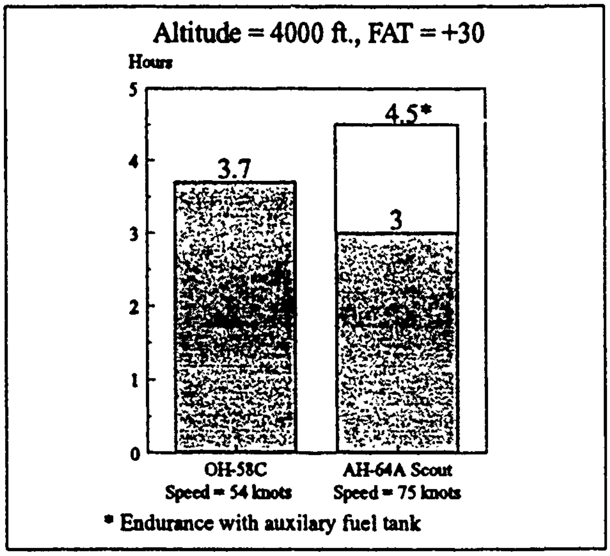


Figure 3-4. Endurance in SWA environment

3-2. Effectiveness Analysis. The purpose of the effectiveness analysis was to evaluate the basecase and ARI case force structures in force-on-force combat simulations. The attack battalions were employed in NEA and SWA environments and were evaluated in high- and low-resolution combat simulations. Appendix E gives a listing of the force structures played. Appendix E is a classified appendix pulished under a separate cover.

a. *Janus high-resolution gaming and analysis.* The high-resolution gaming was conducted in SWA and NEA to show the differences in tactics, techniques, and procedures executed by the scout helicopters.

(1) HRS 31.AABS scenario. The TRADOC standard HRS 31 scenario depicts a Blue mechanized brigade conducting a first-light attack against a Red armored corps that has established a hasty defense in NEA. Figure 3-5 depicts our excursion which portrayed the air

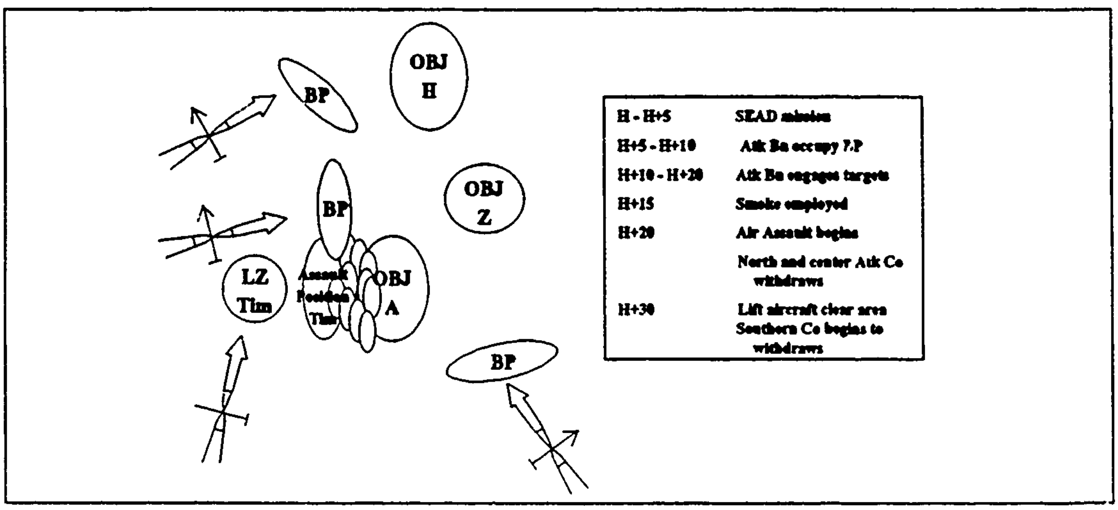


Figure 3-5. HRS 31.AABS scenario

assault mission that was scripted into the standard scenario, but not gamed. The mission was conducted at night with 1/4 moon illumination. The scenario began with a suppression of enemy air defense (SEAD) mission conducted while the attack battalion was enroute to its battle positions (BP). When the SEAD lifted, the three companies of the attack battalion left their holding areas and moved into position to attrit the enemy forces in objectives (OBJs) Hotel, Zulu, and Alpha. At H+15, Blue artillery began firing smoke rounds to cover the landing zone (LZ) for the air assault. The northern and central attack companies left their battle positions just before the assault company arrived at the LZ. The southern company remained in its BP to provide cover for the air assault until that mission was completed. The scenario ended with the egress of the assault company.

(a) An important thing to remember in this scenario is that the Red forces possessed very little in the way of a high-technology threat. Because the mission was flown at night, Red could not detect or engage the Blue helicopters. The FLIR conditions were poor in this scenario resulting in the AH-64A FLIR not working well.

(b) The HRS 31 standard scenario documentation can be obtained by accessing Defense Technical Information Center (DTIC) number ADC959525L.

(2) HRS 24.AABS. Figure 3-6 depicts the SWA scenario in which the mission was conducted at night with a 1/4 moon illumination. Intelligence sources discovered a Red corps making a tactical roadmarch, and the attack battalion was sent on a deep attack mission to engage the southernmost armored brigade of that corps. The battalion attacked simultaneously from three battle positions to disrupt the Red advance and destroy as much of the Red brigade as possible. Approximately 31 percent of the threat force was destroyed by the attack battalion during the gaming.

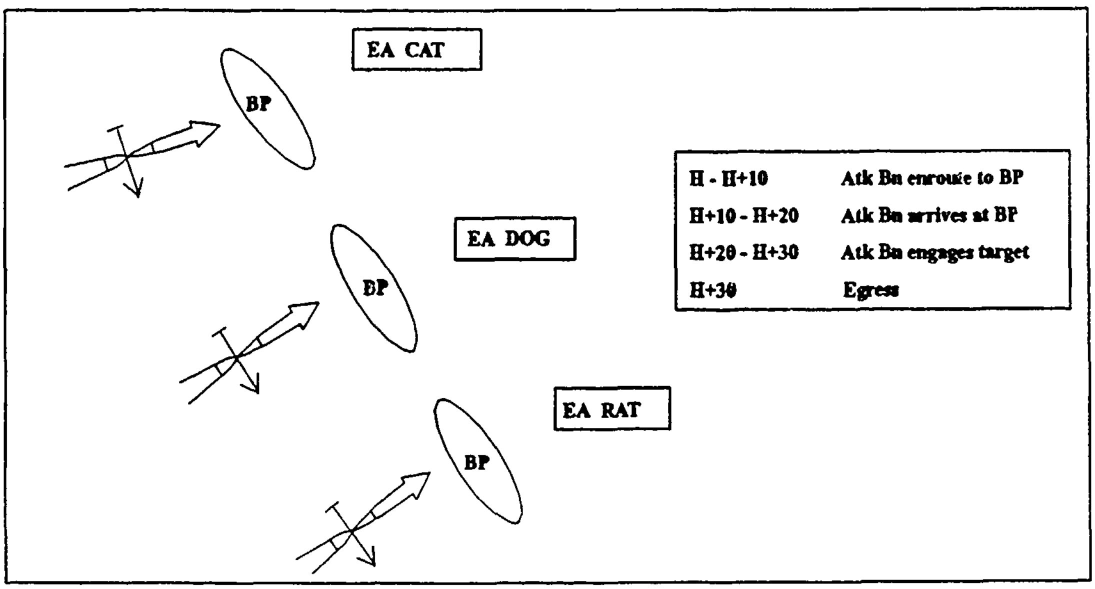


Figure 3-6. HRS 24.AABS scenario

(a) The Red forces in this scenario were more formidable than they were in HRS 31.AABS. They possessed both radar and thermal imaging systems to counter the Blue helicopters. Another key difference in this scenario was that the lines-of-sight in SWA were virtually unlimited. This meant that the Blue helicopters were usually able to identify enemy systems before they got within direct fire range. Additionally, the difference between the ground temperature and the combat system temperature for this area of operation was extremely high, resulting in the AH-64As FLIR working at optimal effectiveness.

(b) The HRS 24 standard scenario documentation can be obtained by accessing DTIC number ADC958234L.

(3) Tactics, techniques, and procedures (TTP). One of the main reasons the study used the Janus high-resolution model was because of the level of detail available. In Janus, each individual helicopter was played by a gamer. Because of this detail, differences could be identified in the execution of the TTP between the basecase and the ARI case. Therefore, the basecase and ARI case were fought differently, based not on where the scenario took place, but on which helicopter performed the scout mission. The primary targets for the scout helicopters were air defense artillery (ADA), threat aircraft, and any system requiring the scout to act in self-defense. The primary attack helicopter targets were direct fire systems.

(a) Starting conditions.

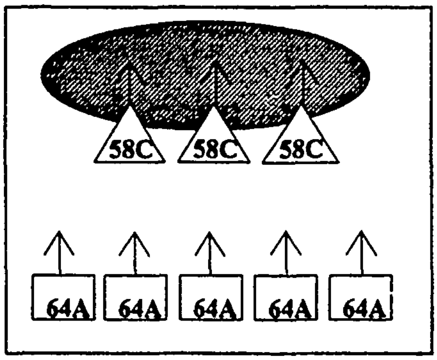
1. In NEA, the scout and attack helicopters began the scenario enroute to their holding area. They were separated by approximately one minute of flight time (approximately 3 kilometers (km)). This separation was the same for both the basecase and the ARI case, and represented a reasonable separation for this type of mission in this terrain.

2. In SWA, the scouts started a fixed distance away from the threat corps security element (10 km) and the attack helicopters were placed in a notional holding area another 10 km behind the scouts. This method of emplacing the helicopters provided a baseline for evaluating the difference in overall mission times between the two cases.

(b) Movement to contact. In both scenarios and cases, the attack helicopters remained in their holding areas until one of the battalion's scouts detected a target. Once any scout had a detection, all three companies of attack helicopters moved forward to their BP (see figure 3-7). In the basecase, that first detection usually came when an OH-58C was destroyed by a threat system it had not detected (especially in SWA). The OH-58C detections always came at a close range, so that while the AH-64A attack helicopters were moving forward, the OH-58C scouts had to move out of direct fire range as quickly as possible. The AH-64A scouts made their first detections at a much greater distance. This allowed the AH-64A scouts to remain out of range, call the attack aircraft forward to handle the threat, and then to continue toward the BP.

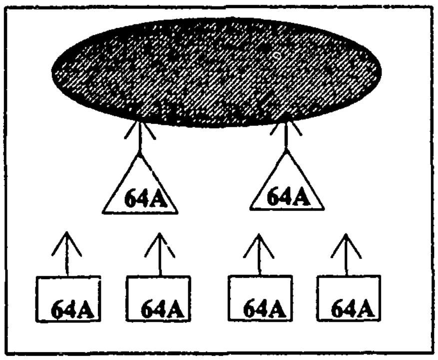
(c) Attack phase. Figure 3-8 shows the TTP used during the attack phase. When the battalion arrived at the BP, the difference in the ability of the OH-58C and the AH-64A scout to detect targets was magnified and had a definite impact on how the battle was fought. In both

Basecase



- Once the scouts detected a target, the attack aircraft moved forward.
- Scouts cleared the area while AH-64As came forward to eliminate the threat.

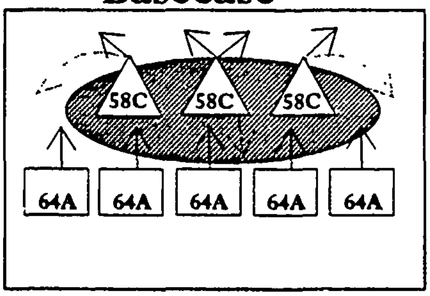
ARI case



- The scouts detected targets early.
- The scouts would designate for the attack aircraft which had moved forward to fire.
- The attack aircraft were out of direct fire range.

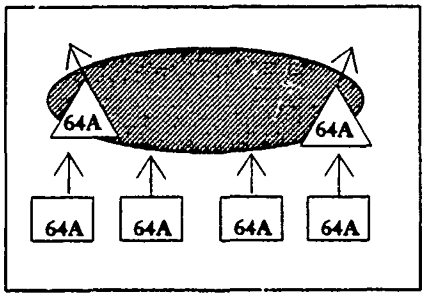
Figure 3-7. Movement to contact

Basecase



- The scouts moved far forward to attempt to locate red forces but obtained very few, if any, detections. Relocated to provide security.
- The attack aircraft were required to move farther forward due to lack of detections by the OH-58Cs.

ARI case



- The attack aircraft did not have to go to the front of the BP to fire their missiles.
- Scouts made many detections.

Figure 3-8. Attack phase

scenarios and cases, the scouts were sent in ahead of the attack aircraft to clear the BP. In the basecase, the OH-58Cs detected very little. This forced the AH-64As to move well forward in the BP and find their own targets, while the OH-58Cs withdrew to provide rear and flank security. In the ARI case, the AH-64A scouts were able to find the threat and, in many cases, designate targets for the attack helicopters.
Because the AH-64A scouts were able to perform their mission, fewer of the attack AH-64As were within direct fire range of the enemy.

(4) Detections.

(a) Table 3-2 shows how many minutes elapsed before the first detection occurred in each case. The enhanced detection capabilities of the AH-64A allowed it to detect targets much earlier than the OH-58C. Therefore, the ARI case battalion had more time to react to and destroy the threat before getting within direct fire range.

Table 3-2. Time of first detection (minutes into the gaming)

Alternative	Game time (min)
SWA Basecase	6:45
SWA ARI Case	0:25
NEA Basecase	7:51
NEA ARI Case	5:46

(b) Figure 3-9 shows the average distance at which a detection was made by a scout helicopter. The increased detection distance in the SWA ARI case is due to the FLIR system on the AH-64A scout. In SWA, because of the improved scout detection range, both the scout and attack helicopters were able to engage at greater ranges. The improvement in detection distance was not as dramatic in the NEA ARI case because 95 percent of the threat targets were in full defilade and the FLIR conditions were at their worst. The FLIR works best when it has a constant background against which it can detect threat targets. In NEA, the background was varied - it contained ground, water, and trees. In addition, water vapor in the air absorbs IR energy, so rain and snow present in NEA degraded the FLIR performance. The result was that the detection and standoff attack range for the AH-64A was reduced because of poor weather, but so was the threat's ability to detect or engage the helicopters.

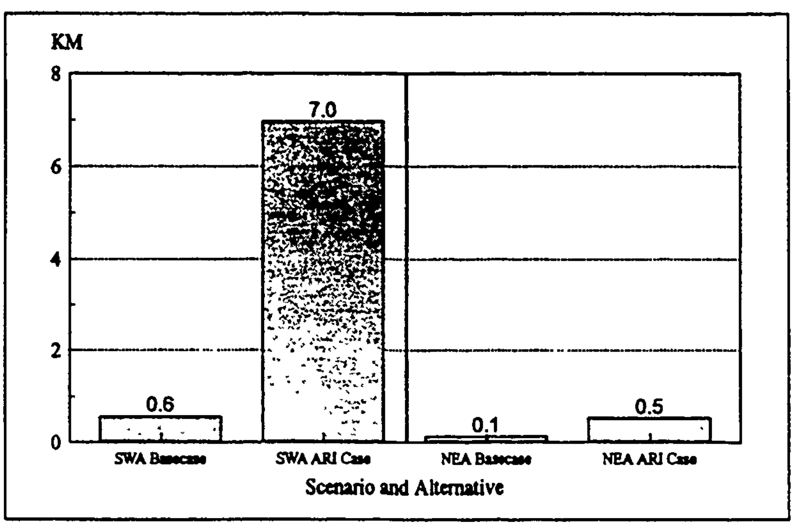


Figure 3-9. Average scout detection distance

(c) Figure 3-10 shows the number of individual threat system detected by the attack and scout helicopters. One of the unexpected side effects of the tactics used was that the basecase had as many detections as the ARI case in SWA. In the basecase, all five attack AH-64As were required to move forward in the BP to obtain detections while, in the ARI case, the two scout AH-64As were able to perform the scout mission for the rest of their company. The result was that the basecase had "more eyes" forward in the battle position, but in doing this they were putting themselves at increased risk because they were within direct-fire range of the threat systems. The AH-64As in the basecase performed the duties of the scout helicopter at the expense of the attack mission. In NEA, the FLIR provided additional detection capability for the scout helicopter. Threat radar systems were able to detect the Blue helicopters in NEA, but the associated antiaircraft weapons did not have the range to effectively engage Blue aircraft. In addition, Blue jamming of Red communications prevented Red from calling for indirect fire.

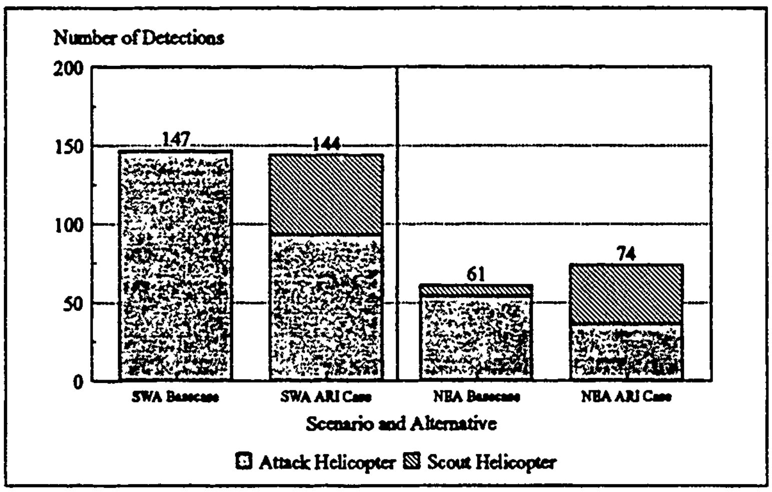


Figure 3-10. Number of detections

(5) Kills.

(a) Figure 3-11 shows the total Blue helicopter kills of threat systems. In SWA, the total kills remained similar between the two cases. This would be expected because the total number of detections was the same and because the firepower between the basecase and ARI case remains similar. The difference lies in which helicopter was doing the killing. In the ARI case, each AH-64A scout had 4 Hellfire missiles and 19 rockets available to fire as self-protection or when it had an opportunity. Since the AH-64A scout was able to kill some of the threat targets, the AH-64A attack helicopter was not required to get in as close to the BP. The AH-64A scout should also be able to gather intelligence and pass that information to the attack aircraft and higher headquarters. In NEA, the kills of threat systems increased in the ARI case. The enhanced combat capability of the AH-64A scout accounted for the increased kills. Blue helicopter kills of major threat system classes are shown in figures 3-12 and 3-13.

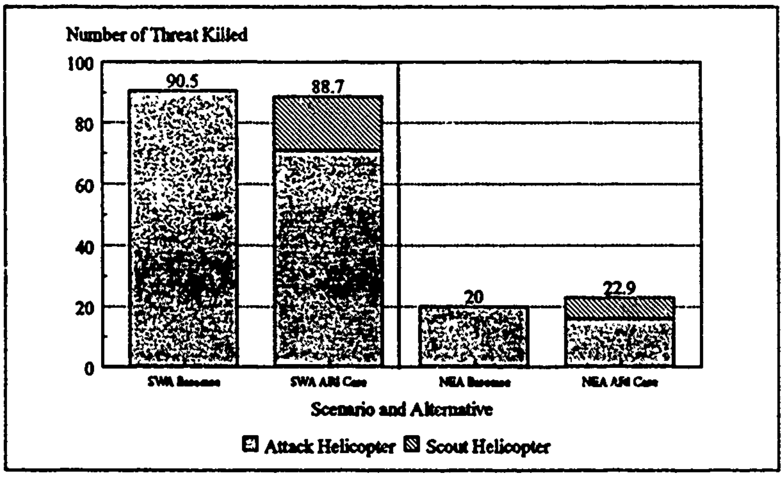


Figure 3-11. Blue helicopter kills of threat major systems

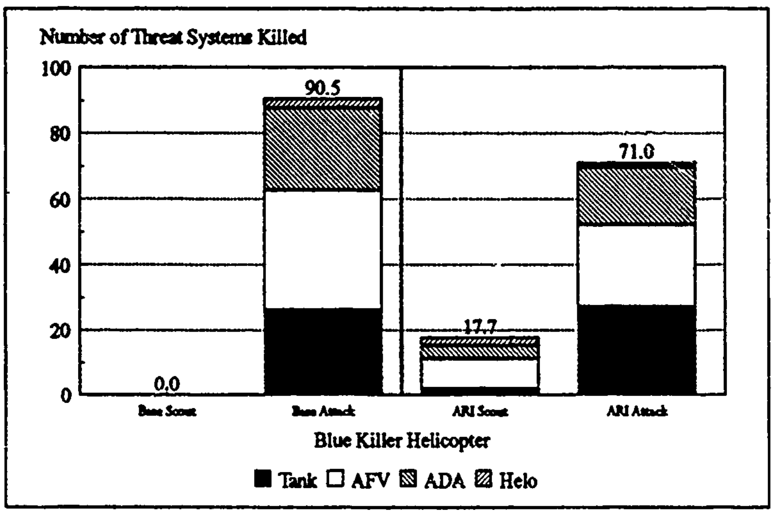


Figure 3-12. Blue kills of threat system classes, SWA

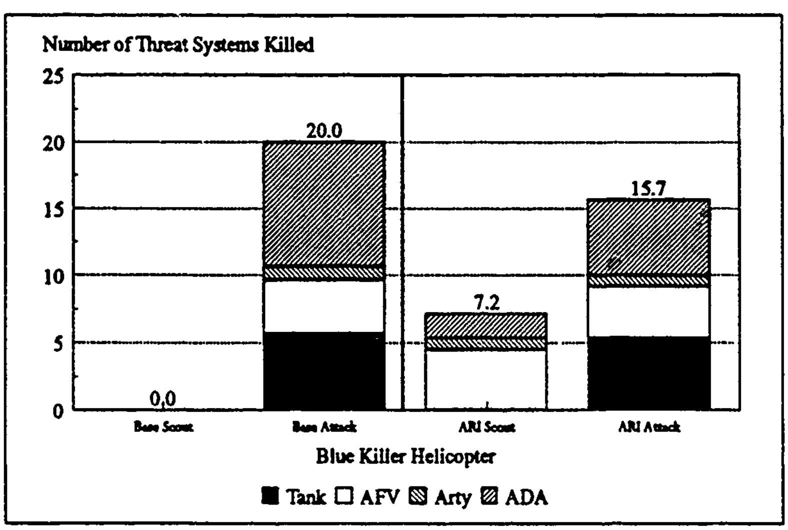


Figure 3-13. Blue kills of threat system classes, NEA

(b) Janus only accounts for catastrophic kills. Janus does not take into account mobility and firepower kills, although they would occur during combat situations such as those gamed in Janus. Although is was not possible to determine during the gaming, it is probable that with the increased capabilities of AH-64A as the scout, there would have been more mobility and firepower kills in the ARI case than in the basecase.

(6) Losses.

(a) Figure 3-14 shows the losses incurred by the attack helicopter battalion. The ARI case significantly decreases the losses of attack and scout helicopters in the SWA scenario. Losses went up slightly in the NEA ARI case. The decrease in losses in SWA is attributed to the fact that the AH-64A scout was doing its scout mission so the AH-64A attack helicopter was able to stay further back in the BP and to focus entirely on its attack mission. In NEA, losses of scout helicopters went up. Because of the terrain, the detection distances were so short that once a scout helicopter was close enough to see a threat system, he could also be seen and the AH-64A presents a much larger target than the OH-58C. Major threat system class kills of Blue helicopters are shown in figures 3-15 and 3-16.

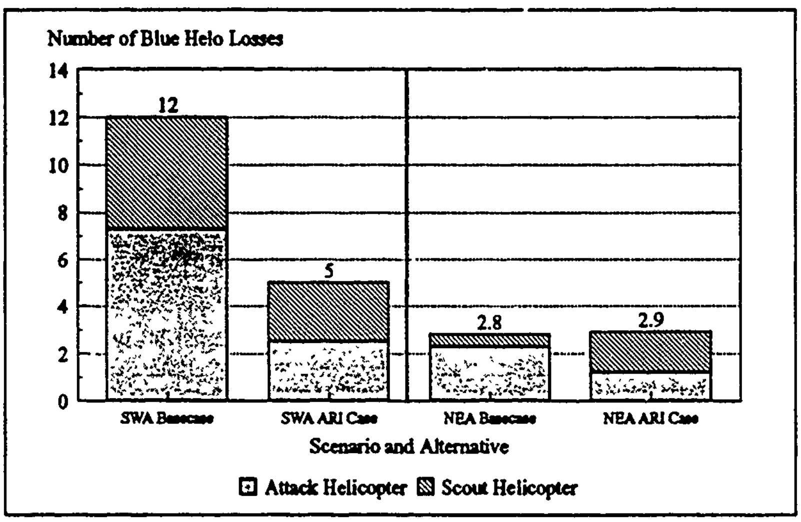


Figure 3-14. Blue helicopter losses

(7) SER. Figure 3-17 shows the SER. The SER is calculated in the following way:

$$\frac{\text{Total\_major\_system\_threat\_kills\_made\_by\_specific\_system}}{\text{Total\_losses\_of\_specific\_system}}$$

The focus is on the kills by and losses of one specific system. The larger the number, the better the results are for the U.S. forces. This chart shows the value of the enhanced capabilities of the AH-64A in the scout role. SERs for both scout and attack helicopters go up in ARI cases.

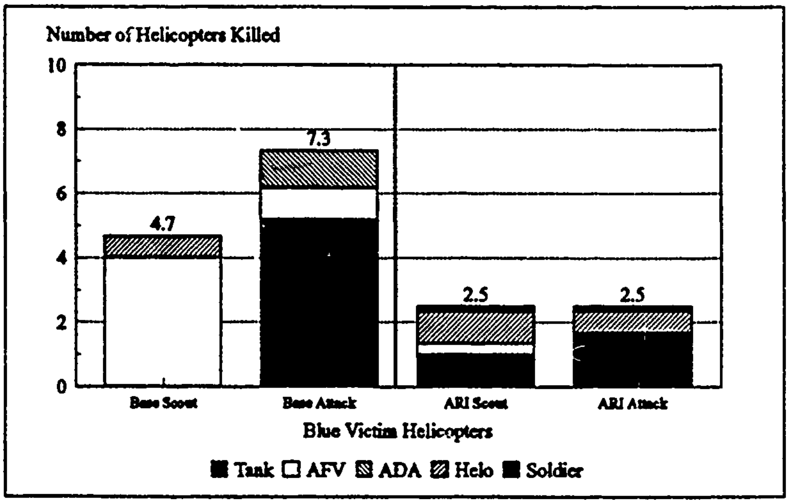


Figure 3-15. Threat kills of Blue helicopters, SWA

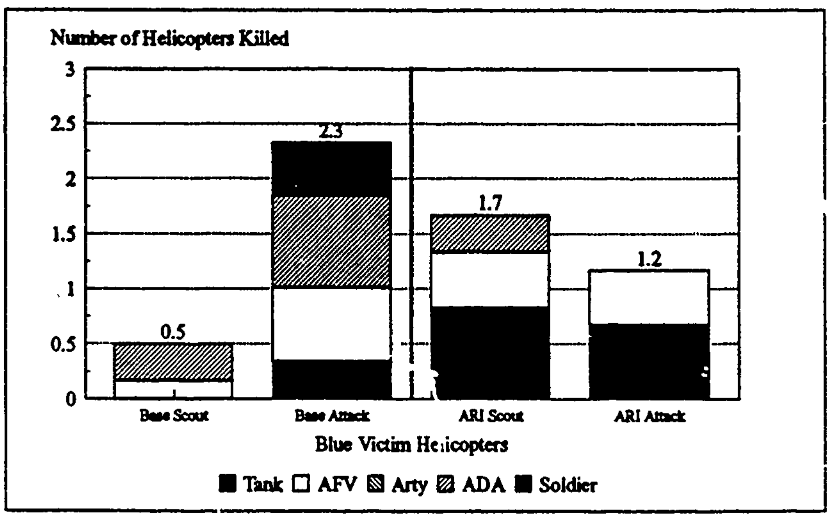


Figure 3-16. Threat kills of Blue helicopters, NEA

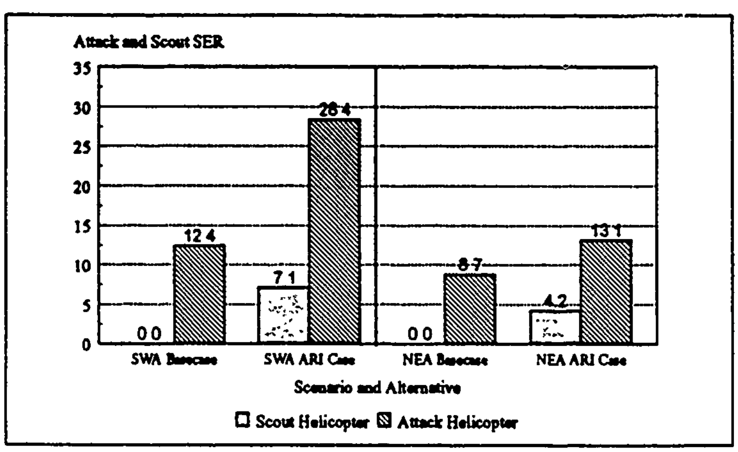


Figure 3-17. SER

(8) LER. Figure 3-18 shows the LER. The LER is calculated in the following way:

$$\frac{Total\_major\_system\_threat\_losses}{Total\_Blue\_helicopter\_losses}.$$

The larger the LER, the better the results are for the U.S. forces. The SWA ARI case LER was much better than the basecase LER. The total kills of the threat by the Blue helicopters did not change significantly (2 percent) but the total losses of Blue helicopters dropped considerably (58 percent). The LER improved in the ARI case by approximately two and one-third times the basecase. The NEA ARI case LER also went up. In NEA, the total kills of the threat went up by 15 percent and helicopter losses went up by 4 percent. The result is an LER that is 11 percent better than the basecase.

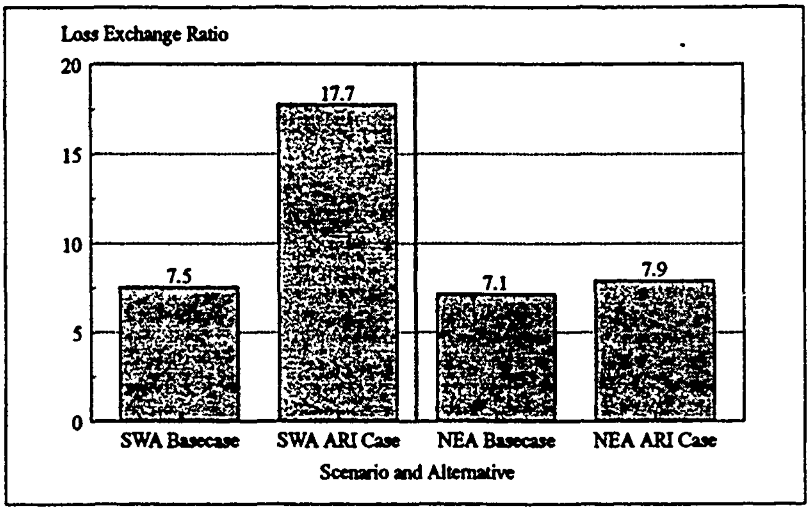


Figure 3-18. LER

b. *Eagle low-resolution gaming and analysis.* The low resolution gaming was conducted to show the effectiveness of the battalion within a division-level exercise. Results were similar to those seen in the Janus gaming. Charts showing Eagle gaming kills and losses can be found in appendix C.

(1) SWA 4.0.1 scenario. The SWA 4.0.1 scenario is a LRS gamed in the Eagle model. Dynamic gaming involved a U.S. 1999 AOE armored division and a reinforcing artillery brigade with three multiple-launched rocket system battalions and one Howitzer battalion. The aviation brigade consisted of two attack battalions and the division cavalry (DIVCAV). An exception to the 1999 AOE structure was the aviation brigade, which is a present day structure. The Red force consisted of a FY04 armored division with two separate attached armored brigades, an air defense artillery (ADA) regiment, a battalion equivalent of attack helicopters, and two artillery brigades.

(a) Scenario excursion. This scenario was an extension of SWA 4.0. The standard scenario is contained in two SWA 4.0 volumes. Volume One is the operational scenario consisting of threat and U.S. operations and can be obtained by accessing DTIC number

ADC958487. Volume Two contains the dynamic scenario narrative and representative statistical results and can be obtained by accessing DTIC number ADC958488. The dynamic gaming of this scenario covered 30 hours of battle simulation.

(b) Threat operational scenario overview. At the start of the exercise the threat forces were in deliberate defensive positions with the threat force artillery and ADA units spread throughout the battlefield. The threat plan (see figure 3-19) was to make the U.S. force conduct a frontal attack against the division and then attack into the Blue force flank and rear with the two attached brigades. The initial strength of the maneuver and air defense units was 75 percent and the initial strength of the field artillery and aviation units was 60 percent. These strengths were a result of the air campaign.

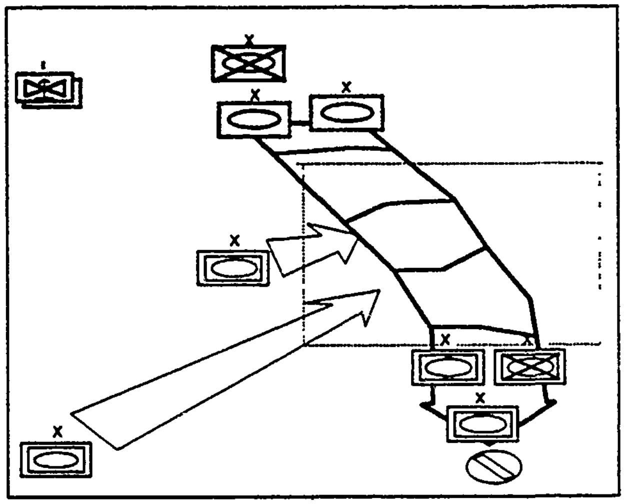


Figure 3-19. Threat plan

(c) U.S. operational scenario overview. The U.S. plan (see figure 3-20) was to conduct a deliberate attack to defeat the Red armored division and secure the airfield as rapidly as possible. The DIVCAV would lead with ground troops conducting an advance guard. One air troop would conduct a zone reconnaissance in front of the ground troops and the second air troop would conduct a screen of the DIVCAV right flank. The division would move with 1st and 2d brigade abreast. The 3d brigade would follow the 1st brigade. The main force would bypass the northern threat brigade. One battalion from 3d brigade would assume a blocking position east of the northern Red brigade to protect the division rear. At H-hour, one attack battalion would conduct a deep attack to neutralize the southern Red armored brigade. At H+1:30, the second attack battalion would conduct a hand-off from the DIVCAV to neutralize the northern Red brigade as the main body bypasses it. After both aviation attack battalions completed their mission, they would become the division reserve for the main attack on the threat division. The U.S. force was at full strength.

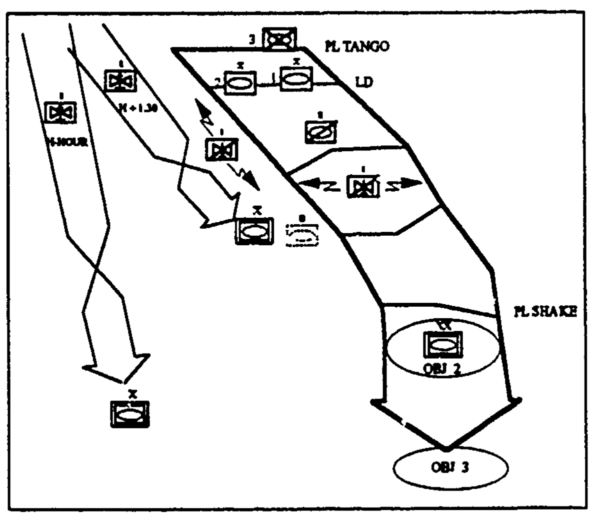


Figure 3-20. U.S. plan

(c) Surrogate data. In order to account for the aircraft survivability equipment (ASE) available on the AH-64A, it was necessary to degrade the acquisition data for the threat ADA. The only system that had degraded acquisition data available against an AH-64A with ASE was the SA-18. The acquisition data was degraded 60 percent. The USAAVNC agreed that the 60 percent degradation factor could be used for the all the ADA systems played within SWA 4.0.1.

(2) Dynamic gaming. The phase of the Blue plan that was gamed for this study was the movement to contact from the line of departure (LD) to phase line (PL) Shake which included the deep attack and the close attack by the two aviation attack battalions.

(a) Deliberate attack. At H-hour, the Blue division crossed the LD leading with the DIVCAV. One of the attack battalions began the deep attack against the southern Red separate brigade and the reinforcing artillery brigade began firing on the northern Red separate brigade. Through non-human intelligence (HUMINT) sensors the Blue commanders knew the locations of the threat units to include the Red division and the two threat separate brigades. The threat commanders also knew the locations of the Blue units through non-HUMINT sensors. The threat forces were in a deliberate defense.

(b) Deep attack. Figure 3-21 shows a graphic of what occurred during the deep attack. The first unit detection by the scout helicopters was of the threat ADA units. A SEAD mission was not fired because the unit was out of range of Blue artillery. In the basecase, the aviation attack battalion bypassed the ADA units. In the ARI case the AH-64A scouts attacked the ADA units with their 2.75-inch rockets and experienced success in suppressing the units. The Blue helicopters were detected and were fired upon but no helicopter was lost in either case. The next unit detection by the scout helicopters was of the southern threat brigade. In both cases the scouts conducted a hand-off to the attack helicopters. During the hand-off in the basecase, eight of the nine scout helicopters were shot down by threat tanks or armored fighting vehicles (AFV). In the ARI case, only two of the six scout helicopters were shot down by ADA. The AH-64A scouts in the ARI case were able to conduct armed security during the entire battle. They focused primarily on ADA systems. Both cases were successful in neutralizing the threat brigade. In both cases the aviation attack battalion stayed on station for 25 minutes then returned to the forward area rearm/refuel point (FARP) to refuel, rearm, and become the division reserve. Figure 3-22 shows that one ARI company was able to rearm, refuel, and be ready for any follow-on missions before any of the basecase companies had returned to the FARP. The ARI case battalion executed its mission and returned to the FARP sooner because it was not slowed by the OH-58C as the basecase battalion was.

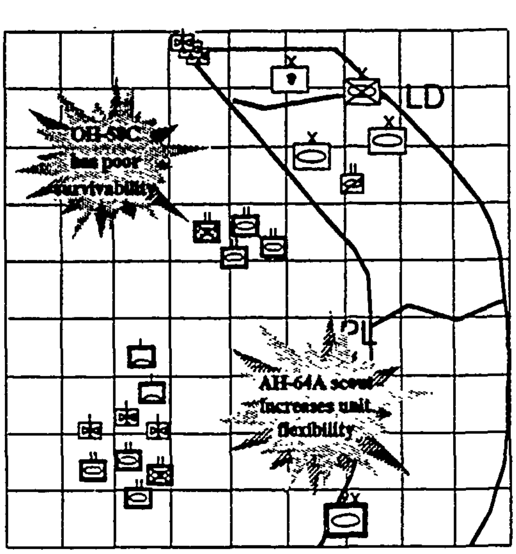


Figure 3-21. Deep attack

(c) Close attack. Figure 3-23 shows a graphic of the close attack. By 0720 hours, the DIVCAV had discovered the disposition of the northern Red brigade. In both cases an artillery

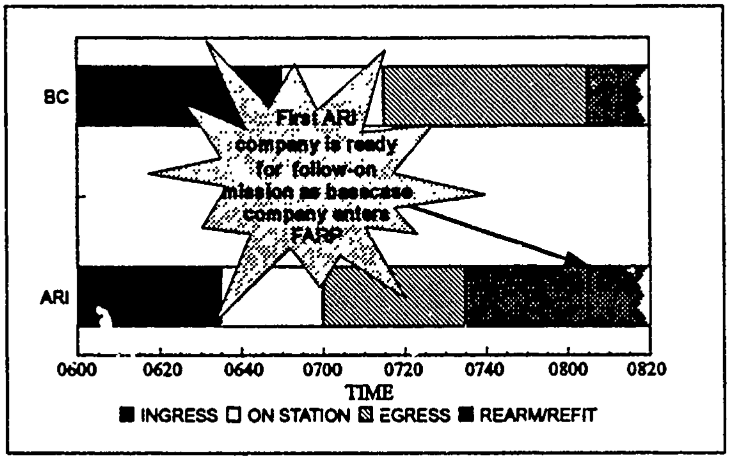


Figure 3-22. Deep attack mission time

preparation was fired onto the northern Red brigade and was then followed by the DIVCAV conducting a hand-off to the aviation attack battalion. This battle was fought using a phased attack tactic to increase on-station time. This allowed the main body enough time to bypass the threat brigade safely. In the basecase, the first attack company arrived on station at 0800 hours while in the ARI case it arrived on station at 0755 hours. The following two companies arrived on station at 15 minutes interval of each other in both cases. The mission of the scouts was to conduct security during the battle. Again, in the basecase, eight of the nine scout helicopters were shot down by threat tanks or AFVs. In the ARI case, no scout helicopters were shot down. Therefore, the scouts in the ARI case were able to conduct armed security successfully. Both cases were successful in neutralizing the brig[illegible] and preventing the attack into the main [illegible] flank or rear.

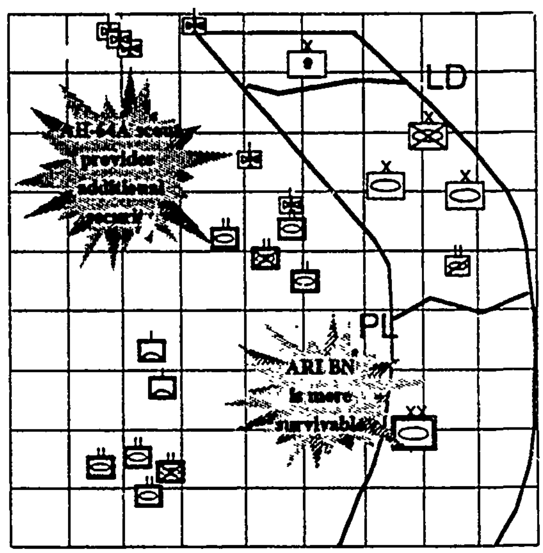


Figure 3-23. Close attack

(3) Low resolution analysis. Because of the losses to the scout helicopters in the basecase, the commander lost his capability to use his scouts very early in the battle. In the ARI case, the scout helicopter's survivability remained better than 80 percent. The commander was able to maintain his reconnaissance and security capability throughout both of the ARI battles. This scenario was modeled in four different cases; basecase day, basecase night, ARI case day, and ARI case night. The night cases performed just as well as the day cases because the AH-64A uses the same sensors for detections and for acquisition during both day and night. All cases successfully accomplished the deep and close attack missions. In the basecase, 90 percent of the scouts were lost to the threat tanks and AFVs. These threat systems out-range the detection capability of the OH-58C. Figure 3-24 shows the scout helicopter strength in the basecase and

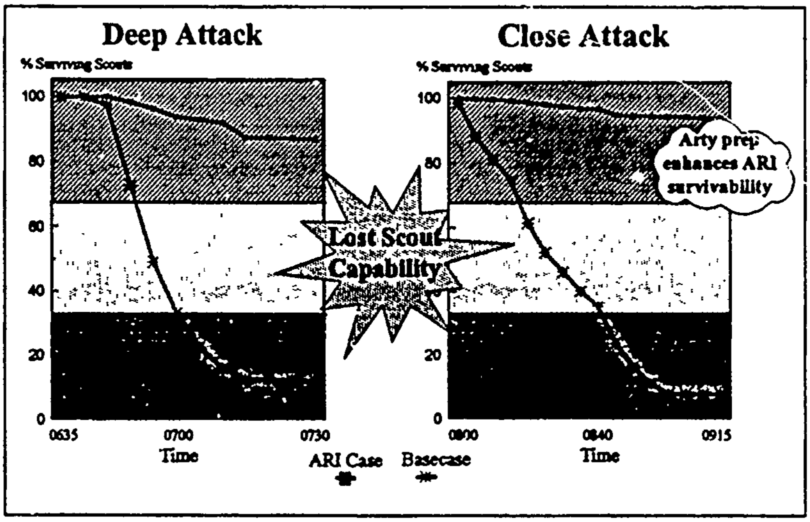


Figure 3-24. Scout strength

ARI case during the deep and close attacks. The artillery preparation conducted against the northern threat brigade enabled the ARI scout helicopters to be more survivable when engaged in the close attack.

3-3. Sustainability Analysis. The purpose of the sustainability analysis was to evaluate the logistics impacts of changing the attack battalion to the ARI configuration. The impact on deployment requirements was also taken into account.

a. *Manpower analysis.* Mission requirements together with soldier availability factors determine manpower requirements. Table 3-3 addresses changes in the major manpower areas within the actual TOE for both cases.

Table 3-3. TOE battalion manpower

	Basecase	ARI Case	Difference
HHC	31	47	16
SUPPORT	42	43	1
FUEL	20	21	1
AMMO	13	13	0
C,CSS FLT SEC	12	0	(12)
AVN COs	99	81	(18)
AVUM CO	82	97	15
TOTAL	299	302	3

(1) Basecase. The basecase is constrained by the AOE force structure ceiling and does not have all the manpower required to support the mission. The basecase headquarters and

headquarters company (HHC) is understaffed by 16 personnel and aviation unit maintenance (AVUM) personnel levels are set at 69 percent of the MARC requirement. This recognized shortfall results in the inability of AVUM mechanics to cope with their workload. The excess workload is passed back to the aviation intermediate maintenance (AVIM) level.

(2) ARI case. The ARI design is staffed to meet the full ground and aviation MARC manpower requirement. Even though the full requirement is met, there is only a net increase of three personnel in the battalion. The following paragraphs discuss the increases and decreases in personnel at each element of the battalion.

(a) HHC. Due to the removal of the AOE force structure ceiling, the strength of the HHC was increased by 16 people.

(b) Support/fuel. In the areas of support and fuel personnel, the minor changes evident are a result of modernized equipment or new operational concepts that deal with introducing additional AH-64A aircraft into the TOE.

(c) Combat, combat service support (C, CSS) flight section. This section has been removed by retiring the older OH-58C aircraft. However, the recovery mission still exists elsewhere in the brigade (OH-58D recovery) so the section was moved to the General Support Aviation Battalion (GSAB) in the brigade. No net savings to the brigade is accomplished by this move.

(d) Attack companies. The attack companies show a net decrease of 18 personnel. This is due to the removal of the 6 crew chiefs and 12 scout observers associated with the OH-58C.

(e) AVUM company. The increase of 15 people in the AVUM company is directly related to the removal of the AOE force structure ceiling and application of full MARC for AVUM.

b. *Maintenance analysis.* Replacing the older, less complex OH-58C with the highly sophisticated AH-64A helicopter in the scout role causes maintenance requirements to change.

(1) Maintenance Characteristics. One of the primary reasons for the differences in maintenance requirements is the maintenance characteristics of the two aircraft (see table 3-4). The data table 3-4 was taken from the LH COEA and is an average of values provided by USAALS, USAAVNC, and the project manager (PM) for each aircraft. This maintenance characteristics comparison table points out the major differences in support requirements for the two different aircraft. Three of the five characteristics define aircraft reliability and two characterize the maintenance workload associated with each aircraft. Mean time between essential maintenance actions, mean time between mission affecting failures, and mean time between aborts all clearly show that the OH-58C is the more reliable aircraft. The mean time to repair and the maintenance ratio (maintenance man-hours per flight hour) show that the AH-64A presents a much higher maintenance burden.

Table 3-4. Maintenance characteristics

	MEAN TIME BETWEEN (HRS)				
	Essential maintenance actions	Mission affecting failures	Aborts	Mean time to repair	Maintenance ratio (MMH/FH)
OH-58C	4.8	13.9	61.2	1.6	3.5
AH-64A	2.4	5.8	19.9	2.2	10.7

Data is from the LH COEA

(2) Maintenance manpower requirements. Maintenance manpower requirements were determined using the aviation MARC process. However, in the basecase, the AOE force structure ceiling constrains the number of mechanics allowed. Since the ARI case was able to fulfill the full MARC requirement, the 100 percent MARC figures for the basecase were used to compare the alternatives (see table 3-5). The actual (L-Series) TOE figures as they are currently staffed are also shown in the center columns of the table but they were not used in the comparison.

Table 3-5. Aviation mechanic requirements

	L-Series TOE at 100% MARC			L-Series TOE Currently Staffed			A-Series TOE - Staffed at 100% MARC		
	AVUM	AVIM	Total	AVUM	AVIM	Total	AVUM	AVIM	Total
AH-64A	89	51	140	70	32	102	108	62	170
OH-58C	41	12	53	22	10	32			
UH-60L	13	6	19	7	3	10			
Total	143	69	212	99	45	144	108	62	170

(a) MARC requirements. MARC provides a capability for identifying aviation unit design requirem[illegible] based on aircraft density, a DA flying hours program; equipment reliability, availability, and maintainability characteristics; and mechanic availability factors. The number of hours that a mechanic is available to work on aircraft has a direct bearing on the total requirement. New soldier availability factors are imbedded in the MARC calculations for the ARI case. These factors are dependent upon unit type and range from 4.6 to 9.4 hours per day for the base case and from 8.6 to 12.0 hours per day for the ARI case. Thus, under the ARI design, mechanics will devote a greater portion of their time to maintaining the aircraft. These figures represent the workload driven maintainers at 100 percent MARC at the AVUM and AVIM slice maintenance levels for the base and ARI cases. Neither of the 100 percent MARC figures include the AOE personnel constraints and the resulting workload passback problems faced by the actual basecase force (see table 3-5). Table 3-6 shows the mechanic requirement by MOS at the AVUM level for each case.

Table 3-6. Unit level maintainers

Maintainer	MOS	Basecase	ARI Case
AH-64A repair	67R	39	61
OH-58C repair	67V	16	0
UH-60L repair	67T	6	0
Aircraft powerplant repair	68B	2	3
Aircraft power train repair	68D	2	2
Aircraft structural repair	68G	3	4
Aircraft pneumatics repair	68H	2	3
Avionics mechanic	68N	7	4
Armament/electronic repair	68X	22	31
Total maintainers		99	108

(b) MARC results. The overall picture for mechanics shows a 20 percent decrease in personnel requirements between the two cases (25 percent at the unit and 10 percent for the division support slice). The removal of the AOE force structure ceiling raised the ratio of maintainers per AH-64A from 5.7 in the base case to 7.1 in the ARI design. A savings is realized by the retirement of the older OH-58C aircraft and its associated maintainers (32 aircraft specific slots) and the increased maintainer availability. The apparent savings of 10 UH-60L (Blackhawk) maintainers is really a shift of maintenance burden up to the brigade (to the GSAB). The medium-lift mission still resides in the brigade.

(3) New AVIM maintenance unit design. A key maintenance design feature that evolved as a result of the ARI effort was the elimination of the policy of passback maintenance and the linking of AVIM support capability to specific aviation units via TOE documentation. ARI seeks to improve the flexibility of the aviation maintenance structure. The policy of passback maintenance effectively locked specific corps to division alignments and precluded the deployment of these alignments in any other configuration without incurring serious disconnects in personnel, MOS distribution, and equipment. As a result, AOE AVIM designs did not support a force projection Army.

(a) Force projection requires the ability to task organize and rapidly deploy the proper mix of combat and associated support units. The current AVIM organizational design does not link maintenance capability to specific aviation units and it lacks sufficient redundancy in low-density MOSs and equipment to adequately support task organization at the tactical level.

(b) The new AVIM design would key maintenance capability, both systems and subsystems, to the individual aviation organizations the AVIM unit supports. It should contain sufficient personnel and equipment redundancies to support task organization. This design is still under development and pending TRADOC and DA approval. Thus, while mechanic requirements can be calculated using MARC considerations, any attempt to describe what these units will eventually look like would be purely conjectural.

(4) Recovery. Table 3-7 shows the appl.. .ole recovery assets for the OH-58C and the AH-64A. The OH-58C is much more susceptible to loss so it may need to have more recovery assets available. The AH-64A was built to be survivable and the combat simulation gaming showed that it was more survivable. In the Janus SWA scenario, the ARI case battalion took fewer total AH-64A (scout and attack) losses than the AH-64A attack helicopters in the basecase. Currently the CH-47 (Chinook) is the only recovery asset in the army inventory that can recover the AH-64A without requiring modifications. Sufficient army aviation assets are not available to exclusively support the recovery of aerial assets. These recovery assets have a defined role in the recovery of ground assets and they may be called upon to support allied equipment in joint operations. Ground recovery assets will be needed to augment efforts in support of the initial phases of recovery of downed aerial assets. The only ground recovery asset that may fill this role is the M270 trailer (12 ton) but it would require some modifications to accommodate the airframe. The trailer also requires a lift device to load the aircraft on the trailer.

Table 3-7. Recovery assets

ASSET	Helicopter Supported	
	OH-58C	AH-64A
UH-1	✓	
UH-60	✓	
CH-47	✓	✓
M270 TRL (12 TON)	✓	✓ (modifications required)
M172A1 TRL	✓	
5/7.5 TON CRANE	✓	
SOURCE OF SUPPORT	AVUM/AVIM	CORPS

(5) Test, measurement, diagnostic equipment (TMDE). Table 3-8 shows the TMDE requirements in terms of numbers of individual test sets for each aircraft mix. Retirement of the older OH-58C and realignment of the UH-60L leaves only one aircraft type to maintain. The TMDE requirement at the AVIM level was reduced.

Table 3-8. TMDE requirement

	Basecase	ARI Case
AVUM	22	21
AVIM	181	156

c. *Supply analysis.*

(1) General. CASCOM is the logistics planning factors manager for the Army and developed the Logistics Planning Factors Data System to store, process, and disseminate approved planning factors for all classes of supply. CASCOM provides logistics planning factors to customers Department of Defense (DOD)-wide to support both combat developments and joint, strategic, contingency and operational planning.

(2) Data types. Supply data can be divided into two categories:

(a) Classes of supply that are sensitive to equipment and density and to the level of unit activity (intense, moderate, reduced, reserve). Fuel and ammunition fall into this category. The rates that CASCOM provided are for moderate intensity unit activity. For this analysis, the moderate rates are considered sustainment rates.

(b) Classes of supply that are sensitive to population more than to equipment, do not to vary by intensity, and are considered theater independent. Classes I, II, IV, VI, and VIII fall into this category.

(3) Daily sustainment requirements. Table 3-9 displays the daily sustainment requirement for selected classes of supply expressed in STON per day or gallons per day for both cases. Daily supply requirements show some minor differences in specific areas. The category "other" (which includes classes I, II, IV, VII, VIII, and IX) and water are determined by unit strength and consequently show very little difference between the cases. Fuel and ammunition requirements are sensitive to equipment density and are addressed separately in tables 3-10 and 3-11.

Table 3-9. Total battalion daily supply requirements

		Basecase	ARI Case	% change
Class III	Gallons	18,565	18,740	1
Class V	STONs	54	56	4
Other	STONs	8	8	0
Water	Gallons	2,601	2,618	1
Unit strength	Personnel	299	302	

(a) Class III. Table 3-10 shows fuel usage by aircraft mix. The USAAVNC directed that the scout AH-64A would not have a different operational tempo (OPTEMPO) than the attack AH-64A, so the fuel requirement would be the same for both. The exchange of the OH-58Cs for 6 additional AH-64As in the battalion resulted in a 20 percent increase in attack and scout fuel requirements. The realignment of the UH-60Ls into the brigade shifted the UH-60L's fuel requirements to the brigade. The tradeoff of increased attack and scout fuel with the shifting of UH-60L fuel to the brigade resulted in only a one percent change in the fuel requirements at the battalion level. A potential problem in the battalion level fuel requirement arises in the ARI case battalion when you consider that the UH-60L does not only recover downed OH-58Cs. The UH-60Ls may be task organized back into the battalion from the GSAB to carry ammunition and fuel to the FARP or to recover AH-64A crews. They would probably not bring their own fuel with them so it would have to be supplied by the battalion. This could result in a 12 percent increase in the total fuel requirement for the ARI case battalion.

Table 3-10. Total battalion daily fuel requirement

	Basecase	ARI Case
AH-64A	12,480	16,650
OH-58C	1,400	
SUBTOTAL	13,880	16,650
UH-60L	2,105	
OTHER	2,580	2,090
TOTAL	18,565	18,740

(b) Class V. Table 3-11 shows ammunition requirements for the two cases. To differentiate between attack and scout rates the USAAVNC provided SME estimations of the scout rates as a percentage of the attack rates (which are found in FM-101-10-1). The SME scout rates were as follows: 30 percent of the attack helicopter Hellfire usage; 40 percent of the attack helicopter rocket usage; 50 percent of the attack helicopter 30mm ammunition usage. The difference in ammunition usage between the cases is minimal at the battalion level.

Table 3-11. Total battalion daily ammunition requirement

	Basecase		ARI Case	
AMMO TYPE	Rounds per day	STONS	Rounds per day	STONS
Hellfire	234	22	230	21
Rockets	602	14	622	14
30MM	28,080	17	30,420	19
Other		1		2
Total		54		56

(4) Total supply requirement. Table 3-12 lists the requirements for all classes of supply.

Table 3-12. Total battalion supply requirements

	Basecase	ARI Case
CL I	1	1.12
CL II	0.42	0.47
CL III	0.06	0.08
CL IV	1.13	1.27
CL V	54	56
CL VII	5.06	5.01
CL VII	0.09	0.1
CL 1X	0.3	0.26
TOTAL (STON)	62.06	64.31
CL III(B) (Gals)	18,565.00	18,740
Water (Gals)	2,601	2,618

d. *Deployment analysis.* This analysis was conducted based on one attack helicopter battalion deploying to the SWA theater of operations.

(1) Airlift. All outsized equipment was loaded on the C-5 or the C-17 aircraft and any remaining area was filled with other equipment for efficient C-5 or C-17 loads. The outsize equipment in the basecase included the 18 AH-64A helicopters, three UH-60L utility helicopters, and one LMTV truck van. The 24 AH-64A helicopters and the LMTV truck van were the outsize equipment in the ARI case. All remaining cargo was loaded on C-141 aircraft. The basecase attack battalion weighed 1,036 STON and the ARI case battalion weighed 1,009 STON. The airlift requirements and closure for both cases are shown in table 3-13.

Table 3-13. Airlift, sealift and closure

	Airlift Sorties						Sealift	
	C-141	C-5	Closure	C-141	C-17	Closure	% RORO required	Closure
Basecase Atk BN	40	4	3 days	45	7	3 days	31%	14 days
ARI Case Atk BN	38	5	3 days	42	9	3 days	28%	14 days

(2) Sealift. To determine the sealift requirements, this analysis used an average roll-on/roll-off (RORO) vessel which has about 130,000 square feet of available cargo space. Applying a stow factor of 0.8 leaves 104,000 square feet of actual cargo that could be loaded. The total square feet of the basecase and ARI case for organic cargo vehicles empty and loaded are shown in table 3-14. Figure 3-13 shows that the basecase would require approximately 31 percent of the RORO vessel and the ARI case would require 28 percent. It would take the same number of days to get each case to SWA via sealift.

Table 3-14. Basecase and ARI case square footage

	Square feet utilized*	
	Empty	Loaded
Basecase	34,749	31,963
ARI case	31,319	28,850
* This includes accompanying supplies and ammunition	Note: Loaded weights were used in the analysis	

(3) Self-deployment. Figures 3-25 and 3-26 show how many nautical miles an OH-58C or a AH-64A could self-deploy under the conditions specified. The AH-64A is loaded with four auxiliary fuel tanks. Neither helicopter is carrying any weapons. The ARI case battalion fully supports the NMS. It would rapidly be available for contingency operations.

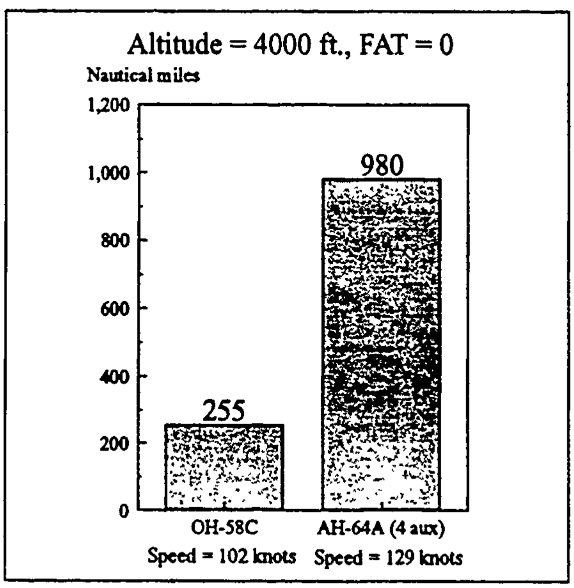


Figure 3-25. Self-deployment at FAT=0

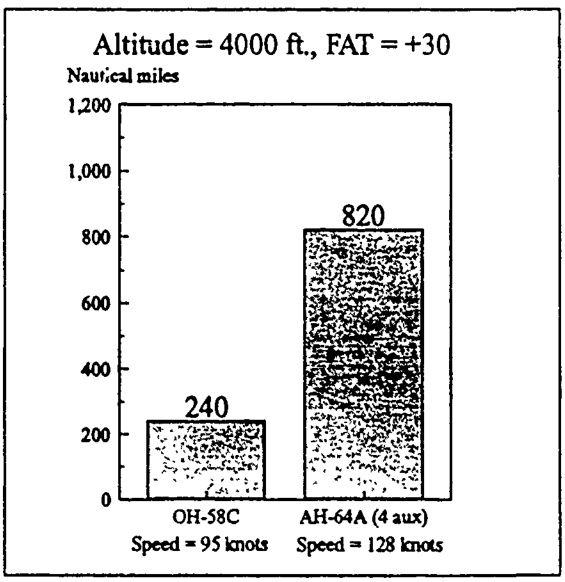


Figure 3-26. Self-deployment at FAT= +30

AVIATION ATTACK BATTALION STUDY

CHAPTER 4

FINDINGS AND CONCLUSIONS

4-1. Findings. The purpose of this study was to identify the benefits and liabilities involved in replacing the OH-58C with the AH-64A as the scout helicopter in the heavy division attack helicopter battalion. The following findings review the insights gained during the analysis of the performance, effectiveness, and sustainability of each of the aircraft within the basecase or ARI case attack battalion.

a. There was a decrease in the total number of helicopters lost in the ARI case over the basecase in both the SWA low-resolution and high-resolution gaming.

b. Lack of detections by the OH-58C forced the AH-64As to get within direct fire range of threat systems in the basecase.

c. Use of the AH-64A scouts to designate targets for the attack helicopters allowed greater survivability for the battalion.

d. The AH-64As in the basecase performed the duties of the scout (detections, target handover), at the expense of attack missions. The OH-58C could not perform the scout duties adequately.

e. The AH-64A provides enhanced communications, navigation, pilotage, target acquisition, and weapons capabilities over the OH-58C.

f. The ARI battalion provides the possibility of increased combat power.

g. The ARI battalion provided the commander with additional unit flexibility.

h. Daily sustainment requirements were about the same.

i. The ARI case personnel requirements are as supportable as the basecase requirements while being staffed at its full MARC requirement.

j. Maintenance requirements for AH-64A are considerably higher than for the OH-58C.

k. The new AVIM structure should facilitate task organization and deployment.

l. The ARI attack battalion corrects previously identified shortcomings in aviation maintenance.

m. The ARI battalion supports the National Military Strategy. The ARI battalion is a power projection force designed to protect national interests

4-2. Conclusion. The ARI battalion met or exceeded the capabilities of the basecase battalion in the areas of performance, combat effectiveness, and sustainability.

APPENDIX A

Headquarters Training and Doctrine Command Tasker

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DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651-

REPLY TO ATTENTION OF

ATAN-AP (5-5) 9 March 1993

MEMORANDUM FOR Commander, TRADOC Analysis Command, Fort Leavenworth, KS 66027

SUBJECT: Aviation Force Structure Study

1. Reference Memo, HQ TRADOC, ATAN-SM, 18 Dec 92, Subject: Use of TRADOC Analysis.

2. Purpose. Directs TRAC to conduct a study to determine impact on United States Army of changing the configuration of division aviation attack battalions.

3. Mission Statement. Conduct a study using force-on-force simulations and sortie comparisons to determine impact of alternative designs with respect to the five Army modernization objectives:

a. Project and sustain the force.

b. Protect the force.

c. Win the information war.

d. Conduct precision interdiction operations throughout the battlefield.

e. Dominate the maneuver battle.

4. General.

a. Non-major, high-visibility study.

b. Study Sponsor: USAAVNC, Combat Developments, ATZQ-CD.

c. Study Agency: TRADOC Analysis Command (TRAC).

d. Certifier (study plan and final report): CG, TRAC.

e. Approver (study plan and final report): DCG, TRADOC, CAC.

ATAN-AP
SUBJECT: Aviation Force Structure Study

f. Within 60 days after receipt of final report, study sponsor (ATZQ-CD) should respond to CG, TRADOC memo (ref) on how study was, or will be, used to support Army needs.

g. CG, TRAC certification and USAAVNC (ATZQ-CD) concurrence must be obtained prior to releasing the study or its results outside TRADOC.

h. Study alternatives:

(1) Current Design: one battalion per division; operational availability of three companies; five AH-64A attack and three OH-58C scout helicopters per company.

(2) Proposed Design: one battalion per division; operational availability of three companies; four AH-64A attack and two AH-64A "scout" helicopters per company.

5. Milestones:

a. Study Plan, Mar 93.

b. Gaming and analysis, Jun - Sep 93.

c. Final Report, Oct 93.

6. Points of contact:

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c. HQ TRAC: Mr. Ed Arendt, ATRC-FC, DSN 552-3814.

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ATAN-AP
SUBJECT: Aviation Force Structure Study

USAAVNC (ATZQ-CD, ATZQ-CDC-S), Ft Rucker, AL
USATRAC (ATRC-TD, ATRC-PC), Ft Leavenworth, KS
USACAC (ATZL-CD, ATZL-CDF-A), Ft Leavenworth, KS

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APPENDIX B

Aviation Attack Battalion Study Plan

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Study Plan TRAC-SP-0393
June 1993

Aviation Attack Battalion Study
Study Plan

U.S. ARMY
TRADOC ANALYSIS CENTER - OPERATIONS ANALYSIS CENTER
COMBINED ARMS ANALYSIS DIRECTORATE
FORT LEAVENWORTH, KANSAS 66027-5200

Distribution Statement:
Approved for public release;
distribution unlimited

Study Plan TRAC-SP-0393
June 1993

TRADOC Analysis Center - Operations Analysis Center
Combined Arms Analysis Directorate
Fort Leavenworth, Kansas 66027-5200

AVIATION ATTACK BATTALION STUDY

STUDY PLAN

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Jul 19, 1993 Date	20 Jul 93 Date	5 Aug 93 Date

Distribution Statement:
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CONTENTS

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1. Purpose. This plan identifies the study objectives for the Aviation Attack Battalion Study. The study will identify impacts on the U.S. Army of changing the configuration of the attack battalion. The study agency is the Training and Doctrine Command (TRADOC) Analysis Center (TRAC), with participants at Fort Lee (TRAC-LEE) and at the Operations Analysis Center (TRAC-OAC) at Fort Leavenworth. The U.S. Army Aviation Center (USAAVNC) is the study sponsor.

2. References.

a. Memorandum, ATAN-SM, 18 December 1992, subject: Use of TRADOC Analysis.

b. Memorandum (study tasker), ATAN-AP, 9 March 1993, subject: Aviation Force Structure Study.

c. The Army Modernization Plan, Headquarters, Department of the Army (HQDA), Office of the Assistant Deputy Chief of Staff for Operations and Plans (DCSOPS), Force Development, ATTN: DAMO-FDR, Washington, D.C. 20310-0400, January 1993.

3. Terms of reference.

a. *Problem.* The Army of the 21st century will be reshaped into a smaller, contingency oriented, power projection Army. The imperative to maintain a viable modernization plan is mandated by the National Military Strategy. For the aviation component of this Army, fixing the most critical problems with the current force is a concern, as well as ensuring the retention of the most modern systems, particularly as research, development, and acquisition dollars for new equipment are reduced. The OH-58C scout helicopter limits the effectiveness of the attack battalion due to constraints on speed and flight time, an age of the airframes that exceeds 30 years, lack of self-protection, lack of night flight and adverse weather capabilities, and other considerations. The Comanche helicopter is planned as the replacement for the OH-58C in this role, in addition to being a replacement for the OH-58D, but may not be available for many years. If Comanche acquisition is delayed, an interim solution must be developed, which may include using AH-64A attack helicopters reconfigured for the scout and reconnaissance missions. If the AH-64A has true versatility to serve in this role, other advantages (range, speed, remaining life, etc.) it holds over the current OH-58C scout helicopter may combine for an improved posture in spite of force reductions.

b. *Impact of the problem.* The Army aviation battalion must incorporate the requisite capability for global operations by ensuring overmatch on the battlefield. Implementing downsizing initiatives without fixing existing problems may negate overall U.S. advantages on the battlefield. The Army must ensure that effective, mission-appropriate force structure and equipment is retained or procured. This study will determine if the AH-64A is a part of the interim solution to scout helicopter deficiencies.

c. *Objectives*. Determine the impact of alternative attack battalion designs with respect to the five Army modernization objectives:

(1) Project and sustain the force.

(2) Protect the force.

(3) Win the information war.

(4) Conduct precision interdiction operations.

(5) Dominate the maneuver battle.

d. *Scope*. This is a nonmajor, high-visibility study. The focus of the study is to evaluate two alternatives for the heavy division aviation attack battalion.

(1) The current design (base case) includes a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60 helicopters, with an operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 3 OH-58C scout helicopters and 5 AH-64A attack helicopters. There are two attack battalions in each division. The scouts will fly with the attack helicopters (limiting the speed capabilities of the AH-64A). This alternative will be gamed in SWA 4.0.1, HRS 24.2, and HRS 31.1.

(2) The modified base case includes a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60 helicopters, with an operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 3 OH-58C scout helicopters and 5 AH-64A attack helicopters. There are two attack battalions in each division. The scouts will fly security behind the attack helicopters (due to the inability of the OH-58C to keep up with the AH-64A). This alternative will be gamed in SWA 4.0.1. It will not be gamed in the two high-resolution scenarios due to time constraints.

(3) The proposed alternative (AH-64A case) includes a battalion of 24 AH-64A helicopters (9 scout and 15 attack) with the same operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 6 AH-64A helicopters. Two of the AH-64A helicopters have a reconnaissance and security mission and

4 have an attack mission. There are two attack battalions in each division. The scout will fly with the attack helicopter. This alternative will be gamed in SWA 4.0.1, HRS 24.2, and HRS 31.1.

(4) The armed reconnaissance alternative will examine the scout helicopters from the AH64A performing an armed reconnaissance mission looking for a high-value target. This alternative will be examined both during the day and night.

e. *Limitations.*

(1) Analysis will be conducted using the Eagle model. Eagle is a prototype model developed by TRAC-OAC, with the support of the Deputy Under Secretary of the Army for Operations Research (DUSA-OR), which has not had verification, validation, and accreditation (VV&A) performed on it. Eagle has been used on the Reconnaissance and Security Study conducted by TRAC-OAC and has been benchmarked against the Vector-in-Commander (VIC) model. The USAAVNC is working closely with the Eagle model team to insure that the model accurately represents helicopter capabilities. They have provided subject-matter experts to oversee the tactics, techniques, and procedures employed by helicopters in the model.

(2) Cost analysis will not be included in the study. These details must be considered by the USAAVNC as part of their overall Aviation Restructure Initiative.

f. *Assumptions.*

(1) The scenarios used are representative of likely situations for employment of attack helicopter assets.

(2) Threat forces will field systems in the types and quantities specified in the approved scenario.

(3) The attack helicopter battalion is accurately depicted, and will perform as specified for force-on-force simulations.

g. *Methodology.*

(1) General. A mix of wargaming, sustainment analysis, deployability analysis, and static comparisons will be used to address essential elements of analysis (EEA) and meet study objectives. A TRADOC operational scenario will serve as the basis for wargaming and sustainment analysis and will define the force structure of interest in deployability analysis. The SWA 4.0.1 scenario will be represented in the Eagle division-level model, with one attack battalion employed against a deep

high-value target and one attack battalion employed against an attacking brigade in battle hand-off from the division cavalry. High resolution scenario (HRS) 24.2 and HRS 31.1 will be gamed in the Janus model. HRS 24.2 represents an attack battalion in a deep attack against a Red armored brigade in SWA. HRS 31.1 represents an attack battalion prepping the battlefield in Northeast Asia (NEA) for an air assault.

(2) EEA and approach.

(a) Objective 1: Project and sustain the force.

EEA 1a. What are the deployability requirements (airlift, sealift, and self-deployment) for a heavy division structured with both alternatives? TRAC-LEE will provide assistance to and coordinate with the Military Traffic Management Command (MTMC) to conduct an analysis estimating resources and timelines required to deploy the base case and alternative force in the SWA and NEA scenarios used for wargaming.

EEA 1b. What are the differences in sustainment requirements of the two alternatives? TRAC-LEE will conduct an analysis to identify sustainment differences between the base case and alternative forces in the SWA and NEA scenarios used for wargaming.

(b) Objective 2: Protect the force.

EEA 2. How do the alternatives differ in ability to survive, detect, destroy, and defend? TRAC-OAC will conduct static comparisons of system characteristics, and will analyze scenarios employing alternatives in close and deep operations and at night.

(c) Objective 3: Win the information war.

EEA 3. How do the alternatives differ in ability to see and hear the enemy and disrupt, deny, and damage the threat information systems? TRAC-OAC will conduct static comparisons of system characteristics and use the SWA and NEA scenarios to examine capability to conduct reconnaissance and counter-reconnaissance.

(d) Objective 4: Conduct precision interdiction operations throughout the battlefield.

EEA 4. How do the alternatives differ in the ability to locate, attack, and destroy the threat deep?

TRAC-OAC will conduct static comparisons of system characteristics and examine the attack battalion against a fixed, deep high-value target during the wargaming analysis.

(e) Objective 5: Dominate the maneuver battle.

EEA 5. What are the differences in contributions of each alternative to maneuver, firepower, mobility, and the ability to gather threat information and transmit it around the battlefield? TRAC-OAC will conduct static comparisons of system characteristics, and will analyze a scenario employing alternatives in close and deep operations, including excursions at night and in adverse weather during the wargaming analysis.

4. Support and resource requirements.

a. *Support requirements.*

(1) TRAC-LEE will serve as a supporting analytic agency with responsibility for the analysis of requirements to project and sustain the force. TRAC-LEE will write the analysis plan for Objective 1. TRAC-LEE will assist in activities and coordinate data required from TRAC for the deployment analysis to be conducted by MTMC.

(2) TRAC-OAC will serve as lead study agency and will analyze impacts on the remaining four of the five Army modernization objectives; namely, to protect the force, to win the information war, to conduct precision interdiction operations, and to dominate the maneuver battle. TRAC-OAC will integrate inputs from all supporting agencies into the final product. Participating TRAC-OAC directorates include Combined Arms Analysis Directorate (CAAD) for study management, integration of analyses, and preparation of final study report; Production Analysis Directorate (PAD) for wargaming analysis with Eagle; and Technical Support Directorate (TSD) for editorial and publication support.

(3) USAAVNC will sponsor the study. USAAVNC will provide subject matter expertise for configuration of the helicopters and employment of the attack battalion alternative. Rationale for the configuration and employment options must be provided by USAAVNC so the study team will understand the intent. USAAVNC will provide helicopter system performance data to be used in the static comparision analysis. USAAVNC will participate in the scenario certification process for SWA 4.0.1. THE USAAVNC will also perform the Janus gaming of the base case and alternatives in HRS 24.2 and HRS 31.1 and document HRS 31.1 for certification.

(4) TRAC Study and Analysis Center (TRAC-SAC) will provide weapon system performance data for wargaming analyses.

(5) TRAC Scenarios and Wargaming Center (TRAC-SWC) will review the proposed study scenario, develop necessary modifications, review implementation of modifications, and certify scenarios for study use.

(6) Combined Arms Command (CAC) Threats Directorate will review the proposed study scenario and approve threat and threat portrayal as part of the scenario certification process.

(7) CAC Combat Developments Force Design Directorate (CAC-CD FDD) will review proposed force structures for the study, recommend modifications, and participate in the scenario certification process.

(8) TRAC Operations Directorate (TRAC-OD) will review the study plan and final study product for certification recommendation. TOD will also provide production and quality oversight, and attend in-progress reviews (IPR) as required.

(9) HQ TRADOC Office of the Deputy Chief of Staff for Analysis (DCSA) will provide a liaison for coordination with HQ TRADOC staff elements for any support or information needed during the study.

(10) MTMC will perform a deployability analysis in support of EEA 1a. MTMC will provide the methodology and report for the deployability analysis to be incorporated in the sustainment analysis plan and report.

(11) Combined Arms Support Command (CASCOM) will support EEA 1b by providing data required to conduct the sustainment analysis.

b. *Resource requirements*. Estimates of professional staff year (PSY) requirements are provided in table 1 for each agency.

c. *Data requirements*. Weapon system data for fiscal year (FY) 99 Blue forces, FY99 Blue systems, and 2004 threat forces will be developed for input to Eagle and Janus by TRAC-SAC. Helicopter system performance data for use in the static comparision of system capabilities will be provided by USAAVNC.

5. Administration.

a. *Study review*. The study plan and final report will be certified by the Director, TRAC, and approved by the Deputy Chief of Staff for Combat Developments (DCSCD), as specified in the study tasker. In-progress reviews (IPR) will be held throughout the study for Director, TRAC-OAC; Director, CAAD, TRAC-OAC;

Table 1. Resource requirements.

AGENCY	Professional Staff Years
TRAC-LEE	0.6
TRAC-OAC:	
CAAD	0.8
PAD EAGLE	0.8
TSD	0.2
USAAVNC	0.8
TRAC-SAC	0.2
TRAC-SWC	0.4
CAC-THREATS	0.3
CAC-CD FDD	0.2
MTMC	0.2
CASCOM	0.2
TRAC-OD	0.2
DCSA	0.1
TOTAL	5

Director, PAD, TRAC-OAC; and, the Chief, Concepts and Studies Division, USAAVNC. The Study Review Group (SAG) will consist of the DCSCDD; Commander, USAAVNC; Director, TRAC; and, Director, TRAC-OAC.

b. *Study schedule.*

Approve study approach	15 Feb 93
Coordinate study plan	31 Mar 93
Working group	14 May 93
Coordination brief to USAAVNC	26 May 93
Study Plan approval	28 Jun 93
Scenario approval brief	7 Jul 93
Complete Janus gaming	30 Jul 93
Emerging results IPR	25 Aug 93
Complete deployability analysis	1 Sep 93
Complete sustainability analysis	1 Sep 93
Complete wargaming analysis	1 Sep 93
Present study results at the Functional Area Assessment	23 Sep 93
Final results SAG	28 Sep 93
Final report	31 Oct 93

c. *Study sponsor*. CG USAAVNC. POC is Mr. Nathan Cleek, ATZQ-CDC-SB, DSN 558-4709.

d. *Study director*. Mrs. Laurie Hable, Analysis Division II, CAAD, TRAC-OAC; DSN 552-2425 or commercial (913) 684-2425, Fax DSN 552-2344. Mailing address is Director, TRAC-OAC, ATTN: ATRC-FCB, Fort Leavenworth, Kansas 66027-5200.

6. Coordination. This study plan was coordinated with USAAVNC, TRAC-LEE, TRAC-SAC, TRAC-SWC, CAC Threats, CAC-CD FDD, and TRAC-OD. Their comments and input were incorporated into this document.

APPENDIX A

TRAC-LEE ANALYSIS PLAN

AVIATION ATTACK BATTALION STUDY
LOGISTICS IMPACT ANALYSIS (LIA) PLAN

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1. Purpose. The purpose of this LIA is to assess the logistic impacts of changing the configuration of the attack helicopter battalion by replacing the current OH-58C reconassance aircraft with AH64A attack helicopters reconfigured for the scout mission.

2. Reference. Memorandum (study tasker), ATAN-AP, 9 March 1993, Subject: Aviation Force Structure Study.

3. Terms of Reference.

a. *Problem.* The Army of the 21st century will be reshaped into a smaller, contingency oriented, power projection Army. The imperative to maintain a viable modernization plan is mandated by the National Military Strategy (NMS). For the aviation component of this Army, fixing the most critical problems with the current force is a concern, as well as ensuring the retention of the most modern systems, particularly as research, development, and acquisition (RDA) dollars for new equipment are reduced. The OH-58C scout helicopter limits the effectiveness of the attack battalion due to constraints on speed and flight time, lack of self protection, lack of night flight and adverse weather capabilities, and other considerations. The Comanche helicopter is planned as the replacement for the OH-58C in this role, but may not be available for many years. If Comanche acquisition is delayed, an interim solution must be developed, which may include using AH64A attack helicopters reconfigured for the scout and reconnaissance missions. If the AH64A has true versatility to serve in this role, other advantages (range, speed, remaining life, etc.) it holds over the current OH-58C scout helicopter may combine for an improved posture in spite of force reductions.

b. *Impact of problem.* The Army aviation battalion must incorporate the requisite capability for global operations by ensuring overmatch on the battlefield. Implementing downsizing initiatives without fixing existing problems may negate overall U.S. advantages on the battlefield. The Army must ensure that effective, mission-appropriate force structure and equipment is retained or procured. This study will determine if the AH64A is a part of the interim solution to scout helicopter deficiencies.

c. *Objective.* Determine the impact of alternative attack battalion designs with respect to the following Army modernization objective: Project and sustain the force.This entails a comparison of supply, maintenance, transportation, manpower, and equipment requirements for the base and objective cases.

d. *Scope*.

(1) The study will examine requirements for supply classes III, V, VII, and IX for the base and objective cases.

(2) The study will examine maintenance requirement differences under current support concepts.

(3) The study will examine deployability issues that relate to projection of the force.

e. *Constraints*.

(1) This impact analysis will be constrained in scope and depth by time, with a completion date of 1 Sep 93.

f. *Assumptions*.

(1) The basic structure and support relationships established for in the base case will remain the same for the alternative.

(2) SRC's (AOE TOEs) developed for a heavy division can be used in this study.

(3) Supply requirements based on Army [illegible]ng Factors are representative of supply requirements.

(4) Maintenance requirements based on Army MARC Maintenance Data Base information are representative of maintenance requirements.

g. *Essential Elements of Analysis*.

(1) EEA 1a. What are the deployability requirements (airlift and sealift) for a heavy division structured with both alternatives? Estimates of resources and timelines required to deploy a heavy division and support package to SWA and NEA will be provided. The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) will perform a transportability engineering analysis to determine the following:

(a) What are the impacts on transportability associated with fielding the base and objective cases?

1. Identify the transportation mode (highway, rail, marine, and air) constraints for the base and objective cases?

2. Identify the restrictions to shipment in the continental United States (CONUS) and outside CONUS (OCONUS) for both cases.

3. Determine whether there are sufficient transportation assets with the capacity to move each case?

(b) How does the objective case compare with the base case from the transportability perspective?

(2) EEA 1b. What are the differences in sustainment requirements of the two alternatives? A planning factors analysis will be used to identify sustainment differences for the two cases in the SWA theater. Due to time constraints, a planning factors analysis will not be possible in the NEA theater.

(a) What are the annual maintenance manhour (AMMH) requirements for the base and objectives cases?

(b) What is the mechanic manpower requirement at each maintenance level created by the AMMH requirements determined in 3.g.(2)(a) above by MOS?

(c) What are the supply requirements for the base and objective cases at the battalion, brigade and corps levels?

(d) What are the requirements for major items of equipment to support the supply requirements determined in 3.g.(2)(c) above?

4. Measures of Performance (MOP).

a. *Maintenance*. Annual maintenance manhours (AMMH) by MOS for the base and objective cases.

b. *Supply*. Supply requirements for the battalion for the base and objective cases:

(1) Class III expressed in gallons/day.

(2) Class V expressed in short tons/day.

(3) Class VII expressed in short tons/day.

(4) Class IX expressed in short tons/day.

c. *Transportation*. The daily requirement for classes III and V will be converted to truck transportation requirements for the base and objective cases.

d. *Deployability*. The objective of the deployability analysis is to show the impact of each study alternative on the strategic deployment of Army forces. The primary measures of deployability will be the number of transportation assets required (railcars, trucks, ships, aircraft) and time required to deploy Army forces.

5. Alternatives.

a. The current design (base case) includes two battalions in each heavy division, with three companies per battalion. Each company is equipped with five AH64A attack helicopters and three OH-58C scout helicopters.

b. The proposed alternative (AH-64A case) also includes two battalions in each division, with three companies per battalion. In this design, each company consists of six AH64A helicopters. Four are configured for attack missions, and two are configured for scout and reconnaissance missions.

6. Methodology.

a. *General overview*. Comparative analysis will be performed to determine requirements for the base and objective cases in each of the following areas:

(1) Supply, maintenance, and transportation.

(2) Deployability.

b. *Supply, maintenance, and transportation analysis*.

(1) Supply. The determination of supply requirements will be accomplished using a spreadsheet analysis of supply planning factor data from the CASCOM Log Data Base (LDB), which will determine the average daily operational requirements for selected (III, V, VII, IX) classes of supply for each alternative requirement. A spreadsheet calculation and aggregation process will be used to develop supply requirements for the primary equipment within each alternative battalion.

(2) Maintenance. The maintenance requirements for the base case and each alternative will be determined using a spreadsheet analysis and will be based on the annual maintenance manhour (AMMH) requirements for the equipment in each case. The AMMH requirements will be converted into mechanic manpower requirements using AR 570-2 productivity factors.

(3) Transportation. The daily requirement for classes III and V will be converted into truck transportation requirements for each alternative batallion.

c. *Deployability*. The resources and timelines required to deploy the heavy division and support package to the SWA and NEA areas of operations will be developed.

(1) Air sortie requirements will be developed.

(2) Sea lift requirements will be developed.

7. Support and Resource Requirements.

a. *TRAC-OAC.*

(1) Coordinate the final draft study plan.

(2) Coordinate development of the force lists for the base and objective cases.

b. *TRAC-LEE.*

(1) Prepare the LIA plan.

(2) Conduct the LIA.

(3) Provide the completed LIA to TRAC-OAC.

c. *CASCOM.*

(1) Provide AMMH data to TRAC-LEE (FD&E).

(2) Provide Class of Supply data to TRAC-LEE (FD&E-PFB).

d. *MTMCTEA.*

(1) Provide air and sea lift requirements for deployment of both alternatives to SWA and NEA areas of operations.

e. *U.S. Army Aviation Logistics Center & School (USAALS).*

(1) Define aviation maintenance force structure in support of both cases.

(2) Define aviation maintenance support concept for both cases.

8. Administration.

a. *Milestone schedule.*

LIA plan complete	1 Jul 93
Data collection	15 Jul 93
LIA complete	6 Aug 93
Final report complete	20 Aug 93

b. *Control.* TRAC-OAC will monitor the development of the LIA, the force costing, the development of the scripted brief and the final report.

APPENDIX B

TRAC-OAC ANALYSIS PLAN

1. Purpose. This plan outlines the analytical support that the TRAC-OAC will provide to the Aviation Attack Battalion Study. The study will identify impacts on the U.S. Army of changing the configuration of the attack battalion. The U.S. Army Aviation Center is the study sponsor.

2. Scope. This is a nonmajor, high-visibility study.

a. *Assumptions*.

(1) The scenarios used are representative of likely situations for employment of attack helicopter assets.

(2) Threat forces will field systems in the types and quantities specified in the approved scenario.

(3) The attack helicopter battalion is accurately depicted, and will perform as specified for force-on-force simulations.

(4) System descriptions and data will be available in sufficient detail for evaluation purposes.

b. *Limitations*. The focus of the study is to evaluate two alternatives for the heavy division aviation attack battalion.

(1) Analysis will be conducted using the Eagle model. Eagle is a prototype model developed by TRAC-OAC, with the support of the Deputy Under Secretary of the Army for Operations Research (DUSA-OR), which has not had verification, validation, and accreditation (VV&A) performed on it. Eagle has been used on the Reconnaissance and Security Study conducted by TRAC-OAC and has been benchmarked against the Vector-in-Commander (VIC) model. The USAAVNC is working closely with the Eagle model team to insure that the model accurately represents helicopter capabilities. They have provided subject-matter experts to oversee the tactics, techniques, and procedures employed by helicopters in the model.

(2) Cost analysis will not be included in the study. These details must be considered by the USAAVNC as part of the overall Aviation Restructure Initiative.

3. Environmental and threat considerations.

a. *Environment*. The scenarios will take place in SWA and NEA and will include modeling in day and night conditions. The simulation modeling will not include climatic variations, nor nuclear, biological, or chemical warfare. Static comparisons will consider climatic variations in its analysis.

b. *Threat*. The threat year for the scenario will be 2004.

4. Methodology.

a. *Overview*. A mix of wargaming and static comparisons will be used to address EEA and meet study objectives. A TRADOC operational scenario will serve as the basis for wargaming analysis. The SWA 4.0.1 scenario will be represented in the Eagle division-level model, with one attack battalion employed against a deep high-value target and one attack battalion employed against an attacking brigade in battle hand-off from the division cavalry. HRS 24.2 and HRS 31.1 will be gamed in the Janus model. HRS 24.2 represents an attack battalion in a deep attack against a Red armored brigade in SWA. HRS 31.1 represents an attack battalion prepping the battlefield in NEA for an air assault. Static comparisons will involve evaluating the system capabilities of the OH-58C and the AH-64A.

b. *EEA*. The study objectives and the EEA for which TRAC-OAC has responsibility are detailed in the following paragraphs.

(1) Objective 2: Protect the force.

EEA 2. How do the alternatives differ in ability to survive, detect, destroy, and defend?

(2) Objective 3: Win the information war.

EEA 3. How do the alternatives differ in ability to see and hear the enemy and disrupt, deny, and damage the threat information systems?

(3) Objective 4: Conduct precision interdiction operations throughout the battlefield.

EEA 4. How do the alternatives differ in the ability to locate, attack, and destroy the threat deep?

(4) Objective 5: Dominate the maneuver battle.

EEA 5. What are the differences in contributions of each alternative to maneuver, firepower, mobility, and the ability to gather threat information and transmit it around the battlefield?

c. *Measures of performance and effectiveness*. Two sets of measures are used for analysis. The first set is measures of performance (MOP) which will be used to measure a system's ability to perform a specified mission. The second set is measures of effectiveness (MOE) which will be used to measure the combat effectiveness of the force. MOP and MOE will be referred to throughout this document as MOP/E. Table B-1 maps the MOP/E to the specific EEA they will answer. TRAC-OAC may identify additional MOP/E as the study develops.

(1) MOP 1. Percent of detections made by the scout.

(2) MOP 2. Distance at which threat units are detected by the scout.

(3) MOP 3. Changes in battle flow and time events occur.

(4) MOP 4. Airframe maneuver capability.

(5) MOP 5. Other helicopter system capabilities.

(6) MOE 6. Blue force survivability index. This index should give insights into the effectiveness of the Blue force. All else held constant, the greater the survivability of the Blue force, the more effective the force design.

$$SI_{BlueForce} = \frac{Number\_of\_Blue\_Systems\_Committed - Number\_of\_Blue\_System\_Losses}{Number\_of\_Blue\_Systems\_Committed}$$

(7) MOE 7. Blue helicopter survivability index. This index should give insights into the effectiveness of the aviation battalion force design. All else held constant, the greater the survivability of the blue helicopter, the more effective the force design.

$$SI_{BlueHelo} = \frac{Number\_of\_Blue\_Helos\_Committed - Number\_of\_Blue\_Helo}{Number\_of\_Blue\_Helos\_Committed}$$

(8) MOE 8. Blue helicopter kills against a deep threat.

(9) MOE 9. Blue helicopter kills of threat systems.

(10) MOE 10. Number of surviving attack and scout helicopters.

(11) MOE 11. Number of calls for indirect fire made by Blue helicopters.

(12) MOE 12. Surviving maneuver force ratio differential (SMFRD). This MOE addresses maneuver force survivability, as opposed to whole force survivability.

$$SMFRD = \frac{Number\_Blue\_Surviving\_Weapons}{Number\_Blue\_Initial\_Weapons} - \frac{Number\_Threat\_Surviving\_Weapons}{Number\_Threat\_Initial\_Weapons}$$

(13) MOE 13. Fractional loss exchange ratio (FLER). This MOE is a measure of Blue force effectiveness against the threat force using fractional loss exchange ratios. The higher this ratio, the more effective the Blue force design.

$$FLER = \frac{\frac{Total\_Threat\_Losses}{Initial\_Threat}}{\frac{Total\_Blue\_Losses}{Initial\_Blue}}$$

(14) MOE 14. Fractional loss exchange ratio for helicopters only. This MOE is a measure of Blue helicopter effectiveness against the threat force using fractional loss exchange ratios. The higher this ratio, the more effective the Blue force design.

$$FLER_{Helo} = \frac{\frac{Total\_Threat\_Losses}{Initial\_Threat}}{\frac{Total\_Blue\_Helo\_Losses}{Initial\_Blue\_Helos}}$$

Table B-1. MOP/E mapping to EEA.

	EEA 2	EEA 3	EEA 4	EEA 5
MOP 1	x	x		
MOP 2			x	
MOP 3				x
MOP 4				x
MOP 5	x	x	x	x
MOE 6	x			
MOE 7	x			
MOE 8	x		x	x
MOE 9	x			x
MOE 10	x			
MOE 11		x	x	x
MOE 12				x
MOE 13				x
MOE 14				x

d. *Alternatives.*

(1) The current design (base case) includes a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60 helicopters, with an operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 3 OH-58C scout helicopters and 5 AH-64A attack helicopters. There are two attack battalions in each division. The scouts will fly with the attack helicopters (limiting the speed capabilities of the AH-64A). This alternative will be gamed in SWA 4.0.1, HRS 24.2, and HRS 31.1.

(2) The modified base case includes a battalion comprised of 18 AH-64A, 13 OH-58C, and 3 UH-60 helicopters, with an operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 3 OH-58C scout helicopters and 5 AH-64A attack helicopters. There are two attack battalions in each division. The scouts will fly security behind the attack helicopters (due to the inability of the OH-58C to keep up with the AH-64A). This alternative will be gamed in SWA 4.0.1. It will not be gamed in the two high-resolution scenarios due to time constraints.

(3) The proposed alternative (AH-64A case) includes a battalion of 24 AH-64A helicopters (9 scout and 15 attack) with the same operational availability of three companies per battalion. Each company has an aircraft availability rate of 75 percent and operates with 6 AH-64A helicopters. Two of the AH-64A helicopters have a reconnaissance and security mission and 4 have an attack mission. There are two attack battalions in each division. The scout will fly with the attack helicopter. This alternative will be gamed in SWA 4.0.1, HRS 24.2, and HRS 31.1.

(4) The armed reconnaissance alternative will examine the scout helicopters from the AH-64A case performing an armed reconnaissance looking for a high-value target. This alternative will be examined both during the day and night.

e. *System employment and organization plan.* N/A

f. *Mission profiles.* N/A

g. *Models.*

(1) Eagle. The Eagle model is an automated combined arms force-on-force simulation representing land and air forces at the U.S. Army corps and division levels. It is a deterministic, time-stepped, Lanchester-equation based combat model with resolution at battalion level. Eagle's software architecture is based on object-oriented design. It is written using Knowledge Engineering Environment (KEE), an expert system shell, in the programming language Common Lisp Object System (CLOS). Eagle allows the user to control the level of representation of various functional areas. These functional areas include: direct fire, artillery fire support, command and control, communications, engineer operations, tactical air operations, intelligence, helicopter operations, air defense, target acquisition, and logistics.

(2) Janus. The Janus model is an interactive, high-resolution, force-on-force, brigade-level, stochastic combat simulation. The principal focus of Janus is on ground maneuver and artillery units, but Janus also models rotary and fixed wing

aircraft, engineer support, minefield employment and breaching, resupply, weather and its effects, and day and night visibility.

h. *Method of analysis.*

(1) Wargaming analysis. TRAC-OAC will use the Eagle medium-resolution simulation model to wargame the SWA 4.0.1 scenario and the Janus high-resolution model to wargame HRS 24.2 and HRS 31.1. A current division force structure equipped with 1999 equipment (except for the aviation brigade which will utilize present day equipment) will be gamed as the base case. The base case will show how well the division conducts its mission with an aviation brigade containing OH-58Cs in the scout role. The MOP/E will be used to evaluate the success or failure of the division and more specifically, the aviation brigade, in performing its mission. The alternative force will then be implemented in the model and the same measurements will be taken. A run matrix is included at table B-2.

Table B-2. Run matrix.

	Eagle SWA 4.0.1 Day	Eagle SWA 4.0.1 Night	Janus (night) HRS 31.1 (NEA)	Janus (day) HRS 24.2 (SWA)
Base Case	x	x	x	x
Modified Base Case	x	x		
AH-64A case	x	x	x	x
Armed Recon (AH-64A)	x	x		

(2) Sustainment analysis. TRAC-LEE will conduct a logistics impact analysis. This analysis will include determination of the requirements to arm, fuel, fix, move, and sustain the alternatives.

(3) Deployability analysis. TRAC-LEE will conduct the deployability analysis with support from MTMC. The deployability analysis will include airlift analysis for the base case and the alternative.

5. Resource and support requirements.

a. *Support requirements.*

(1) TRAC-OAC, CAAD.

(a) Serve as lead agency for incorporating analyses provided by other agencies.

(b) Write the study plan for the Aviation Attack Battalion Study.

(c) Write the analytical support plan for the TRAC-OAC portion of the analysis.

(d) Prepare scripted briefing of final analysis.

(e) Write final report.

(2) TRAC-OAC, PAD.

(a) Develop the SWA 4.0.1 base case for Eagle.

(b) Serve as the lead agency for Eagle computer simulation of the SWA 4.0.1 scenario and implementing the alternative force structures.

(2) TRAC-LEE.

(a) Serve as a supporting analytic agency with responsibility for the analysis of requirements to project and sustain the force.

(b) Write the analysis plan for Objective 1.

(c) Coordinate data required from TRAC for the deployment analysis to be conducted by MTMC.

(3) USAAVNC.

(a) Sponsor the study.

(b) Provide subject matter expertise for configuration of the helicopters and employment of the attack battalion alternative.

(c) Serve as the lead agency for the Janus computer modeling of HRS 24.2 and HRS 31.1 and the implementing of the alternative force structure.

(4) TRAC Study and Analysis Center (TRAC-SAC) will provide weapon system performance data for wargaming analyses.

(5) TRAC Scenarios and Wargaming Center (TRAC-SWC) will review the proposed study scenario, develop necessary modifications, review implementation of modifications, and certify scenarios for study use.

(6) Combined Arms Command (CAC) Threats Directorate will review the proposed study scenario and approve threat and threat portrayal as part of the scenario certification process.

(7) CAC Combat Developments Force Design Directorate (CAC-CD FDD) will review proposed force structures for the study, recommend modifications, and participate in the scenario certification process.

(8) TRAC Operations Directorate (TRAC-OD) will review the study plan and final study product for certification recommendation, and will coordinate all study review group meetings.

(9) MTMC will conduct a deployability analysis.

(10) Combined Arms Support Command (CASCOM) will support EEA 1b by providing data required to conduct the sustainment analysis.

b. *Resource requirements.*

(1) Travel: $4,000.

(2) Contracts: None.

c. *Data requirements.* The best available data will be used in all cases for this study.

6. Study schedule.

Approve study approach	15 Feb 93
Coordinate study plan	31 Mar 93
Working group	14 May 93
Coordination brief to USAAVNC	26 May 93
Study Plan approval	30 Jun 93
Scenario approval brief	7 Jul 93
Complete Janus gaming	30 Jul 93
Emerging results IPR	25 Aug 93
Complete deployability analysis	1 Sep 93
Complete sustainability analysis	1 Sep 93
Complete wargaming analysis	1 Sep 93
Present study results at the Functional Area Assessment	23 Sep 93
Final results SAC	28 Sep 93
Final report	31 Oct 93

APPENDIX C

GLOSSARY

AH	attack helicopter
CAAD	Combined Arms Analysis Directorate
CAC	Combined Arms Command
CAC-CD	Combined Arms Command - Combat Developments
CASCOM	Combined Arms Support Command
DCSA	Deputy Chief of Staff for Analysis
DCSCD	Deputy Chief of Staff for Combat Developments
DCSOPS	Deputy Chief of Staff for Operations and Plans
EEA	essential elements of analysis
FDD	Force Design Directorate
FY	fiscal year
HQDA	Headquarters, Department of the Army
HRS	high resolution scenario
IPR	in-progress review
MOE	measure of effectiveness
MOP	measure of performance
MTMC	Military Traffic Management Command
OH	observation helicopter
PAD	Production Analysis Directorate
SAG	study advisory group
SWA	Southwest Asia
TRAC	TRADOC Analysis Command
TRAC-LEE	TRAC Fort Lee
TRAC-OAC	TRAC Operations Analysis Center
TRAC-OD	TRAC Operations Directorate
TRAC-SAC	TRAC Study and Analysis Center
TRAC-SWC	TRAC Scenarios and Wargaming Center
TRADOC	Training and Doctrine Command
TSD	Technical Support Directorate
U.S.	United States
USAAVNC	U.S. Army Aviation Center
VIC	Vector-in-Commander
VV&A	verification, validation, and accreditation

APPENDIX D

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P. O. Box 6276
Newport News, VA 23606-0276

APPENDIX C

Essential Elements of Analysis

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APPENDIX C

ESSENTIAL ELEMENTS OF ANALYSIS

C-1. Sustainability analysis.

a. *EEA 1a: What are the deployability requirements (airlift, sealift, and self-deployment) for an aviation battalion structured with each alternative?* Table C-1 and figures C-1 and C-2 show the requirements for airlift, sealift and self-deployability. There is very little difference between the two cases in the areas of airlift and sealift. The AH-64A does have a much greater ability to self-deploy than the OH-58C. Because the AH-64A can deploy farther, it more readily supports the NMS requirement to be rapidly available for contingency operations. It would not be realistic to expect the OH-58C to self-deploy.

Table C-1. Airlift, sealift and closure

	Airlift Sorties						Sealift	
	C-141	C-5	Closure	C-141	C-17	Closure	% RORO required	Closure
Basecase Atk BN	35	11	3 days	37	21	3 days	31%	14 days
ARI Case Atk BN	35	13	3 days	36	25	3 days	28%	14 days

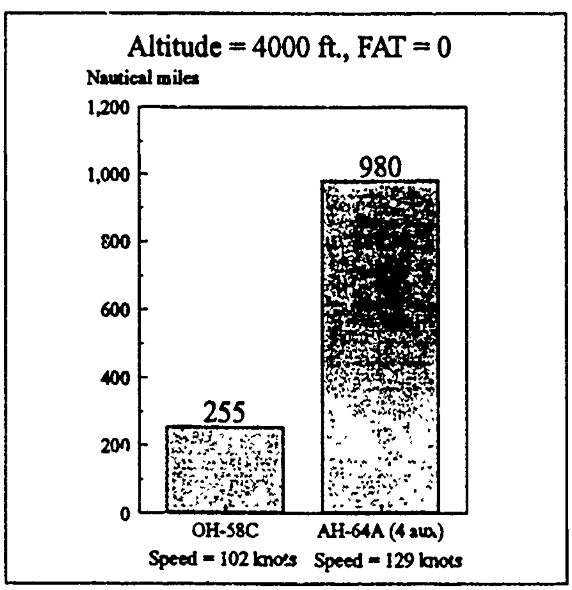

Figure C-1. Self-deployment at FAT=0

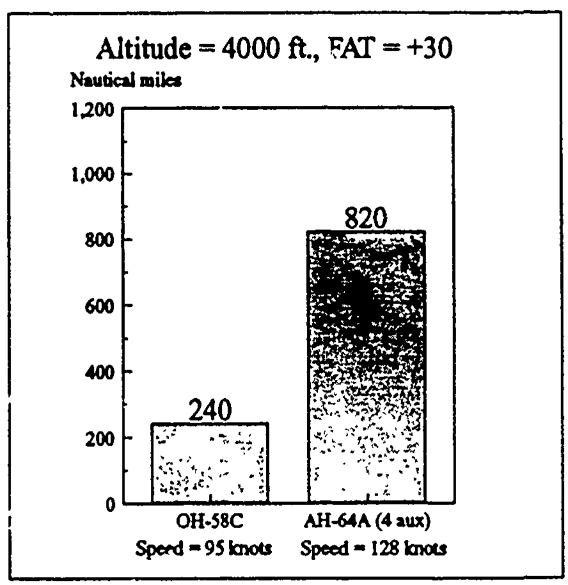

Figure C-2. Self-deployment at FAT= +30

b. *EEA 1b: How do the alternatives in sustainment requirements?* The sustainability analysis section in chapter 3 of this report discusses the differences in detail. Although there is no difference between the personnel needed in the battalion, the ARI case battalion is staffed at the full MARC requirement while the basecase battalion is staffed at approximately 69 percent of the MARC requirement. Table C-2 shows the staffing levels for both the basecase and the ARI case battalions. There is also very little difference in the supply requirements (see table C-3).

Table C-2. TOE battalion manpower

	Basecase	ARI Case	Difference
HHC	31	47	16
SUPPORT	42	43	1
FUEL	20	21	1
AMMO	13	13	0
C,CSS FLT SEC	12	0	(12)
AVN COs	99	81	(18)
AVUM CO	82	97	15
TOTAL	299	302	3

Table C-3. Total battalion daily supply requirements

		Basecase	ARI Case	% change
Class III	Gallons	18,565	18,740	1
Class V	STONs	54	56	4
Other	STONs	8	8	0
Water	Gallons	2,601	2,618	1
Unit strength	Personnel	299	302	

C-2. Performance and effectiveness analysis.

a. *EEA 2: How do the alternatives differ in ability to survive and destroy?* The AH-64A is equipped to be more survivable. The ASE package on the OH-58C only includes radar and laser warning receivers while the ASE package on the AH-64A includes radar- and laser-warning receivers, radar and IR jammers, and a chaff dispenser. The AH-64A was also designed to be more survivable. Approximately 2,500 pounds of airframe weight is for ballistic protection (armor fittings or oversized components). The drive shaft is able to take a 12.7mm strike and keep functioning and the cockpit can withstand a 23mm projectile. Figures C-2 and C-3 show that the ARI case battalion with the AH-64A scout was more survivable in the Janus and Eagle gaming, respectively. Both aircraft has a air-to-air capability in the form of the Stinger missile. In addition, the AH-64A also carries a 30mm chain gun, 2.75-inch rockets, and the Hellfire missile. Figure C-4 shows that the ARI case met or exceeded the kills made by the basecase in the Janus high-resolution gaming. Figure C-5 shows that the ARI case also made more kills made during the Eagle low-resolution gaming.

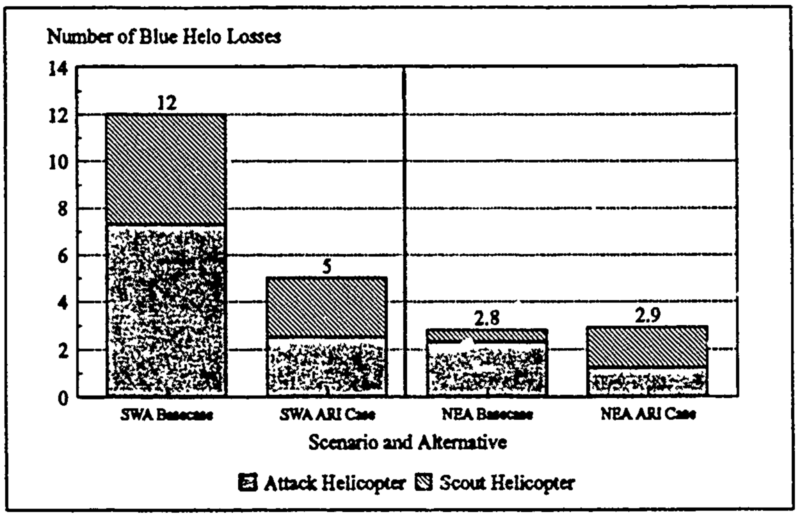

Figure C-2. Blue helicopter losses in Janus gaming

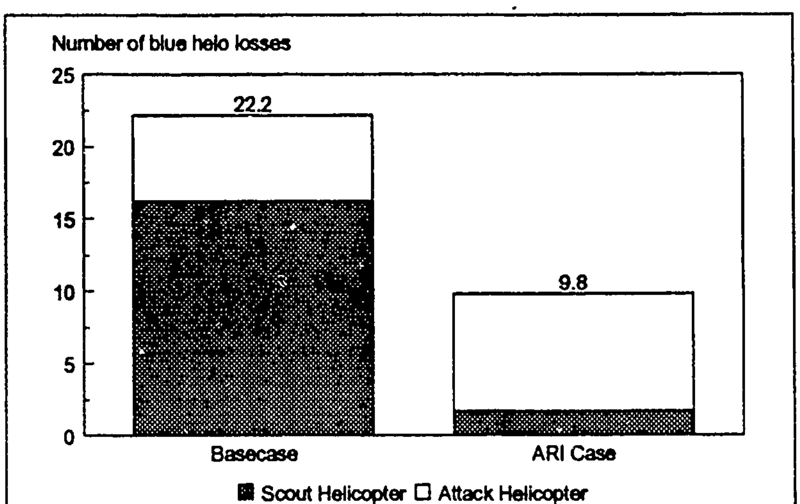

Figure C-3. Blue helicopter losses in Eagle gaming

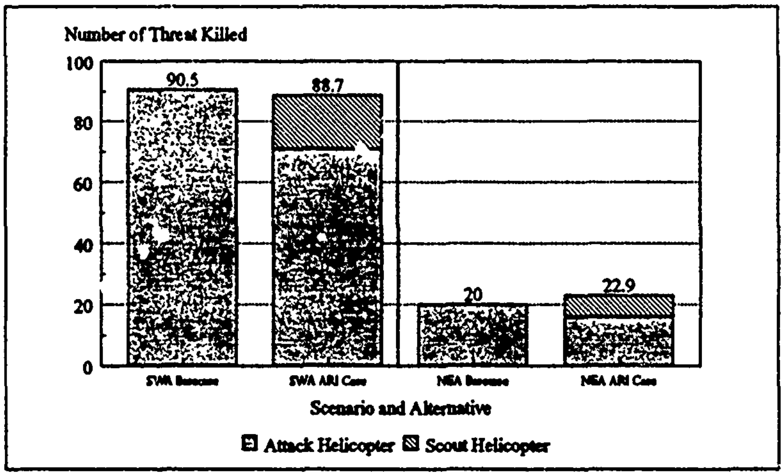

Figure C-4. Blue helicopter kills of threat in Janus gaming

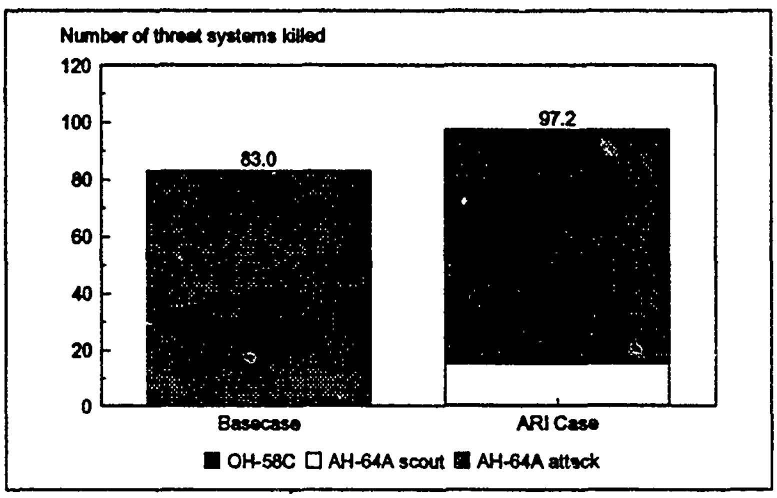

Figure C-5. Blue helicopter kills made in Eagle gaming

b. *EEA 3: How do the alternatives differ in ability to see and detect the enemy?* The OH-58C is limited in its ability to see and detect the enemy because its target acquisition equipment consists of optics. The pilot is able to use NVG at night but is limited to a range of 500 meters. The AH-64A is equipped to correct the acquisition and detection problems of the OH-58C. The AH-64A has a variety of capabilities with it TADS system that enhance the ability of the pilot to acquire and target the threat. The IR TV is used for smoke and haze penetration, the FLIR is used for night and bad weather acquisition, and the DVO provides a wide field of view for detection. The AH-64A is able to detect targets as far out as 8 km. Figures C-6 and C-7 show how the increased abilities of the AH-64A in the scout role improve the average range at which scout detections are made, the number of total detections, and the number of detections made by the scout.

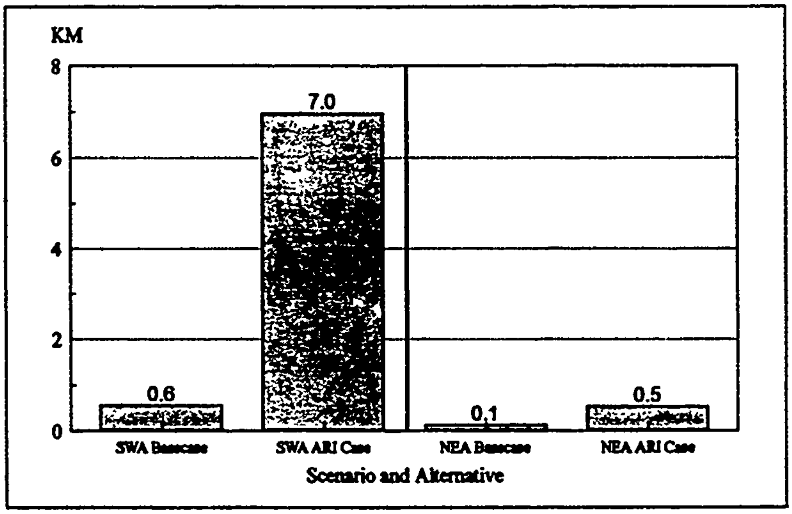

Figure C-6. Average scout detection distance in Janus gaming

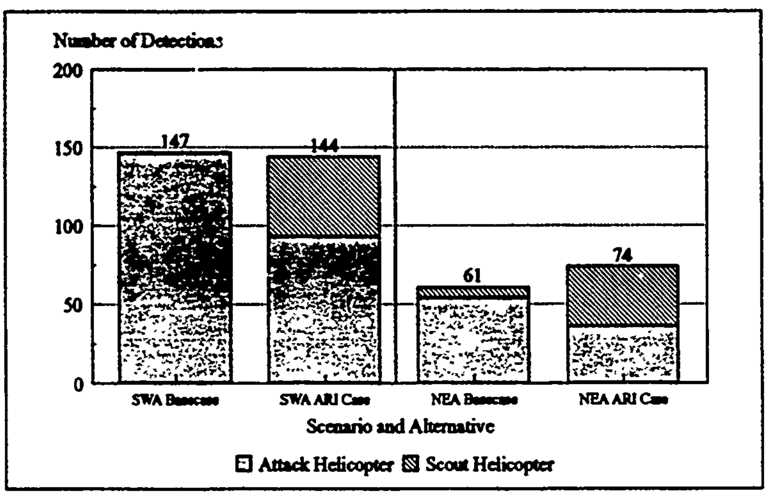

Figure C-7. Number of detections made in Janus gaming

c. *EEA 4: How do the alternatives differ in the ability to attack and destroy the threat deep?* This study looked at a deep battle in two SWA scenarios: HRS 24.AABS and SWA 4.0.1. In both scenarios, the threat brigade was defeated. Figure C-4 shows that the total kills made by Blue helicopters against the threat in HRS 24.AABS was approximately the same in both cases. This would be expected because the total number of detections was the same. The difference lies in which helicopter was doing the killing. In the ARI case, each AH-64A scout had 4 Hellfire missiles and 19 rockets available to fire as self-protection or when it had an opportunity. Since the AH-64A scout was able to kill some of the threat targets, the AH-64A attack helicopter was not required to get in as close within the BP. This resulted in increased survivability for the battalion. Figure C-8 shows that the total kills of a deep threat increased in the ARI case in SWA 4.0.1 (Eagle gaming). The improved ability of the scout aircraft in the ARI case accounts for the increased kills. Another factor that is important to a deep attack is aircraft endurance. Figures C-9 and C-10 show that with an auxiliary fuel tank loaded on the AH-64A, it can stay in the air approximately one hour longer than the OH-58C. The distances flown and time on station required for the scenarios gamed did not stress the aircraft so we were unable to gain combat modeling insights in this area.

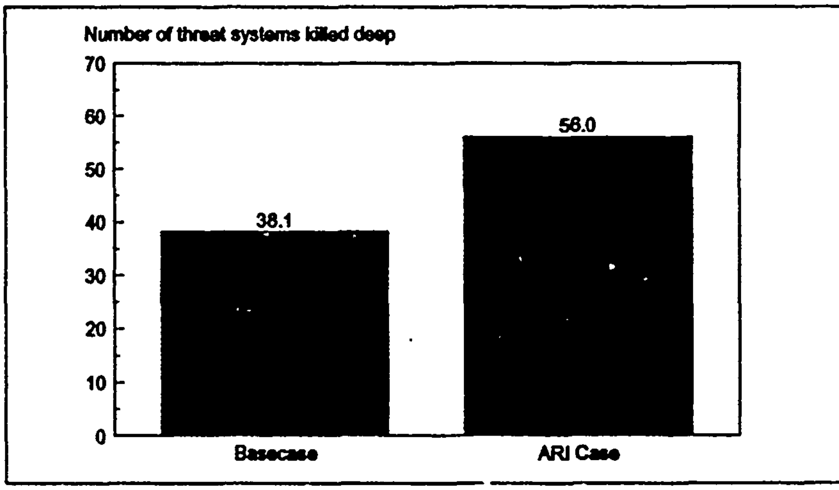

Figure C-8. Threat systems killed deep in Eagle gaming

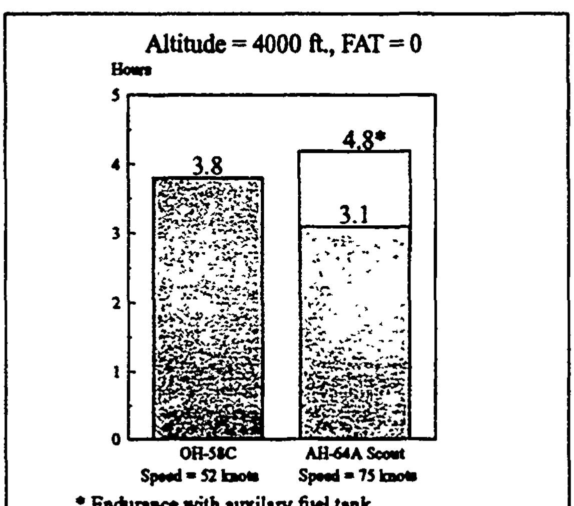

Figure C-9. Endurance in NEA environment

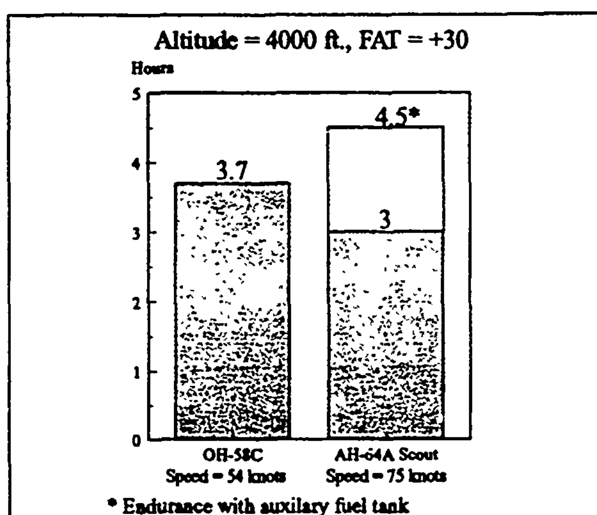

Figure C-10. Endurance in SWA environment

d. *EEA 5: What are the differences in contributions of each alternative to maneuver, firepower, mobility, and the ability to detect the enemy on the battlefield?* The effectiveness analysis section in chapter 3 of this report discusses in detail the differences in contributions of both the basecase force and the ARI case force. The ARI battalion was more survivable, obtained as many or more detections, and killed the same or more of the threat systems. In the basecase, the attack helicopter had to perform the duties of the scout helicopter at the expense of attack missions. The bottom line was that the ARI battalion met or exceeded the abilities of the basecase battalion.

APPENDIX D

Logistics Impact Analysis

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Tradoc Analysis Center - Fort Lee
Modeling Division
Fort Lee, Virginia 23801-6140

AVIATION ATTACK BATTALION STUDY

LOGISTICS IMPACT ANALYSIS

by

Mr. Bill Palmer
Ms. Pat Doherty

October 1993

Table Of Contents

1. Purpose. This LIA assessed the logistics impacts of changing the configuration of the attack helicopter battalion by replacing the current OH-58C reconnaissance aircraft with AH-64A attack helicopters reconfigured for the scout mission.

2. Summary. The new attack helicopter battalion design developed during the Aviation Restructure Initiative (ARI) effort has about the same overall manpower requirements as the current design. Some missions of the attack battalion are moved elsewhere in the brigade which results in no real savings. The ARI design reflects 100% staffing levels in aviation maintenance positions. Maintenance requirements for the AH-64A are considerably higher than for the OH-58C. The new attack battalion corrects previously identified shortcomings in aviation maintenance. The recovery mission for battalion aviation assets is entirely dependent on corps assets. There are some minor differences in sustainment requirements in specific areas but overall there are no major differences in the sustainment requirements for the two alternatives. A new AVIM structure will facilitate task organization / deployment of the battalion and its support slice.

3. References.

a. "Aviation Attack Battalion Study Plan", March 1993, TRAC, Fort Leavenworth, Kansas.

b. "Light Helicopter (LH) Program Cost and Operational Effectiveness Study." March 1991. TRAC, Fort Leavenworth, Kansas.

c. "Aviation Restructure Initiative" Brief, May 1993, Aviation Warfighting Center, Fort Rucker, Georgia.

4. Discussion. The Aviation Restructure Initiative focused on our new National Military Strategy (NMS) for a CONUS based power projection Army. The redesign of aviation to support this NMS is based on the following guidance: Fix the aviation AOE deficiencies; reduce logistics requirements; retire old aircraft; and stay within the resource box. ARI was approved on 3 Feb 1993 by the Chief of Staff of the Army during the Winter 93 Force Design Update. Force structure decisions to allocate resources to support the new design were made in the Total Army Analysis 01 process. This LIA examines those staffing levels, quantifies requirements in aviation mechanic manpower and logistics sustainment and identifies possible logistics concerns with the new attack battalion design.

5. Terms Of Reference.

a. Objectives.

(1) Compare staffing levels for the current and new ARI attack battalion designs.

(2) Evaluate mechanic manpower and supply sustainment requirements for the current and ARI designs.

(3) Identify potential logistics impacts associated with adoption of the new ARI design

b. Scope.

(1) The analysis determined battalion level logistics support requirements.

(2) The sustainment analysis was based on DA approved operational planning factors for a SWA theater.

(3) Manpower Requirements Criteria (MARC) data was used to develop aviation maintenance manpower requirements.

(4) LH COEA Study recovery and test, measurement, and diagnostic equipment (TMDE) requirement results were used in this report.

c. Assumptions.

(1) The warfight represented in the DA SWA scenario is appropriate for the purposes of this analysis.

(2) Classes of supply planning factor data from all sources adequately reflect supply requirements.

(3) Maintenance requirements based on AR 570-2 Army Manpower Requirements Criteria (MARC) are representative of maintenance requirements.

(4) Approved ARI TOE designs are appropriate for use in this analysis.

d. Constraints. This impact analysis was constrained in scope and depth by the specific study objectives and timelines.

e. Essential Elements of Analysis.

(1) What is the mechanic manpower requirement at the Aviation Unit (AVUM) and Intermediate (AVIM) Maintenance levels for the alternatives?

(2) What are the daily sustainment resupply requirements for each of the battalion designs?

6. Alternatives. Two TOE unit designs are being considered in this study. The current design or base case is the L-Series (AOE) constrained TOE. Equipment in the base case is current day (1994). The objective case is the A-Series TOE developed during ARI. The A-Series ARI design contains equipment that will be available in FY 2000.

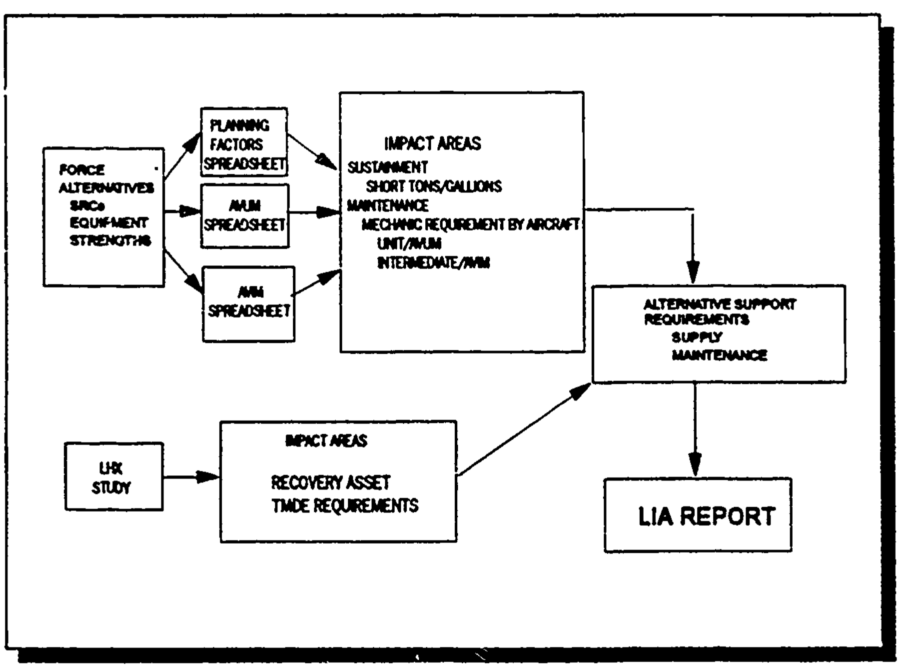
a. Base case - The current design (Base case) includes two battalions in each heavy division, with three companies per battalion. Each company is equipped with six AH-64A attack helicopters and four OH-58C scout helicopters. The Headquarters and Headquarters Company (HHC) has one OH-58C scout helicopter. This analysis focused on the equipment mixes described below but other equipment within the base case that has been reassigned to the brigade will be addressed (medium lift UH-60Ls).

b. Objective case - The proposed alternative (ARI case) also includes two battalions in each heavy division, with three companies per battalion. In this design, each company consists of eight AH-64A helicopters. Five are configured for attack missions and three are configured for the scout mission. The HHC has no scout helicopter.

7. Methodology.

a. General Methodology Overview. An overview of the analytical methodology is graphically depicted in figure 1. The analysis determined logistics impacts in manpower, maintenance, and supply.

FIGURE 1. LIA OVERVIEW



b. Manpower. This analysis was based on the approved TOEs referenced in paragraph 6. above. Manpower categories were developed by Manpower, Personnel, and Training Division, TRAC-LEE.

c. Maintenance. This part of the analysis was based primarily on results produced by USAALS and USAAVNC using automated spreadsheets. The Aviation MARC was used to compare both alternatives. MARC computes the number of required maintainers given aircraft density anu a DA flying hour program.

d. Supply. CASCOM developed daily supply requirements for each alternative using a spreadsheet aggregation of supply planning factor data from their Logistics Data Base (LDB). Requirements were developed for Supply Classes I through IX.

8. Analysis of Alternatives.

a. Manpower. Mission requirements together with soldier availability factors determine manpower requirements. Table 1 addresses changes in the major manpower areas within the actual TOEs for both cases.

Table 1. TOE Battalion Manpower

	BASE CASE	ARI CASE	DIFFERENCE
HHC	31	47	16
SUPPORT	41	43	1
FUEL	20	21	1
AMMO	14	13	(1)
C,CS FLT SEC	12	0	(12)
ATK COs	99	81	(18)
AVUM CO	82	97	15
TOTAL	299	302	3

(1) Base Case. The base case is constrained by the AOE force structure cap and does not have all the manpower required to do the mission. The base case HHC requirement was decremented by 16 people under AOE and AVUM personnel set at 69% of the MARC requirement. This recognized shortfall results in the inability of AVUM mechanics to cope with their workload. This excess workload is passed back to the intermediate level.

(2) ARI Alternative. The ARI design is staffed to meet the full ground and aviation MARC manpower requirement. However, there are also other factors which result in a net increase in the battalion of only three people.

(a) HHC. Due to the removal of the AOE cap the strength of the HHC was increased by sixteen people.

(b) Support/Fuel/Ammo. In the areas of support, fuel, and ammo personnel, the minor changes are a result of the increased number of AH-64As and the introduction of modernized CSS equipment into the TOE.

(c) Combat support, combat service support flight section. The CS,CSS flight section UH-60L recovery mission has been removed by retiring the older OH-58C aircraft. However, the recovery mission still exists elsewhere in the brigade (OH-58D recovery) and the UH-60L assets have been moved to the General Support Aviation Battalion (GSAB). medium-lift support requirements in the attack battalion will be handled by the GSAB in the brigade.

(d) Attack companies. The attack aviation companies show a net decrease of 18 spaces. This is due in part to the removal of the 6 Crew Chiefs and 12 Scout Observers associated with the OH-58C, the removal of the UH-60Ls and the increase in the number of ah-64as.

(e) Avum Company. The increase of fifteen people in the unit AVUM company is directly related to the removal of the AOE cap and application of 100% MARC for aviation unit maintenance.

b. Maintenance Impacts.

(1) Background. Replacing the older, less complex OH-58C with the highly sophisticated AH-64A helicopter causes maintenance requirements to change. There are considerable differences in the maintenance characteristics of these aircraft, however, there are other factors described below which also impact the requirement.

(2) Maintenance Characteristics. One of the primary reasons for the differences in maintenance requirements is the maintenance characteristics of the two aircraft (Table 2). This table points out the major differences in support requirements for the two different aircraft. The first three define aircraft reliability and the other two characterize the maintenance workload associated with each aircraft. Mean Time Between Essential Maintenance Actions, Mean Time Between Mission Affecting Failures, and Mean Time Between Aborts all clearly show that the OH-58C is the more reliable aircraft. The mean time to repair and maintenance ratio (maintenance man-hours per flight hour) show that the AH-64A presents a much higher maintenance burden.

Table 2. Maintenance Characteristics [1]

	MEAN TIME BETWEEN (HRS)				
	ESSENTIAL MAINT. ACTIONS	MISSION AFFECTING FAILURES	ABORTS	MEAN TIME TO REPAIR	MAINT. RATIO (MMH/FH)
AH-64A	2.4	5.8	19.9	2.2	10.7
OH-58C	4.8	13.9	61.2	1.6	3.5

1. Data taken from the LHX COEA Report.

(3) Maintenance Manpower Requirements. Maintenance manpower requirements were determined using the Aviation MARC Process. However, for the base case TOE, the AOE cap constrained the number of mechanics allowed. Since the ARI case is unconstrained MARC, the 100 per cent or unconstrained MARC figures for the base case, as shown in table 3, are used to compare the alternatives. The actual (L-Series) TOE figures are also shown in the center columns of the table but they are not used in the MARC comparison.

Table 3. Aviation Mechanic Requirements

	BASE CASE 100% MARC			BASE CASE L-SERIES TOE			ARI A-SERIES TOE		
	AVUM	AVIM	TOTAL	AVUM	AVIM	TOTAL	AVUM	AVIM	TOTAL
AH-64A	89	51	140	70	32	102	108	62	170
OH-58C	41	12	53	22	10	32			
UH-60L	13	6	19	7	3	10			
TOTAL	143	69	212	99	45	144	108	62	170

(a) MARC Requirements. MARC provides a capability for identifying aviation unit design requirements based on aircraft density, a DA flying hour program, equipment RAM characteristics, and mechanic availability factors. The number of hours that a mechanic is available to work on aircraft has a direct bearing on the total manpower requirement. New soldier availability factors are imbedded in the MARC calculations for the ARI alternative. These factors are dependent upon unit type and range from 4.6 to 9.4 hours per day for the base case to 8.6 to 12.0 hours per day for the ARI design. Thus, under the ARI design, mechanics will devote a larger portion of their time to maintaining the aircraft. The left and right sides of Table 3 show the MARC figures used to compare both alternatives. These figures represent the workload driven maintainers at 100% MARC at the unit (AVUM) and the intermediate (AVIM slice) maintenance levels for the base and ARI cases respectively. Both sets of figures provide a point of departure for comparative purposes. These figures are not clouded with the AOE personnel constraints and the resulting workload passback problems evident in the base case TOE.

(b) MARC Requirements Comparison. Table 3 shows a 20% decrease in personnel requirements between the 100% MARC base case and the ARI case (25% decrease at the unit and 10% for division support slice). A savings is realized by the retirement of the older OH-58C aircraft and its associated maintainers (32 aircraft specific slots) and the increased maintainer availability. The apparent savings of 10 UH-60L maintainers is really a shift of maintenance burden up to the brigade level (General Aviation Support Bn). Thus, the medium lift mission still resides in the brigade.

(c) Constrained AOE design. Table 3a shows the mechanic requirement by MOS at the unit (AVUM) level for the AOE and ARI cases. Intermediate (AVIM) figures, which involve fractional quantities, are not included in this table. The removal of the AOE cap raised the ratio of maintainers per AH-64A from 5.7 in the AOE base case to 7.1 in the ARI design.

Table 3a. Constrained AOE Unit Level Maintainers (AVUM)

MAINTAINER	MOS	AOE BASE CASE	ARI CASE
AH-64A REPAIRER	67R	39	61
OH-58C REPAIRER	67V	16	0
UH-60L REPAIRER	67T	6	0
A/C PWR PLT REPAIR	68B	2	3
A/C PWD TRN REPAIR	68D	2	2
A/C STRUCT REPAIR	68G	3	4
A/C PNEUD REPAIR	68H	2	3
AVIONIC MECHANIC	68N	7	4
ARMT/ELECT	68X	22	31
TOT MAINTAINERS		99	108

(4) New Intermediate (AVIM) Maintenance Unit Design. ARI seeks to improve the flexibility of the aviation maintenance structure. Key maintenance design features that evolved as a result of the ARI effort are the elimination of the policy of "passback" maintenance and the "linking" of AVIM support capability to specific aviation units via TOE documentation. Part of this initiative involved removing the policy of passback maintenance which effectively "locked" specific corps to division alignments and precluded the deployment of these "alignments" in any other configuration without incurring serious disconnects in personnel, MOS distribution and equipment. As a result, AOE AVIM designs did not support a force projection Army.

a. Problem. Force projection requires the ability to task organize and rapidly deploy the proper mix of combat and associated support units. The current AVIM organizational design does not "link" maintenance capability to specific aviation units and it lacks sufficient redundancy in low density MOSs and equipment to adequately support task organization at the tactical level.

b. Design. The new AVIM design will key maintenance capability, both systems and subsystems, to the individual aviation organizations the AVIM unit supports. It will contain sufficient personnel and equipment redundancies to support task organization. This design (A-Series TOEs) is still under development and pending TRADOC and DA approval. Any further attempt to describe what these units will eventually look like would be purely conjectural.

(5) Recovery. Table 4 shows the applicable recovery assets for the OH-58C and AH-64A and their location in the theater. Currently the CH-47 is the only recovery asset in the army inventory that can recover the AH-64A without requiring modifications.

Table 4. Recovery Assets.

ASSET	HELICOPTER SUPPORTED	
	OH-58C	AH-64A
UH-1	X	
UH-60	X	
CH-47	X	X
M270 TRL(12TON)	X	X [1]
M172A1 TRL	X	
5/7.5 TON CRANE	X	
SOURCE OF SUPPORT	AVUM/AVIM	CORPS

1. (MODIFICATIONS REQUIRED)

Sufficient Army aviation assets are not available to exclusively support the recovery of aerial assets. These recovery assets have a defined role in the recovery of ground assets and they may also be called upon to support allied equipment in joint operations. Ground recovery assets will be needed to augment efforts in support of the initial phases of recovery of downed aerial assets.

The only ground recovery asset that may fill this role is the M270 trailer (12 ton) and it requires some modifications to accommodate the airframe. The trailer also requires a lift device to load the craft on the trailer. A definitive Developmental Ground and Air Battlefield Recovery Doctrine, Operations, Training, Leader Development, Material, And Soldiers (DOTLMS) Requirements Study is currently being sponsored by USAOC&S. USAALS is also conducting the Aviation Ground Recovery Study to explore this problem.

(6) Test, Measurement, and Diagnostic Equipment (TMDE). Table 5 shows the TMDE requirements in terms of numbers of individual test sets for each aircraft mix. Retirement of the older OH-58C and realignment of the UH-60L leaves only one aircraft type to maintain which substantially reduces the TMDE requirement for the battalion.

Table 5. TMDE Requirements[1].

	BASE CASE	ARI CASE
AVUM	22	21
AVIM (SLICE)	181	156

1. Data taken from the LHX COEA Report.

c. Supply Impacts.

(1) General. CASCOM, the logistics planning factors manager for the Army, provided the planning factors for this analysis

(2) Data types. Supply data can be divided into two categories:

(a) Classes of supply that are sensitive to equipment and density and to the level of unit activity (intense, moderate, reduced, reserve). Fuel and ammo fall into this category. The rates that CASCOM provides are for moderate intensity unit activity. In this analysis, the moderate rates were considered sustainment rates.

(b) Classes of supply that are sensitive to population more than to equipment, are considered not to vary by combat intensity and are considered theater independent. Classes I,II,IV,VI,and VIII fall into this category.

(3) Daily Sustainment Requirements. Table 6 displays the daily sustainment requirement for both cases expressed in short tons per day or gallons per day. Daily supply requirements show some minor differences in specific areas. The category "other" which includes classes I,II,IV,VII,VIII, and IX and water show very little difference between the alternatives. Fuel and ammunition requirements are sensitive to equipment density and are addressed in detail in tables 7 and 8.

Table 6. Battalion Daily Sustainment Requirement

SUPPLY CLASS		BASE CASE	ARI CASE	% CHANGE
CLASS III	GAL	18,565	18,740	1
CLASS V	S/TONS	54	56	4
OTHER	.S/TONS	8	8	NONE
WATER	GAL	2,601	2,618	1
UNIT STRENGTH		299	301	

a. Fuel. Table 7 shows fuel usage by aircraft mix. There is no net change in the attack battalion requirement for fuel. However, there are two major factors which influenced this result. The first is the replacement of the OH-58C with the AH-64A which resulted in a 20% increase in the attack/scout fuel requirement. The second was the realignment of the UH-60L within the brigade . This removed the fuel burden from the battalion but retained it in the brigade. Other changes in fuel requirements for ground vehicles were the result of modernization changes in the TOE.

Table 7 Battalion Daily Fuel Requirements (Gallons)

ITEM	BASE CASE	ARI CASE
AH-64A	12,480	16,650
OH-58C	1,400	
ATK/SCOUT	13,880	16,650
UH-60L	2,105	
GRND VEHS	2,580	2,090
TOTAL	18,565	18,740

b. Ammunition. Table 8 shows ammunition requirements for the two cases. Since standardized factors have not been developed for the AH-64A in the scout role, Subject Matter Experts (SME) at the Aviation Center provided usage factors to convert the attack usage rates to scout usage rates. These SME estimates of scout usage rates as a function of attack usage rates are as follows: 30% Hellfire; 40% Rockets; 50% 30mm. The difference in ammunition usage between the alternatives is minimal at the battalion level.

Table 8. Battalion Daily Ammo Requirements

AMMO TYPE	BASE CASE		ARI CASE	
	RNDS / DAY	STONS	RNDS/DAY	STONS
HELLFIRE	234	22	230	21
ROCKETS	602	14	622	14
30MM	28,080	17	30,420	19
OTHER		1		2
TOTAL		54		56

(4) Total Supply Requirement. Table 9 lists requirements for all classes of supply.

Table 9. Total Battalion Supply Requirements.

	BASE CASE	ARI CASE
CL I	1	1.12
CL II	0.42	0.47
CL III (PKG)	0.06	0.08
CL IV	1.13	1.27
CL V	54	56
CL VII	5.06	5.01
CL VIII	0.09	0.1
CL IX	0.3	0.26
TOTAL (STONS)	62.06	64.31
CL III(B) (GALS	18,565	18,740
WATER (GALS)	2,601	2,618

9. Conclusions. The ARI case with AH-64As performing the scout mission has approximately the same overall logistics requirements as the base case. There are some differences which contribute to these results. They are:

a. The two alternatives have about the same over all manpower requirements. This is counter intuitive at first glance but unit redesign initiatives which correct previously identified TOE shortfalls, mission realignments, and redistribution of personnel within the brigade account for the similarity of strengths. Some missions of the attack battalion are moved elsewhere in the brigade which results in no real savings.

b. Maintenance requirements for AH-64A are considerably higher than for OH-58C.

c. The new AVIM structure will facilitate task organization / deployment.

d. The battalion aerial asset recovery requirement is dependent on corps assets.

e. The new attack battalion corrects previously identified shortcomings in aviation maintenance.

f. There are some minor differences in sustainment requirements in specific areas but overall there are no appreciable differences in the sustainment requirements for the two alternatives.

APPENDIX E

(U) Scenario Force Structure (S)

Published under separate cover

To obtain a copy of appendix E, please contact

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APPENDIX F

Glossary

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AAA	antiaircraft artillery
AABS	Aviation Attack Battalion Study
ADA	air defense artillery
AH-64A	Apache helicopter
AOE	army of excellence
AR	army regulation
ARI	Aviation Restructure Initiative
ASE	aircraft survivability equipment
AVIM	aviation intermediate maintenance
AVUM	aviation unit maintenance
BP	battle position
CAC	Combined Arms Command
CASCOM	Combined Arms Support Command
CASTFOREM	Combined Arms and Support Task Force Evaluation Model
CONUS	continental United States
CSA	Chief of Staff, U.S. Army
DA	Department of the Army
DCSCDD	Deputy Chief of Staff for Concepts, Doctrine, and Developments
DIVCAV	division cavalry
DOD	Department of Defense
DTIC	Defense Technical Information Center
DVO	direct view optics
EA	engagement area
EEA	essential elements of analysis
FARP	forward area rearm/refuel point
FAT	free air temperature
FLIR	forward-looking infrared
FY	fiscal year
GSAB	General Support Aviation Battalion
HHC	headquarters and headquarters company
HRS	high-resolution scenario
HUMINT	human intelligence
IR	infrared
km	kilometer

LB	Longbow
lbs	pounds
LD	line of departure
LDB	Logistics Data Base
LH	light helicopter
LRS	low-resolution scenario
LZ	landing zone
MARC	Manpower Authorization Requirements Criteria
MEP	mission equipment package
METT-T	mission, enemy, terrain, troops, and time available
MMH/FH	maintenance manhour per flight hour
MOE	measures of effectiveness
MOP	measures of performance
NEA	northeast Asia
NMS	National Military Strategy
NVG	night vision goggles
OBJ	objective
OH	observation helicopter
OPTEMPO	operational tempo
PL	phase line
POD	port of debarkation
POE	port of embarkation
RAH-66	Comanche helicopter
RAPIDSIM	Rapid Intertheater Deployment Simulation
RORO	roll-on/roll-off
SAL	semiactive laser
SEAD	suppression of enemy air defense
SER	system exchange ratio
SME	subject-matter expert
STON	short ton
SWA	southwest Asia
TADS	target acquisition designation sight
TARGET	Transportability Analysis Reports Generator
TMDE	test, measurement, and diagnostic equipment
TOE	table of organization and equipment
TRAC	TRADOC Analysis Center
TRAC-Lee	TRAC Fort Lee
TRAC-OAC	TRAC Operations Analysis Center

TRAC-SWC	TRAC Scenarios and Wargaming Center
TRADOC	U.S. Army Training and Doctrine Command
TTP	tactics, techniques, and procedures
TV	television
USAALS	U.S. Army Aviation Logistics School
USAAVNC	U.S. Army Aviation Center
VIC	Vector-in-Commander
VV&A	verification, validation, and accreditation

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APPENDIX G

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