REPORT TO THE CHAIRMEN
APPROPRIATIONS AND
ARMED SERVICES COMMITTEES
CONGRESS OF THE UNITED STATES

Close Air Support: Principal Issues And Aircraft Choices

B-173850

Department of Defense

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

DEC. 8, 1971

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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To the Chairmen of the Appropriations
and Armed Services Committees
Congress of the United States

This is our report on the close air support mission of the Department of Defense.

This review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

It is our intent to provide the authorization and appropriation committees of the Senate and the House of Representatives with information that may be useful in their deliberations on the Department of Defense budget requests for close-air-support weapon systems.

We have not obtained written comments from the Department of Defense, although we have considered, in this report, comments provided by various officials concerned with close air support in the Office of the Secretary of Defense and in the military services during our work.

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; and the Commandant, United States Marine Corps.

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CHAIRMEN, APPROPRIATIONS AND ARMED SERVICES COMMITTEES, CONGRESS OF THE UNITED STATES

THE CLOSE AIR SUPPORT: PRINCIPAL ISSUES AND AIRCRAFT CHOICES
Department of Defense B-173850

D I G E S T

WHY THE REVIEW WAS MADE

The Army, Navy, Marine Corps, and Air Force all participate in close air support or reinforcement of ground troops by close-in delivery of ordnance from aircraft. The services have differed over, among other things, the best equipment to employ, the tactics to use, and the priority of this type of mission.

Congressional committees have reviewed these service differences and related problems from time to time, but the issues have been exceedingly difficult to resolve. Congressional concern recently has been expressed that three different aircraft candidates now under consideration for the close-air-support mission--the Army's AH-56A Cheyenne helicopter, the Marine Corps' Harrier, and the Air Force's A-X--may be duplicative or substantially overlapping in capabilities.

The General Accounting Office (GAO) undertook this study due to congressional interest in the subject and due to the large sums of money involved.

Although various Department of Defense (DOD) officials who read drafts of this report gave GAO their comments to consider, DOD did not comment formally on this report.

FINDINGS AND CONCLUSIONS

All three proposed aircraft are designed to defeat tactical targets, such as battle tanks, armored personnel carriers, field fortifications, and enemy troops; but the aircraft differ markedly.

- --The Cheyenne is a "compound" aircraft having, in addition to rotary blades, wings for lift, like a fixed-wing plane, and a pusher-propeller in the tail. (See ch. 2.)

- --The Harrier is the first vertical-takeoff airplane to become operational, after nearly 25 years of experimentation with this aeronautical concept. (See ch. 3.)

- --The A-X is to be a conventional fixed-wing aircraft, the first fixed-wing aircraft in more than a generation to be designed specifically for the close-air-support mission. (See ch. 4.)

A cohesive plan covering total DOD requirements for close air support has not been prepared. Ordinarily such a plan would be the basis for determining the

total number of aircraft and the capabilities they need to carry out the close-air-support mission. Instead the sizes and the tactical concepts of close-air-support fleets have been proposed by the individual services, planning independently, without taking into account (1) each other's plans, (2) the quantities and capabilities of existing aircraft, or (3) the resources of U.S. Allies.

The case for a new close-air-support aircraft could be argued more convincingly if there were common agreement among the services about available inventory aircraft (their numbers, accuracy, payloads, response times, and other properties) and if it could be shown that there was a gap between these resources and the combined services' needs.

Some factors hampering effective management of the close-air-support mission and the development of an overall plan are:

1. Constraints on each service that restrict the range of choice among weapon-system types that each can develop. The Army, for example, is limited to helicopters through an agreement with the Air Force. (See p. 44.)

2. Lack of joint military doctrine on how to conduct the mission and on the right equipment for the job.

3. Lack of adequate data on how effectively the weapons now under consideration will perform in their ultimate environments and on certain human abilities needed for operating the weapons.

4. Equipping, staffing, and training for support missions usually are underfinanced in peacetime in favor of a service's first-priority mission. The more complex support missions--such as close air support--which require close, even delicate, coordination between air and ground troops, therefore are difficult to gear up when hostilities break out.

Selection among the three aircraft would be difficult to make with any confidence at this time. It is not known, for example, whether they will be more effective than existing aircraft. The following capabilities of the three aircraft have not been proven through testing in a combatlike environment employing the tactics planned for each of them.

--Ability to find and identify enemy targets in time to launch weapons and before the enemy can fire at the aircraft.

--Survivability against a well-equipped enemy.

--Effectiveness against typical close-air-support targets.

--Capability for a high, sustained rate of attack (sortie surge rate) in the battle area.

Data on proposed target-kill capabilities and survivability are conflicting and incomplete. (See p. 41.) Cost-effectiveness studies on those aircraft (none have been made on the Harrier) have been:

--Optimistic in their assumptions about environments, tactics, and the severity of enemy defenses.

--Incomplete in their comparisons with similar aircraft.

--Out of date with current cost estimates, which have risen markedly in the last year or two.

Another cost-effectiveness study on the Cheyenne is under way.

DOD completed an interim study of the three aircraft in June 1971. (See pp. 40 to 42.) The Deputy Secretary of Defense, in his summary of the study, concluded that the proposed aircraft would be complementary rather than duplicative, because each was expected to have exclusive capabilities for certain battle situations not possessed by existing aircraft.

He recommended that all three aircraft programs be continued until operational testing could be completed to resolve certain specified uncertainties about each. The list of uncertainties seems to apply to each aircraft alike, but the summary does not indicate that each aircraft will be evaluated against the list. Although further testing of the proposed aircraft is indicated, it is not clear whether they will be compared with each other and with existing aircraft when the operational test data are available.

Recently a deputy directorship was established in the Office of Defense Research and Engineering having direct access to the Deputy Secretary of Defense at certain critical milestones in the weapon acquisition process of these aircraft. The deputy director would do no actual testing but would advise and monitor in-service testing by the services and would evaluate the results.

GAO in this study has not attempted to determine whether the current arrangement for operational testing and evaluation will provide the necessary independence to ensure that there is timely and realistic operational testing of weapon systems before large-scale-production commitments are made.

GAO agrees, however, that a powerful operational test and evaluation authority is needed in the weapon acquisition cycle to give the Congress greater assurance that only proven equipment will be passed on to the troops and that fewer disappointing weapons will be in the arsenal should hostilities break out.

MATTERS FOR CONSIDERATION BY THE COMMITTEES

To manage close-air-support resources more effectively, the committees may wish to require DOD:

1. To establish the total DOD requirement for close-air-support resources within the force structure allowed by the budget.

2. To delineate the single- and joint-service tasks and subtasks in conducting close-air-support missions and to assign authority and responsibility for specific tasks to the individual services.

3. To develop and implement, within some realistic deadlines, joint close-air-support doctrine to include spelling out how military actions are to be conducted and coordinated and prescribing the operational conditions and joint tactics for the employment of weapons.

The committees, at the time they are considering budget requests for production units of the aircraft, may wish also to inquire into the extent of operational testing actually performed. A summary of major issues concerning the three aircraft candidates which the committees may wish to pursue further with DOD are listed on pages 20, 28 to 30, and 39.)

Contents

ABBREVIATIONS

DOD	Department of Defense
GAO	General Accounting Office
NATO	North Atlantic Treaty Organization
OT&E	operational test and evaluation
RAC	Research Analysis Corporation
RDT&E	research, development, test, and evaluation
STOL	short takeoff and landing
TOW	tube launched, optically tracked, wire guided
VSTOL	vertical and short takeoff and landing
VTOL	vertical takeoff and landing

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CHAPTER 1

INTRODUCTION

The definition of the close-air-support mission, as promulgated by the Joint Chiefs of Staff (and concurred in by our allies), is:

> "Air attacks against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces."

Close-air-support strikes are made against such enemy targets as tanks and other vehicles, troops, bunkers, artillery, and other battlefield objectives in support of maneuvering ground forces. Attacks may be preplanned; they may be in response to a ground commander's call; or the targets may be discovered during armed-escort or armed-reconnaissance flights. The mission requires well-trained and well-motivated pilots, sensitive ground-to-air coordination, and effective weapon delivery without unnecessarily endangering friendly troops. It is often a dangerous mission for the aircraft.

PURPOSE OF THIS REPORT

The proper conduct of the mission, the divergent views of the services, and other related problems have been reviewed from time to time by congressional committees. The issues, though, are extremely difficult to resolve.

Congressional concern is exemplified by the annual reports of the committees concerned with the armed services and with appropriations. In its report on the fiscal year 1971 budget, the Senate Committee on Armed Services said:

> "Two questions about close air support of ground troops have received increasing attention in the last several years: Which services should have the mission of close air support and also what types of aircraft should be used?"

Later in the report, the Committee observed:

> "The record is replete with examples of parochialism among the Services, unwarranted duplication of weapons systems development, and the nonproductive perpetuation of research and development efforts which finally resulted in major program terminations. One example could prove to be the A-X-Cheyenne-Harrier programs on which the Secretary of Defense recently reported to the Congress. Although this is his initial report, it continues the status quo and recommends the continued development of the A-X and Cheyenne and procurement of the Harrier."

The House Committee on Appropriations, reporting on the same budget, remarked:

> "There is a serious question as to whether or not future Defense budgets can support the development and/or procurement of three separate aircraft weapon systems designed to perform essentially the same mission."

A special subcommittee of the House Committee on Armed Services was appointed in 1966 to look into the close-air-support mission. One observation was:

> "The Army has been hesitant to demand better support than it has been getting. Because of the desire on the part of both services to avoid irritating service rivalries and the roles and missions issue, essential questions have gone unanswered, and essential problems have been swept under the rug."

In view of the current congressional concern that the three candidate aircraft may be duplicative or substantially overlapping in their capabilities, we have attempted to identify in this report the problems which handicap the management of close-air-support resources by the Department of Defense.

OBJECTIVES AND SCOPE

Our study objectives were to learn how the experts in and out of DOD think this mission should be performed, to report the positions and views of the services, to identify real or potential problems in the current DOD attempt to satisfy close-air-support mission requirements, to tell how the mission evolved over the years, and to attempt to help the Congress reexamine the principal issues and weapon choices.

We interviewed high-ranking military officers in the United States, Korea, Southeast Asia, and Europe to gather their views on how the close-air-support mission ought to be executed and what kinds of equipment were preferred. Air and ground commanders, pilots, forward air controllers, air liaison officers, and experts detached from DOD were also interviewed personally and by questionnaire. Studies of the cost effectiveness, vulnerability, and combat effectiveness of the proposed systems were reviewed. The considerable literature on tactical air warfare was researched as well.

THREE AIRCRAFT CANDIDATES FOR THE MISSION

The Air Force's candidate is the fixed-wing A-X, which is currently in advanced development; the Army wants to procure the AH-56A Cheyenne helicopter, a gunship now undergoing test and evaluation; the Marine Corps, which uses both fixed-wing airplanes and helicopters for close-air-support tasks, is buying the AV-8A Harrier which is a British-made vertical takeoff and landing aircraft. (See chs. 2, 3, and 4.)

All three close-air-support candidates are intended to defeat tactical targets in a midintensity conflict such as might occur in Europe, Korea, or the Middle East. Effectiveness in a permissive (lightly defended) environment, such as that of Vietnam, is considered secondary.

PROBLEMS IN COMPARING THE THREE AIRCRAFT

Each service has campaigned zealously for its preferred weapon system, which, it sincerely believes, is best for close-air-support tasks.

The problem is to sort out the essential differences and similarities among these aircraft. Symmetrical data with which to compare them for net effectiveness are hard to come by. Comparison is made more difficult by the complementarity argument; that is, each aircraft is said to have exclusive capabilities in a certain battle environment and therefore the aircraft are said to be complementary rather than competitive.

Thus the Marines assert that the Harrier has an exclusive niche to fill in amphibious operations; the Army alleges that the Cheyenne can employ effective weapon-delivery tactics unlike those of any fixed-wing airplanes; the Air Force contends that these other candidates are limited to permissive environments and that only the A-X could "live" through a midintensity conflict.

There are other constraints, too, which force the services down different paths. For instance, the Army air fleet has been mostly limited to rotary-wing aircraft by agreement with the Air Force, so that the Army's close-air-support

candidate has to be a helicopter. The Marine Corps, among other considerations, has a space limitation problem in an expeditionary force; therefore it believes that vertical-takeoff aircraft best suit its needs. Without these constraints on their freedom of choice, the services might be better able to harmonize their requirements in an aircraft design for close air support.

Pervading the issue are the finely drawn differences in service traditions, legacies, philosophies, organizational arrangements, and ways of doing business. Overshadowing these are the tendency of each service to go its own way in assessing the threat, deciding requirements, and equipping itself; disagreement of the services on how to conduct the mission; absence of useful data on weapon-system performance generally; and lack of a cohesive total DOD requirement for close-air-support resources. (See ch. 6.)

CHAPTER 2

THE ARMY CANDIDATE: AH-56A CHEYENNE HELICOPTER

The Army is developing the Cheyenne to increase its combat effectiveness in all types of conflicts. Although the Army already has a Cobra attack helicopter and other helicopter gunships in inventory, the Army believes that the Cheyenne is needed to counter the armor threat posed by the Warsaw Pact nations.

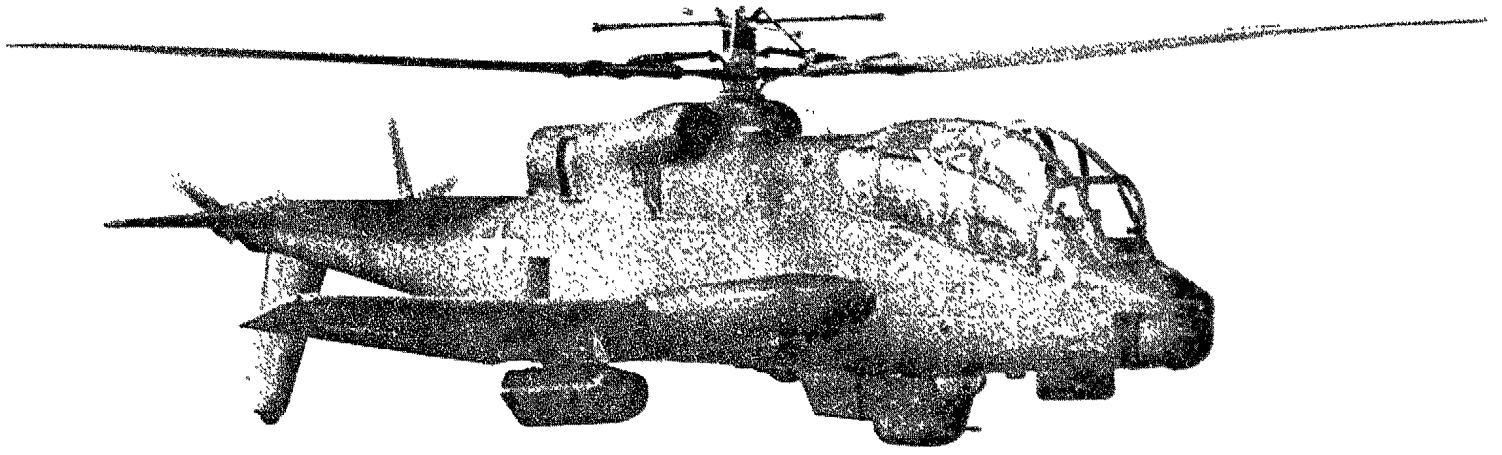
The primary mission of the Cheyenne will be to provide close air support for land and airmobile operations. Although it will perform other tasks, such as reconnaissance, aerial escort of troop and cargo helicopters, and adjustment of field artillery gunfire, the principal mission for the Cheyenne will be to kill tanks and other armored vehicles.

PROGRAM HISTORY

In the early 1960s, the Army was seeking ways to improve conventional helicopter capabilities. In 1963 the Secretary of the Army "disapproved the concept of modifying existing aircraft to provide only an interim solution to the direct fire support helicopter requirement" and directed the Army to "lift its sights" and develop an optimized aerial weapon system. The AH-56A Cheyenne helicopter is the result of that directive.

After several studies, analyses, and contractor competition, in March 1966 the Army awarded a fixed-price incentive contract for engineering development to the Lockheed California Company. The contract included production options for 375, 500, 1,000, and 1,500 aircraft. The Army exercised the first option in January 1968.

There were several technical problems, however--most of them concerned with the main rotor control system. In May 1969, after Lockheed failed to convince the Army that the problems could be corrected within a reasonable time, the Army terminated the production part of the contract for contractor default. The development part of the contract



LOCKHEED

AH-56A CHEYENNE

remained in force, however, and certain performance specifications were subsequently downgraded.

Since May 1969 development activity has been centered around integrating subsystems and testing an improved rotor control system. Simultaneously the Army and Lockheed were negotiating a restructured development program (minus any production options), and on August 17, 1971, they entered into a new contract to continue development.

PHYSICAL AND PERFORMANCE CHARACTERISTICS

The Cheyenne has one engine, an antitorque rotor, small wings, a pusher-propeller, and a rigid main rotor. During high-speed forward flight, the wings and pusher-propeller provide most of the lift and forward propulsion, respectively. The rigid rotor system is not used to any great extent for lift at high speeds but serves to provide flight-control stability and maneuverability.

The aircraft has tandem cockpits. (The copilot-gunner is in front.) It has some armor to protect critical components against small projectiles, has self-sealing fuel tanks, and redundant pilot controls. It is 60 feet long (55 feet when main rotor blades are folded) and 14 feet high and has a wingspan of 27 feet and an empty weight of 12,215 pounds.

Variations in atmospheric conditions and the weight of fuel and ordnance affect the performance of any combat aircraft. Under standard day conditions (59° F. at sea level), the Army expects the Cheyenne to be capable of vertically lifting about 12,000 pounds of fuel, ordnance, and weapon pods. If the Cheyenne is given a few hundred feet of runway for a short takeoff, its payload can be expected to increase slightly. The aircraft's maximum internal fuel load is 2,861 pounds. The Cheyenne's maximum dash speed is expected to be about 245 miles an hour, and its maximum cruise speed is expected to be about 225 miles an hour, although these speeds will decrease with heavy payloads. The Cheyenne is capable, as are more conventional helicopters, of hovering and of sideward and rearward flight. These flight characteristics, coupled with its low speed, permit nap-of-the-earth flight (just clearing ground vegetation) and allow the aircraft to operate in inclement weather with visibility and ceilings that are not negotiable by fixed-wing aircraft.

ARMAMENT

The Cheyenne has gun turrets in its nose and belly and six hardpoint stations on its wings and belly to carry rockets and missiles. Its missile guidance equipment is built in.

In the nose turret is a 7.62 mm antipersonnel minigun with a selectable rate of fire of 750 to 6,000 shots a minute. Interchangeable with that is a 40 mm grenade launcher that fires 350 shots a minute against personnel and light armor. Either weapon may be (1) traversed 120° to the right or left of the aircraft's nose, (2) lowered 60° or (3) raised 18°.

Mounted on the belly turret is a 30 mm automatic cannon that fires 405 shots a minute to an effective range of about 10,000 feet. It will be used against personnel and light armor and can be fired in any direction; it can be lowered 70° and raised 18°.

The wing stations will accommodate up to 152 rockets (2.75 in.) or 36 tube-launched, optically tracked, wire-guided (TOW) missiles. The rockets are forward firing and are used for area fire suppression, and the TOW missile is to be used against heavy armor. Although only one missile can be fired and guided at a time, the aircraft may take evasive action once a missile is locked onto the target.

An evaluation by U.S. Army, Europe, in the European environment showed that a scout-aircraft pilot needed an observer to acquire a target, since the pilot could not simultaneously acquire a target and perform the many other tasks required of him. This may indicate that the Cheyenne pilot may be too involved in flying the aircraft (maneuvering, etc.) to provide effective suppressive fire while the copilot is firing the TOW. The Cheyenne's fire control system and the pilot's helmet sight, however, which were not available during the European evaluation, may enhance the pilot's ability to deliver suppressive fire.

AVIONICS: COMMUNICATIONS, NAVIGATION, AND FIRE CONTROL

The Cheyenne has fully integrated and highly sophisticated avionics. Its communication equipment, for instance, is designed to provide coordination with supported ground units, communication with other aircraft, and air traffic control. There are a self-contained navigation system and other navigational aids to help provide continuous operation in the forward combat area.

The fire control system permits the pilot and copilot-gunner to fire all weapons, but only the copilot can fire the TOW missile. The pilot and gunner, though, can fire simultaneously at different targets. The gunner has a direct sight and a magnifying periscopic sight. The two sights and the gunner's seat are mounted together on a 360° swiveling gunner's station. The lower sight assembly of the station extends out the bottom of the fuselage and contains the telescopic optics, a laser range finder, and the TOW missile guidance equipment. By activating the control for the swiveling gunner's station, the gunner may change his view to any direction.

The pilot can use a direct sight or his helmet sight at will; the turreted weapons are slaved to the helmet sight, so that they turn automatically as the pilot turns his head.

A computer manages the fire control system: as the pilot changes his sight direction the computer automatically transmits corrective commands to the turreted weapons to achieve accuracy. The computer is expected to be capable of storing data about several target positions for subsequent attack and of incorporating a thermal-imaging (heat silhouette) night-vision system for fighting in darkness and poor visibility. (The night vision system enhances visibility through smoke, haze, and fog.)

PROGRAM SCHEDULE AND FUNDING

The Cheyenne is now in engineering development being readied for production, and a new production decision (for budgetary purposes) is anticipated early in 1972. A

production contract, however, is not expected to be signed before October 1972. The Army in September 1971 estimated that the weapon system acquisition cost will total about $2.1 billion, or about $4.5 million for each aircraft.

COMBAT EFFECTIVENESS

Command and control

The Army plans to use the Cheyenne as a primary means of blunting enemy armor thrusts, and for this purpose it will assign the aircraft predominately to division-size units. The Army study of the Cheyenne in midintensity conflict indicates that the aircraft may be placed under the operational control of committed brigades and battalions. The Army believes that this decentralization will provide ground commanders with the quick response needed for fire support and continuity of that fire support.

Antiarmor operations

According to the Army the most serious threat to close-air-support aircraft in a European environment will be radar-controlled antiaircraft artillery, such as the Soviet Union's Quad 23 mm and Twin 57 mm guns. In view of this threat, the Army plans to:

1. Fly the Cheyenne in pairs, thus allowing each aircraft protection by the other.

2. Avoid flying over known enemy positions by attacking targets from behind the friendly side of the battle line.

3. Fly the Cheyenne by nap-of-the-earth flight to the target area to avoid its being detected by enemy air defenses.

4. Use the pop-up technique to reacquire the target (initially located by scout aircraft, friendly units, or other means) and to fire the TOW missile. (The pop-up technique is a tactic in which the aircraft remains concealed close to the earth until ready to fire. The aircraft then ascends until clear of the terrain and fires on the target.)

5. Suppress the target with an additional weapon while firing its main armament.

Several experiments have been made by the U.S. Army, Europe, to evaluate different helicopter operations and tactics, and other experiments are continuing. Reports on the earlier evaluations were made by the Research Analysis Corporation (RAC) under contract to the Army. One of the studies (RAC-T-464) used the data from three experiments to evaluate the effectiveness of helicopters popping up from behind terrain in simulated tactical encounters with enemy ground elements. The report concluded that the pop-up technique enabled helicopter pilots to fire first in most encounters of the types studied. That conclusion was based on data from two experiments. In the first experiment the helicopter had a firing advantage because it was popping up from a concealed position and the enemy vehicle was clearly visible. In the second experiment, when the enemy vehicle changed position (it did not always change), the enemy on the ground got off the first shot almost as frequently as did the helicopter crew.

The report also concluded that popping up appeared to enhance the acquisition effectiveness of pilots flying nap-of-the-earth. The report's statistics showed that helicopters popping up were observed and fired upon fewer times than during the nap-of-the-earth segment of the flight. Ground targets, for example, acquired four times as many helicopters flying strictly nap-of-the-earth flight as the helicopters acquired ground targets; the ground targets fired upon about 50 percent of the acquired helicopters. But, in the pop-up maneuvers, the helicopter acquired twice as many ground targets as acquired them and the helicopter was not fired upon during the pop-up.

Another RAC study (RAC-TP-189) measured the ability of the helicopter's antiarmor teams to engage targets located by reconnaissance elements. The report concluded that missile-firing helicopter crews had difficulty in acquiring enemy target vehicles, especially when those vehicles were stationary. The report showed that the stationary and camouflaged vehicle normally had a firing advantage over the helicopter.

It should be noted at this point that the Army expects the Cheyenne to offer increased capabilities over the

UH-1B helicopter which was used in the RAC studies. The survivability of the Cheyenne, the Army believes, would be enhanced by the aircraft's:

1. Greater speed and maneuverability.

2. Additional protective armor.

3. 360^{o} weapon-firing capability.

4. Greater weapon load and accuracy through computerized fire control.

5. Self-contained navigation system.

6. Night-vision system.

7. Podded electronic counter measure devices.

8. Improved target-acquisition equipment.

During air cavalry troop evaluations by U.S. Army, Europe, for example, the command attributed the limited activity and poor performance at night to the lack of night-vision equipment. It concluded that the air cavalry troop needed an improved night-fighting capability, since a potential enemy could be expected to conduct large-scale offensive operations at night.

The TOW antitank missile is a command-guided, line-of-sight weapon. Itsuse will cause the Cheyenne and crew to be exposed to the enemy target for about 20 seconds when the missile is to travel about 10,000 feet. Although several seconds are needed for missile aiming in the 20-second interval, the pilot may maneuver the Cheyenne during the balance of the firing. He may also deliver suppressive fires with the 30 mm automatic cannon or other weapons, during the engagement, to enhance survivability.

Maintainability and logistical support

The Cheyenne will have built-in test-equipment displays to identify malfunctioning units for the pilot and maintenance personnel. Since the Cheyenne will have many

plug-in replacement components, troubles are expected to be corrected rapidly.

During the air cavalry troop evaluations by U.S. Army, Europe, a major weakness was found to be logistical support. Currently the air cavalry troop relies principally on wheeled vehicles for logistical support, but the report on the evaluation concluded that an aerial resupply capability was needed to augment these vehicles because the troop was expected to move frequently and because the roads were expected to be congested at the beginning of hostilities and ground vehicles might find it difficult keeping up with the air cavalry troop.

Cost effectiveness

The Army conducted several cost-effectiveness studies early in the Cheyenne acquisition cycle to compare the Cheyenne with certain existing aircraft. The studies assessed the Cheyenne in assumed combat environments where the enemy's defenses were less severe than the Army's description of the anticipated threat, they also assumed the use of certain optimistic tactics, and they considered an initial Cheyenne acquisition cost which was substantially less than recent estimates. The Army, however, is currently conducting a new cost-effectiveness study to compare the Cheyenne with existing and proposed helicopters and with the Air Force's close-air-support candidate, the A-X.

AIR FORCE AND MARINE VIEWS ON THE CHEYENNE

The Air Force does not consider the Cheyenne effective or survivable against the wide array of close-air-support targets that it, unlike the Army, may be required to attack.

The Marines have not expressed a need for the Cheyenne for close air support since they view the use of helicopter gunships as escorts of transport helicopters and as attack vehicles in permissive environments only. They believe that true close air support requires a range of munitions that are at present limited to fixed-wing aircraft.

SUMMARY OF THE MAJOR OPEN ISSUES

1. There does not appear to be a clearly defined capability gap which would require the Cheyenne helicopter. This issue may be amplified in view of the fact that the Army is expected to procure TOW missile modification kits for its current Cobra attack helicopters.

2. If the Army had to introduce an attack helicopter into a midintensity war situation against a well-equipped enemy, it would be a first for this kind of aircraft. Meanwhile there are sensitive problems, such as aircraft survivability and weapon systems effectiveness, which require intensive study, testing, and evaluation before confident estimates can be made about its combat expectations. To our knowledge, however, there are no plans to conduct extensive realistic testing of the aircraft before a decision is made to enter it into full-scale production.

3. The Cheyenne is expected to carry about three times the useful weapon load of the Army's current attack helicopter and the fuel requirements of the Cheyenne will also be greater. These factors, among other things, may require additional cargo helicopters and/or ground vehicles to adequately resupply the Cheyenne in the forward combat area. We found no evidence that these logistical support requirements, including their expected financial impact on the Army's budget, had been adequately determined on the basis of the various battle scenarios.

4. Without contesting the concept of forward basing of the Cheyenne, there appears to be a need to assess the expected requirements for maintaining forward-base secrecy and security. There may be a need to employ a substantial ground force, including air defense elements, to forward-base the aircraft.

CHAPTER 3

THE MARINE CORPS CANDIDATE: THE AV-8A HARRIER

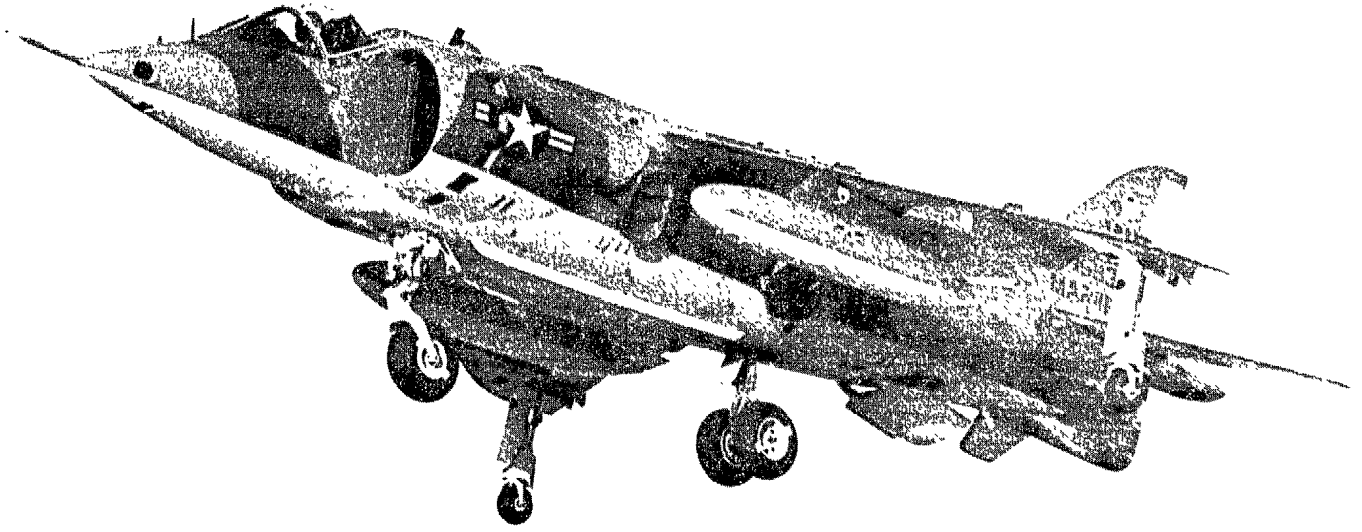
The Marine Corps is buying the Harrier to provide a vertical and short takeoff and landing (VSTOL) light jet-attack capability during amphibious assaults and follow-on land operations. According to the Corps, the new aircraft will (1) increase responsiveness to the ground forces requirements, (2) increase operational flexibility, (3) exploit the potential of VSTOL in air-to-ground operations, and (4) stimulate interest in VSTOL technology within U.S. industry.

The Marine Corps states that the Harrier is to have interdiction and air-to-air capabilities, as well as close air support. Although the Corps conducts close air support with attack helicopters, ground attack aircraft, and fighters, it claims that the additional multimission capability of the Harrier is necessary for its air-to-ground operations. (The Navy also provides close air support to the Marine Corps with fixed-wing attack and fighter aircraft.)

PROGRAM HISTORY

The AV-8A Harrier is manufactured by Hawker-Siddeley Aviation of England, and it has been operational in the Royal Air Force since 1969. The U.S. Army, Navy, and Air Force participated in the development and evaluation of a Harrier predecessor, but at that time did not believe that the aircraft was suitable for their purposes. The British proceeded with the program, however, and the Harrier was developed.

A Paris air show demonstration of the Harrier in 1967 aroused the Marine Corps' interest. It decided to buy the plane in 1969, and the Congress authorized the first production quantity for fiscal year 1970. The Marine Corps flew its first Harrier in October 1970 and introduced it into the fleet in April 1971. To date the only significant testing of the Harrier by the Marine Corps has been the Board of Inspection and Survey trials to which all new Department of the Navy aircraft are subjected. These trials for the Harrier consisted of weapon clearance, aircraft stability,



THE AV-8A HARRIER

in-air refueling, and high-altitude SIDEWINDER firings. Since the Board trials the aircraft has been turned over to a Marine Corps squadron which is now conducting pilot and maintenance training.

The Marine Corps plans to test the sortie surge capability (flights to and from a battlefield) of the Harrier in the spring of 1972, as requested by Deputy Secretary of Defense. That test will be supervised by the Institute for Defense Analyses and the Weapon Systems Evaluation Group will participate.

PHYSICAL AND PERFORMANCE CHARACTERISTICS

The Harrier is the world's first operational vertical takeoff and landing (VTOL) fixed-wing aircraft. It has a one-man crew and a single 21,500-pound jet-thrust engine, whose thrust is vectored (directed) through four rotatable nozzles (two on each side of the aircraft), which provides vertical takeoff capability. Thrust vectoring is also expected to provide increased maneuverability.

The Harrier is a relatively small combat aircraft and has shoulder-mounted swept wings and tailplane. It is about 46 feet long and 11 feet high and has a 25-foot wingspan and a basic operating weight of 12,490 pounds. It is expected to be about one and a half times faster than the A-X and three times faster than the Cheyenne.

No armor plate or self-sealing fuel tanks have been incorporated into the aircraft. We are advised that redundant or backup controls are few, if any.

Under conditions of a standard day (59° F. at sea level), the Harrier will fly at a maximum speed of over 650 miles an hour and will take off vertically with a maximum gross weight of 17,100 pounds. A larger engine, the Pegasus-11, will be installed in the 11th and subsequent aircraft purchased, which is expected to increase the maximum gross weight to 17,800 pounds; it will not, however, provide a substantial increase in ordnance-carrying capability. The Harrier with the Pegasus-10 engine taking off vertically, can fly a 50-mile-radius mission with 1,800 pounds of ordnance, but the Harrier with the Pegasus-11 engine in the

same mission can fly with 200 additional pounds of ordnance. The Harrier's maximum payload (fuel, ordnance, and weapon pods) under VTOL conditions is either 4,610 pounds with Pegasus-10 engine or about 5,000 pounds with the Pegasus-11 engine. If the Harrier uses 1,700 feet of runway, its maximum gross weight with the Pegasus-11 engine becomes 25,410 pounds, which allows 12,920 pounds of payload. (The Harrier with the Pegasus-10 engine is expected to load 12,490 pounds.)

ARMAMENT

On the Harrier's four wing stations and one center-line belly station, a wide range of free-fall weapons may be carried. These weapons include general-purpose, retarded, and laser-guided bombs; Napalm, Rockeye, and fuel-air explosives; rockets (2.75-inch and 5-inch Zunis); and SIDEWINDER air-to-air missiles. The aircraft may also be wired to deliver the BULLDOG air-to-ground missile. It also has two detachable 30 mm guns located on its belly--one on either side of the center-line station.

A typical Harrier close-air-support weapon load will consist of two Rockeye II cluster bombs for use against tanks; six 500-pound general-purpose or retarded bombs for other targets; and the two guns for enemy vehicles, personnel, and so forth. This payload requires several hundred feet of runway for roll takeoff.

AVIONICS: COMMUNICATIONS, NAVIGATION, AND FIRE CONTROL

Although the Harrier comes equipped with a full range of avionics, several items will be replaced to suit the particular needs of the Marine Corps. An on-board radio used for coordination with supported units, for example, will be replaced with two U.S.-manufactured radios. The aircraft will retain other items of radio equipment.

The Harrier has an inertial-navigation attack system and an air data computer for airspeed and altitude corrections. Three other items of on-board navigation equipment will be replaced with standard Marine Corps equipment: the tactical air navigation system, artificial-horizon gyro, and identification-friend-or-foe system.

A heads-up display provides integrated instrument displays of special symbology in the pilot's forward field of view, so that he can navigate, deliver weapons, and land with a less need to watch cockpit dials.

PROGRAM SCHEDULE AND FUNDING

Introduction of the Harrier into the Marine Corps has begun, and it is scheduled to be completed by June 1973. The selected acquisition report dated August 4, 1971, indicated that there had been no development funding attributed to the Harrier program.

Marine Corps procurement expenditures currently are estimated to total $490.5 million for 114 Harriers, or about $4.3 million each. For fiscal years 1970 and 1971, about $150.8 million is committed for 30 Harriers. The remaining procurement of 84 Harriers will cost an estimated $339.7 million. The fiscal year 1972 buy of 30 aircraft is estimated to cost $110.3 million.

COMBAT UTILITY

Marine Corps officials have informed us that VTOL capabilities and the maneuverability gained through the use of vectored thrust could revolutionize tactical air warfare. They analogized the use of Harrier to their exploration of the helicopter early in the 1950's. An Army official who participated in the initial development of the Harrier said that the British designed the Harrier for air superiority and interdiction. The Marine Corps, however, is purchasing the plane as a close-air-support aircraft.

During amphibious operations the Marine force will approach by ship, conduct a landing, and then move forward in land battle. The Corps believes that the VSTOL capability of the Harrier will allow continuous close air support without the need of extensive airfield facilities.

Although the Marine Corps says that it intends to use the Harrier primarily in the short takeoff and landing (STOL) mode, the VTOL mode appears to be the most persuasive feature of the Harrier and also drives up the Harrier cost. The VTOL technology gained through the purchase of the Harrier, although attractive in the terms of great potentials, currently offers limited additional operational capability, because of the short operating radius and the small ordnance-carrying capacity in this use mode.

AIR FORCE AND ARMY VIEWS ON THE HARRIER

The Air Force believes that the Harrier does not have the characteristics of a close-air-support aircraft; its studies show the Harrier to be a "low performance" interdiction aircraft.

The Army has said that it is not currently interested in the Harrier because of its limited endurance (time over target) and payload capacity. The Army has also informed us that the Harrier in its most useful mode is a STOL aircraft and that the Army's interest is in a VTOL aircraft.

SUMMARY OF THE MAJOR OPEN ISSUES

Without contesting the potential of VSTOL in tactical air operations, there are aspects of the Harrier which seem to require further study and operational test and evaluation in a combatlike environment to determine its usefulness.

The following items are in need of further consideration.

1. Payload-carrying capability of Harrier during vertical takeoff

   Data provided to us by the Marine Corps cast doubt on the combat utility of the Harrier in vertical takeoff operations.

	Pounds
Aircraft basic operating weight	12,490
Full internal-fuel weight	5,372
Total (including the 30 mm guns but with no ordnance)	17,862
Maximum vertical takeoff gross weight (on a standard day) with Pegasus-11 engine	17,800

   Under these conditions the Harrier could not be capable of vertical takeoff with a full fuel load. Fuel may be traded off for ordnance; however, it would allow only for about 5,000 pounds for fuel, ordnance, and weapon pods. Vertical takeoff requires substantially more fuel than does conventional takeoff.

   At the time of our request for the above data, the Marine Corps informed us that, to suit its mission requirements, most of its calculations had been based on tropical-day (90° F. at sea level) conditions. Tropical-day conditions, because of decreased air density, would tend to decrease the performance of combat aircraft below the standard-day conditions stated above.

2. Support and forward basing

The susceptibility of the Harrier to foreign-object damage (rocks, dust, and tree branches) and its apparent sensitivity to operations from rough terrain seem to present extra problems in an austere basing operation. The sensitivity of the engine performance to surrounding air temperature and the need for distilled-water injection to produce required lift under warm-day, maximum-payload conditions somewhat hamper its combat utility. These factors, coupled with the ever-present problems of forward-base secrecy, security, logistics, maintenance, and air defense, indicate a need for further study of the usefulness of this aircraft in combat environments. We are informed that these factors will be considered when the Marine Corps complies with the Deputy Secretary of Defense's request for a demonstration of the Harrier's sortie surge-rate performance--now planned for the spring of 1972.

3. Vulnerability

The Harrier design was not oriented to the close-air-support tasks, particularly against armor or well-defended targets. It has no armor and has few backup control systems. The Office of the Secretary of Defense-Joint Staff Service Group's study of the three candidate aircraft included a comparison of their vulnerability with that of existing close-air-support aircraft. Two, and sometimes three, different sets of vulnerability figures, however, are presented on fixed-wing aircraft, but no preference is expressed for any set.

4. Cost effectiveness

No cost-effectiveness study on the Harrier has been conducted. The Marine Corps explained that the Harrier is an "off the shelf" procurement and that no other aircraft could take off vertically and be used for both close air support and interdiction. A study to determine the Harrier's cost effectiveness compared with that of existing and other

proposed aircraft seems to be desirable in substantiating the merits of the Harrier's VTOL capability.

5. Operational test and evaluation

The Marine Corps flew its first Harrier in October 1970, and at the completion of our review it had received about 12 of the 30 Harriers it had ordered through fiscal year 1971. If the fiscal year 1972 request for $110.3 million for 30 additional aircraft is approved by the Congress, about $260 million will have been authorized for 60 Harriers. These figures represent over one half of the total program cost and quantity. To our knowledge the Marine Corps has not scheduled an operational test and evaluation of the Harrier under simulated-combat conditions.

CHAPTER 4

THE AIR FORCE CANDIDATE: THE A-X AIRCRAFT

Although it traditionally has performed the mission with multipurpose aircraft, the Air Force has said that the expected characteristics of the A-X will specialize it for the close-air-support requirements of Army ground forces.

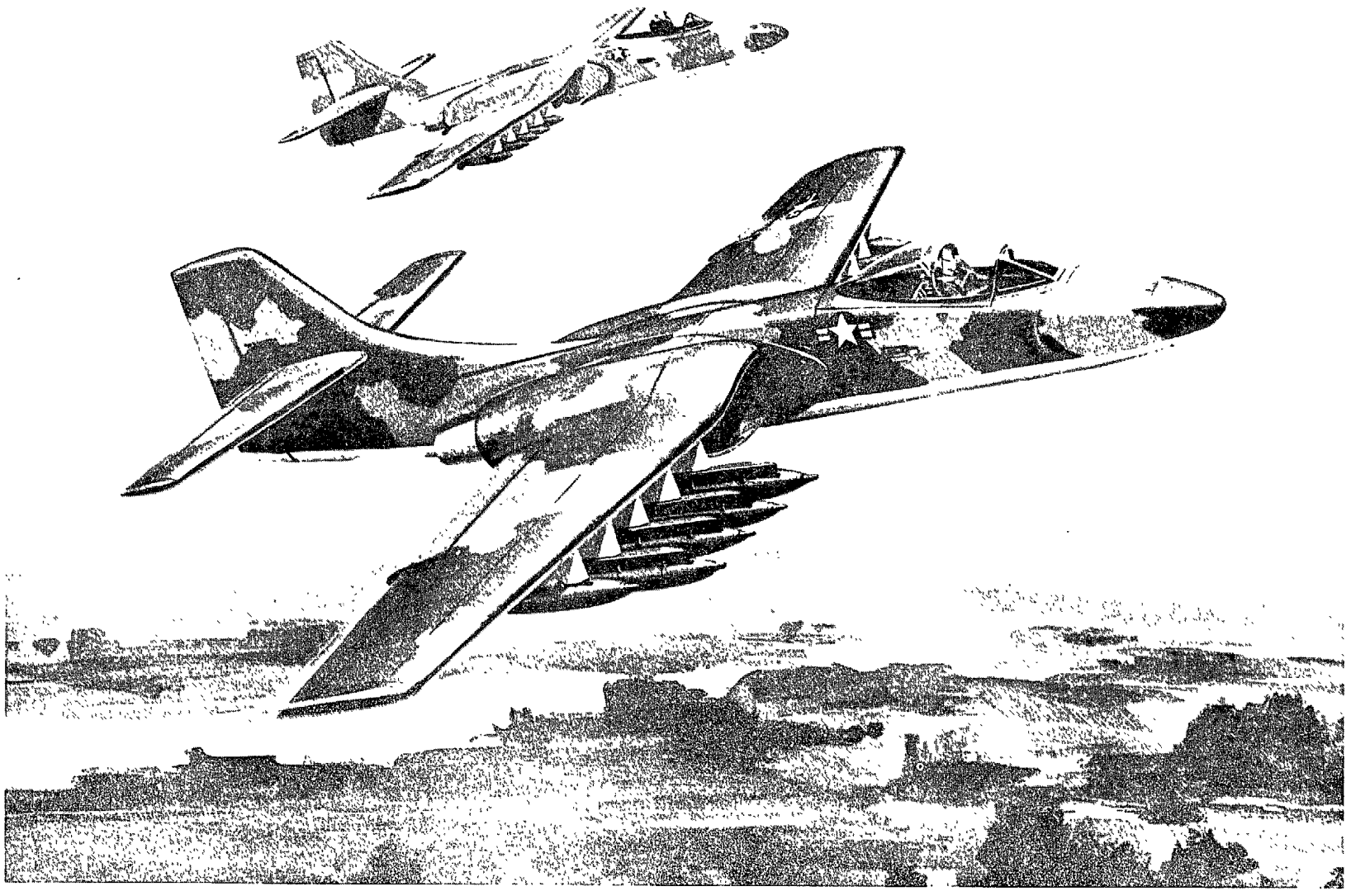
AIRCRAFT HISTORY

A 1966 decision by the Air Force Chief of Staff directed the development of a specialized, new close-air-support aircraft--the first in U.S. Air Force history. During the concept formulation period (September 1966 to April 1970), cost-effectiveness comparisons determined the A-X concept to be superior to the Air Force's existing aircraft. A development concept paper was prepared, was subjected to scrutiny by the other military departments, and was approved by the Deputy Secretary of Defense in April 1970.

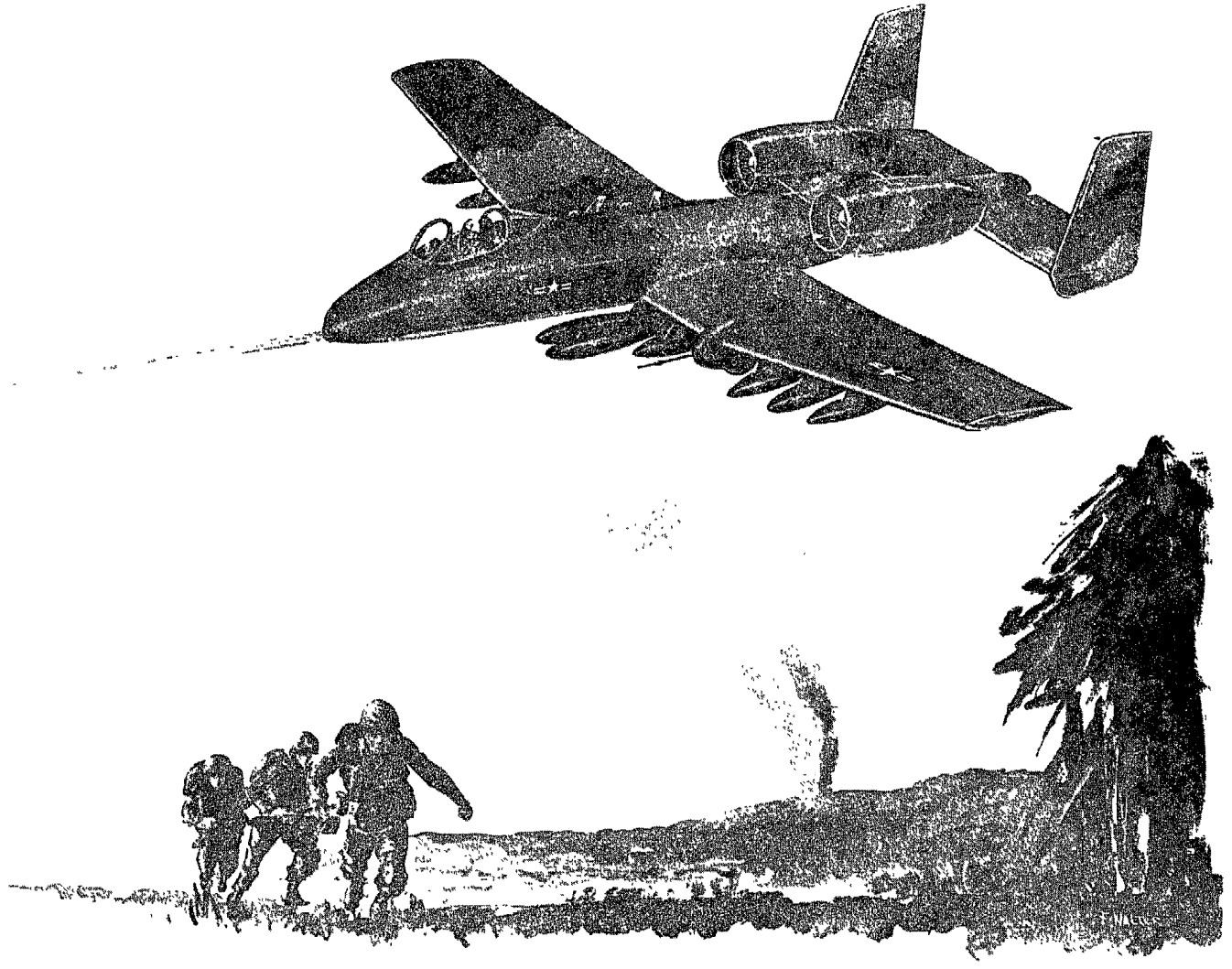
After evaluations of several industry proposals, the Air Force awarded A-X prototype development contracts in December 1970 to the Northrop and Fairchild-Hiller Corporations to build two prototype aircraft each. The aircraft are currently in an advanced development stage.

PHYSICAL AND PERFORMANCE CHARACTERISTICS

The A-X is to be a single-place, subsonic aircraft having twin turbofan engines. Although the physical and performance characteristics will vary with each contractor's version, it is to be about 54 feet long and about 16 feet high; it will have about a 55-foot wingspan and will weigh about 19,000 pounds. Armor plating is to be provided for protection against 14.5 mm and smaller projectiles. For protection against total fuel drainage upon being hit, separate fuel tanks and redundant lines are to be included. Other safety features are to be included in its design to minimize fire and explosives hazards.



THE NORTHROP VERSION OF THE A-X



THE FAIRCHILD-HILLER VERSION OF THE A-X

Unlike most of the Air Force's aircraft assigned to close air support, the A-X is to have a STOL capability to operate from forward airstrips of about 1,000-foot lengths. The development concept paper calls for the A-X to carry 6,500 pounds of payload (weapons and fuel) when operating from such airstrips. It calls for the A-X also to be capable of loitering in the air for 2 hours while carrying eighteen 500-pound bombs on a 250-nautical-mile-radius mission. The aircraft, having an intended maximum gross weight of about 38,000 pounds, is to be capable of carrying 16,000 pounds of ordnance and ordnance pods. A cruise speed of 345 miles an hour and a maximum level flight speed of 460 miles an hour are being sought.

ARMAMENT

According to the concept formulation package, the A-X will be capable of carrying the full range of weapons suitable for close air support, such as Rockeye antitank munitions, 500-pound general-purpose and laser-guided bombs, Napalm, and so forth. The development concept paper also states that the aircraft will carry the MAVERICK antitank missile and that SIDEWINDER air-to-air missiles are to give it a degree of protection against enemy fighters. These various weapons are to be carried on the 10 wing stations of the aircraft.

A 30 mm, high-muzzle-velocity, automatic cannon is being developed to give the A-X a specialized "tank killing" weapon. It is to be a forward, fixed-firing gun to be located on the underbelly of the aircraft. Ammunition for the gun is to be stored internally, and different types of rounds are to be selectable by the pilot. Although the gun is not scheduled to be ready when the A-X competitive prototype flyoff is conducted in 1972, the Air Force anticipates that the aircraft and gun will interface properly.

AVIONICS: COMMUNICATION, NAVIGATION, AND FIRE CONTROL

The A-X is to have a simple avionics subsystem. It will include the necessary communications equipment for coordination with the supported ground forces, tactical air control, friend-or-foe identification, and so forth. Navigation aids will consist of a tactical air navigation system, a heading and altitude reference system, and an automatic direction finder. Some target acquisition will be accomplished with a laser seeker, and weapons delivery will be accomplished visually.

The Air Force has no programmed equipment for night and adverse weather operations, although the Air Force has said that more sophisticated avionics may be added later at additional cost. Although the A-X is to carry the MAVERICK and the SIDEWINDER, the cost to provide the additional avionics for these systems has not been estimated.

PROGRAM SCHEDULE AND FUNDING

The Air Force plans to select the better of the prototype aircraft for further development and production. The competitive flyoff phase is scheduled to begin during June 1972 and to end 6 months later in December 1972. The Air Force plans to have both contractors submit proposals and cost estimates for full-scale development and production of a certain quantity of aircraft 4 months before completion of the competitive flyoff phase. Award of the contract is scheduled for February 1973.

The prototype contract costs are estimated to be $28 million for Northrop and $41.1 million for Fairchild-Hiller. The DOD-selected acquisition report for the A-X as of June 30, 1971, estimated the competitive flyoff phase to be $84.5 million. The total research, development, test, and evaluation costs are estimated to be $281.2 million.

The Air Force's combined estimates for both RDT&E and production as of September 1971 follow.

Air Force Estimates For The A-X

Funding	Fiscal year 1970 and prior	Fiscal year 1971	Fiscal year 1972	Remainder to completion	Total
	(millions)				
RDT&E	$2.0	$27.9	$47.0	$ 204.3	$ 281.2
Procurement	-	-	-	1376.8	1376.8
Total	$2.0	$27.9	$47.0	$1581.1	$1658.0[a]

Quantities:

Developmental prototype	4
RDT&E aircraft	10

[a]Does not include development and procurement of the 30 mm gun.

The A-X prototype development program, the development concept paper, and the selected acquisition report indicate that the Air Force plans to award a fixed-price-incentive-type contract to the winning contractor to continue development. This contract also will cover variable production lot sizes shortly after completion of the flyoff.

OPERATIONAL CONCEPT AND EFFECTIVENESS

The development concept paper for the A-X states that the Air Force envisions three major types of operations for this aircraft. One type of operation is called airborne loiter alert, in which the A-X will orbit over the battlefield; this operation will be used where minimum aircraft-response time is critical. The second type of operation is called forward-operating locations, which will be within, say, 25 miles of the forward edge of the battle area and which will be used in operations involving rapid ground force movements. The third type of operation is called main-base operations, which are air bases within 150 miles of the forward edge of the battle area and which will be used for preplanned (for example, the day before) strikes, armed escort, and reconnaissance missions.

Vulnerability

In a possible midintensity conflict with the Warsaw Pact countries, the most serious threat to close-air-support aircraft is expected to be, as previously mentioned, the Soviet Union's radar-controlled Quad 23 mm and Twin 57 mm antiaircraft artillery.

The A-X's critical components are to be invulnerable to projectiles up to 14.5 mm, but it is not clear how survivable the A-X will be when it encounters the larger weapons. The Office of the Secretary of Defense-Joint Staff Service Group report dated June 22, 1971, presents three widely different sets of figures about the size of the vulnerability areas of the two A-X designs without indicating which set of figures it believes to be the most realistic.

Prototype flyoff

The tank-killing capability of the aircraft for the most part appears to be dependent upon the yet-undeveloped 30 mm cannon. The Deputy Secretary of Defense, in his study on close air support, expressed reservations about "our ability to develop an antitank 30 mm gun and round." Although it is not known whether either of the prototype airframes will withstand the repeated recoil shocks from the high-muzzle-velocity cannon, the cannon is not expected to be on the prototypes during flyoff competition. Further the Air Force does not plan to include any existing or other proposed aircraft in the A-X competitive flyoff phase.

Cost effectiveness

The Air Force made a cost-effectiveness comparison (included in the concept formulation package) of the A-X with some of its existing aircraft. The A-X has not been compared with such others as the A-4, A-6, Cheyenne, or Harrier. The study is thus of limited value in assessing the expected effectiveness of the A-X, because: comparisons were made only with Air Force aircraft; enemy defenses were composed of only 14.5 mm antiaircraft guns; sorties were accomplished only during relatively clear weather and daylight hours; and initial acquisition costs of the A-X were substantially less than recent estimates.

ARMY AND MARINE CORPS VIEWS ON THE A-X

The Marine Corps believes that the A-X is not carrier compatible and therefore not relevant to the Marine Corps because of its amphibious warfare responsibilities. The Marine Corps adds that the mission of the A-X can be performed better by its present mix of capabilities available in the Harrier, A-4, A-6, and F-4; the Marine Corps believes that the close-air-support mission is performed best by aircraft with multipurpose capabilities.

Although the Army has officially endorsed the A-X, it believes that the aircraft should have multipurpose capabilities to allow self-defense, interdiction, and night and bad-weather close air support. The Air Force currently has restricted the A-X to a close-air-support mission without the night and bad-weather capability.

SUMMARY OF MAJOR OPEN ISSUES

1. Although the expected combat effectiveness of the A-X aircraft in close air support will depend largely upon the tank-killing 30 mm cannon, it is not known by DOD whether the cannon and ammunition can be developed. Since the gun will not be ready in time, the Air Force will not know at the time of the prototype flyoff competition whether either of the contractor's aircraft can withstand the cannon's recoil.

2. After the flyoff the Air Force will select the more suitable of the two prototypes. This may not ensure, however, that the one selected will have sufficiently increased capabilities over all of the existing DOD aircraft without a subsequent flyoff competition.

3. The Air Force has stated that at times the A-X will be operated from forward, 1000-foot airstrips. When these small strips are used, however, neither of the other two Air Force aircraft (F-4 and A-7) to be used for close air support can operate from them. This type of basing, like that of the Cheyenne, will require infantry and air defense elements to protect it. Airfield proliferation, logistical support, and redundant air defenses could be major problems.

4. Depending on the number of close-air-support sorties required from the forward air bases, new STOL cargo aircraft may be required to supply these bases since current STOL aircraft may not be capable. In lieu of such STOL aircraft, heavy-lift helicopters or substantial quantities of ground vehicles may be required.

CHAPTER 5

RECENT DOD STUDY ON CLOSE AIR SUPPORT

Interservice rivalry, the lack of coherent overall requirements, and the scarcity of hard data seems to be implied in a recent study of the three aircraft by the Office of the Secretary of Defense-Joint Staff Service Group on close air support.

In October 1970 the House Committee on Appropriations directed DOD to:

> "*** reevaluate the roles and missions and aircraft available relative to close air support, including the Air Force's A-X, the Army's AH-56A Cheyenne, and the Marine Corps' AV-8A Harrier aircraft before recommending substantial procurement of any close air support aircraft. The Committee does not visualize nor does it believe that a significant study effort is involved. The close air support roles and missions problem has been studied and evaluated for years. Unfortunately, it has been beclouded with artificial issues, such as the fixed-wing versus rotary-wing, which are not germane, as well as too little attention given to the large number of extraordinarily fine attack aircraft in our military inventory which can satisfy a portion of the close air support requirement. What is needed now is a resolution of the relevant issues, with full consideration of the need to provide our ground forces with the most effective and timely close air support possible, followed by a determination of the optimum aircraft to meet this all important requirement, whether it be fixed-wing, V/STOL, rotary-wing or fixed-wing STOL."

The close air support review group that was then formed completed a report on June 22, 1971. The Deputy Secretary of Defense, in summarizing the report, recommended that all three programs be continued, because the unique capabilities promised by these aircraft should substantially improve close-air-support strength.

"A-X, Cheyenne, and Harrier offer sufficiently different capabilities for our future forces to justify continuing all three programs at the present time. The Harrier production plan now before Congress should continue. However, decisions to produce A-X and Cheyenne and any subsequent procurement of the Harrier will depend on whether these aircraft meet their cost and performance goals and whether the operational requirement to justify their production is validated."

The Deputy Secretary stated in his summary that the roles and mission issue "is secondary"; that issue was not treated further.

Besides providing that cost and performance goals be achieved, the summary lists a number (but not all) of the uncertainties surrounding the three aircraft that must be resolved before decisions on production are made.

These uncertainties included, for example, the capability of the Cheyenne to acquire targets from missile-launching distances and to get off the first shot, the sortie surge rate of the Harrier, the survivability features of the A-X, and the effectiveness of the Cheyenne and A-X tank weapons.

In addition, the Deputy Secretary said that a large number of performance parameters must be subjected to operational test for all aircraft.

It is not clear whether the three proposed aircraft will be tested in such ways that measurements and evaluations can be made of how well they stack up against one another and against existing aircraft in effectiveness against an array of typical close-air-support targets and of what their relative survivability is likely to be in the presence of a well-equipped enemy.

For example, the Harrier will be tested next spring for its sortie surge rate, but it is not planned that it will be flying against adversarily deployed targets which can "fire back" with gun cameras. We have been advised by DOD

officials that no tests have been planned for the Harrier to measure target effectiveness and survivability.

The Deputy Secretary stated that the report covered the initial phase of the close-air-support study, which indicated that the study might not be complete. Therefore further testing may be planned for these aircraft before additional requests are made for production funding.

MATTER FOR CONSIDERATION BY COMMITTEES

At the time the committees are considering these budget requests, they may wish to ascertain from DOD the extent of testing that actually has been performed.

CHAPTER 6

CLOSE-AIR-SUPPORT PROBLEMS: AN OVERVIEW

A cohesive plan covering total DOD requirements for close air support has not been prepared. Ordinarily such a plan would be the basis for determining the total number of aircraft and the capabilities they need to carry out the close-air-support mission. Instead the sizes and the tactical concepts of close-air-support fleets have been proposed by the individual services, planning independently, without taking into account (1) each other's plans, (2) the quantities and capabilities of existing aircraft, or (3) the resources of our allies for midintensity conflicts.

In addition, the following problems hamper the effective management of the close-air-support mission and the development of an overall plan.

1. There are certain constraints on each service that restrict the range of choice among weapon-system types that each may possess. The Army, for example, is limited to helicopters through an agreement with the Air Force.

2. There is a lack of joint military doctrine on how to conduct the close-air-support mission and on the right equipment for the job.

3. There is a lack of adequate data on how effectively the weapons now under consideration will perform in their ultimate environments and on certain human abilities needed for operating the weapons.

4. The equipping, staffing, and training for support missions usually have been underfinanced in peacetime in favor of a service's first-priority mission. The more complex support missions--such as close air support--which require close, even delicate, coordination between air and ground troops, are then difficult to gear up when hostilities break out.

LACK OF AN OVERALL PLAN

Each service assesses the threat rather independently and decides for itself on the array of resources required to cope with it. The Cheyenne helicopter, coupled with the TOW missile, for instance, is the Army's response to the tank threat in the midintensity environment. The Air Force's proposed answer to the same threat is the A-X, carrying the MAVERICK missile and a 30 mm gun having armor-piercing rounds. Similarly the Marines expect to counter enemy tanks with the Harrier which will be armed with Rockeye cluster bombs, BULLDOG missiles, and other munitions.

The U.S. resources presently assigned and proposed for close air support no doubt could be totaled up, but that sum probably would be a compilation of estimates from many sources, not a carefully planned response to DOD's total requirements for close-air-support strength.

The case for a new close-air-support aircraft could be argued more convincingly if there were common agreement among the services about available inventory aircraft (their numbers, accuracy, payloads, response times, and other properties) and if it could be shown that there was a gap between these resources and the combined services' needs.

Some factors hampering effective management and the development of an overall plan follow.

Constraints on the services

The 1966 Johnson-McConnell agreement between the Army and the Air Force (see p. 60) pretty well limited both services to different aircraft technologies. It was agreed, in effect, that fixed-wing aircraft would be the province of the Air Force and that rotary-wing aircraft would be that of the Army.

The Cheyenne is in accord with that agreement; it is primarily rotary wing, but it also has a small fixed wing and a pusher-propeller in the tail. This hybrid aircraft appears to straddle the border between fixed-wing and rotary-wing aircraft. Nevertheless, under the agreement, the Army cannot possess, even if it wants to, a straightforward fixed-wing aircraft for close air support.

Although the Marines are not under the fixed- and rotary-wing type of restraints as the Air Force and Army are, they have been limited largely to Navy-designed aircraft. This is the first opportunity for the Marines to purchase an aircraft which they consider ideally suited to meet their particular needs.

Lack of joint military doctrine

The purpose of doctrine is to spell out how commanders want military actions carried out. It prescribes, among other things, the operational conditions and tactics for the employment of weapon systems. The dissemination of doctrine to the troops ensures that everyone concerned with a particular mission understands how it is to be performed and their roles in that performance. When the mission requires coordination of four separate services, as does close air support, it is important that each participant understands how the others will act, especially in the employment of different weapon systems.

The lack of jointly approved military doctrine for close air support may be evidence of interservice disagreement about tactics and weapon systems. Although the services are coordinated effectively in Vietnam, this coordination is an ad hoc arrangement established in a permissive environment among local commanders, as is usual in the heat of battle. But such coordination is not usually present in the long-term development and procurement of interservice weapon systems.

Due to the lack of joint doctrine, major problems may arise when close air support is considered in a midintensity or high-intensity conflict, such as a possible NATO-Warsaw Pact confrontation. Command and control of tactical air power becomes far more complex due to the added complications of air superiority, interdiction, and the presence of enemy air power. In the face of sophisticated enemy defenses expected in midintensity warfare, telecommunications, for example, must be coordinated far more intimately than when operating in a permissive environment.

Lack of adequate data on weapon effectiveness

There is a lack of adequate data, generally, on how well the weapons presently under consideration actually will work and on certain human abilities in using the weapons. In the development of weapon systems, there was little stress in the past on realistic operational testing--as in combatlike environments--from which empirical data can be derived to make more confident procurement decisions, to validate requirements, to help decide the size and composition of military forces, and to guide the designers of similar systems.

Simulated combat conditions, including user troops rather than specialists, can provide more useful measurement of weapon accuracy and reliability, for example, than are achievable on test ranges; e.g., weapon accuracy against a camouflaged tank at the edge of a woods will provide more useful numbers than when the weapon is fired at the proverbial black tank on a white desert.

There are important human abilities, too, needed for effective mission performance which have not been measured adequately. In our report on tactical air-to-ground missiles (B-160212), we found that:

> "*** there was not sufficient evidence that average combat pilots could detect live enemy tanks from the distances required to utilize the *** [weapon]. There have been few systematic tests and measurements of pilots abilities in combatlike situations to detect and identify mobile, hard targets at various combinations of range, altitude, and speed."

The intervisibility between ground targets and helicopters and between ground targets and airplanes is problematical at present. Many weapon systems in inventory and in development could benefit substantially from good data on what average combat pilots can see enroute to the target at various ranges and speeds.

Operational testing in combatlike environments of weapons, weapon systems (and modifications), support systems,

and tactical and organizational arrangements furnishes the important input to the evaluation, but such testing should be supplemented by component testing, systems analysis, operations research, and other studies. The important thing is to predict how the system will perform in its ultimate (combat) environment. A December 31, 1970, GAO report (B-160212) said:

> "As congressional defense committees well know, there are considerable differences between the technical promises of new weapon systems and their later performance under both operational testing and actual combat conditions. This fact alone indicates that one of the greatest needs in the Department of Defense today is timely, realistic, and independent operational testing in a combat-like environment before large-scale production commitments are made on new weapons."

Operational testing prior to the production go-ahead often is resisted by the parties concerned with the program. Advocates often see operational testing as disruptive; the contractor may be overcommitted in the development cycle and may have a large staff on hand, and the service proponent may regard the testing as an expensive repetition of testing already done by the contractor, which also could open up a Pandora's box of expensive engineering changes.

Then too, early visibility of uncertainties could arouse adverse attention in the Congress, which might jeopardize the program. Thus zealous advocates may see little to be gained. It is the users of weapons who have had the keenest interest in operational testing for effectiveness, reliability, and maintainability.

Since operational testing often takes place after a system has gone into production, test findings, which might call for design alterations or even cancellation of the equipment, become irrelevant. According to the Blue Ribbon Defense Panel's appendix F:

> "This question of timeliness is extremely important. For this reason it is essential to dispel the widely-held belief that useful OT&E must await

> the completed product of R&D [research and development] - that it is or should be limited to the testing and evaluation of production systems. It is important *** to perform OT&E on operationally - configured production systems, but if the OT&E process only commences at that point it misses most of the opportunity to influence that product on behalf of the operational forces - the ultimate 'users'."

The Deputy Secretary of Defense, in attempting to strengthen the OT&E function, has elevated the function to the position of Deputy Director of Defense Research and Engineering (Test and Evaluation). On the occasions of certain milestones in the acquisition cycle of a weapon system, the Deputy Director is to have direct access to the Deputy Secretary of Defense and to the Defense System Acquisition Review Council.

The Deputy Secretary also ordered the services to set up their own OT&E authorities to be independent of development commands and to report directly to the service chiefs. To date not all the services have complied. "There are *** considerable forces within the Services which resist the independence of OT&E organizations," said the Blue Ribbon Defense Panel's appendix F. The problem surfaced in this year's hearings before the Senate Committee on Armed Services.

> "*** representatives of the Army and Air Force testified that new emphasis is being placed on operational testing and evaluation before production. *** The Navy representative, however, supported the proposition that the current Navy practice of 'suitability testing' after production is sufficient."

Funding and training for support missions

Each service is charged with providing some kind of support to the others. The Air Force is charged with providing close air support to the Army, for example, and, as was said earlier, the Army is responsible for defending Air Force ground facilities. The Navy furnishes sea transport to both. No service, however, is completely happy with all the support rendered by the others.

A special subcommittee of the House Committee on Armed Services was appointed in 1966 to look into close air support. In its report the subcommittee remarked:

> "When funds are limited, first things must come first. Unfortunately, close air support did not have the urgency of airlift, or interceptor raids, or strategic bombing in Air Force planning."

Here are the horns of the interservice dilemma. No service has such great resources--except perhaps in time of war--that it can fund its primary and support missions equally well. Instead the service must allocate scarce resources, and it naturally will place higher priority on its primary missions. It may be significant that, in the latter days of the last three wars, when great resources were available to the Armed Forces, the execution of one support mission--close air support--improved considerably.

In times of tight budgets, as between wars, the allocations for support missions may be more token than meaningful, because the high-priority missions must get the lion's share of the smaller budgets. This may be the taproot to the services' continued dissatisfaction with the quality and quantity of the support that they receive from others.

Peacetime disfavor of close air support

Appendix II discusses the complexity of the mission and the many factors involved in making it effective. The point is made that air-ground training ought to be continuous because the system is too complex to gear up in a few weeks' time. When hostilities erupt the services usually submerge their rivalries to get the job done on the battlefield, but

dedication to joint tasks in peacetime is often luke warm. The trouble is that it may take many months to equip and attune the close-air-support system, and the first few weeks of midintensity hostilities can be crucial.

One of the defects of support missions in the past has been service unwillingness to undertake joint exercises which involve testing weaponry. The Blue Ribbon Defense Panel felt that joint OT&E was very important and stated that:

> "The history of joint OT&E in recent years presents a dreary picture. The large joint tests and exercises which have been conducted seem to have generated a maximum of disagreement (including genuine ill feeling) and a minimum of useful information."

The Deputy Secretary of Defense is seeking to change these attitudes. In a memorandum to principal DOD officials, he said:

> "I want to encourage more joint operational test and evaluation, not only with respect to items which have a natural interface with equipment of another Service, but also to provide more two-sided testing. Toward this end, I am asking [for] a joint Cat. III [Air Force operational test phase] test of the Maverick and an Army combined arms unit."

MATTERS FOR CONSIDERATION BY THE COMMITTEES

To more effectively manage close-air-support resources, the committees may wish to require DOD:

1. To establish the total DOD requirement for close-air-support resources within the force structure allowed by budget limitations.

2. To delineate the single- and joint-service tasks and subtasks in conducting close-air-support missions and to assign authority and responsibility for specific tasks to the individual services.

3. To develop and implement, within some realistic deadlines, joint close-air-support doctrine to include spelling out how military actions are to be conducted and coordinated and prescribing the operational conditions and joint tactics for the employment of weapons.

A SHORT HISTORY OF CLOSE AIR SUPPORT

Close air support has had an interesting if uneven career in military aviation. Although close air support is very effective in certain situations, it has not been thought by some airmen to be as decisive as other missions; for this and other reasons, close air support has had to take a back seat to strategic bombing, air superiority, and interdiction in the scheme of air (if not ground forces) priorities. In the last three wars, the Armed Forces were relatively unprepared to execute the mission when hostilities began but became skillful in executing air support as the wars drew to a close.

THE LIGHTNING WAR, 1939-42

No small part of the brilliant success of the German blitzkrieg, or lightning war, was the teaming up of the tank, infantryman, and Stuka dive bomber (in armed escort) for the panzer drives through Poland, the low countries, France, the Balkans, and Russia. That airplane was specifically designed for close air support. Air-to-ground communication was effected by an air liaison officer riding at the head of the armored column and talking with the air staff. This type of forward air control was not adopted by the Allied forces until the last 2 years of the war.

THE UNITED STATES IN WORLD WAR II

In the United States the Armed Forces were little more than a cadre when the war began in Europe. The Army Air Corps, in quest of autonomy during the 1930's, had stressed the importance of long-range strategic bombing in its scheme of priorities and tended to downgrade missions which required close coordination with the ground armies. Besides the general lack of interest in air support, there was little money available in the 1930's for the development of tactics, equipment, and training.

Because of the scheme of priorities, the lack of training, and the absence of effective air-to-ground communications, close-air-support missions were not well executed until the last 2 years of the war. Joint air-to-ground training was tried early in the war, but it was ineffective

for a number of reasons. Forward air controllers, air liaison officers, and air-to-ground communication equipment were not available in quantity until late 1943 for the Salerno campaign in the European theater and the assault on Bougainville in the Pacific. After the Allied invasion, air-to-ground coordination became quite effective in the drives across France and the Rhineland. Lead tanks in the armored columns were equipped with very high frequency radios so that forward air controllers could talk directly to the pilots overhead.

In the Pacific close air support was more often used than in other theaters; the island hopping, the thick jungles, and the rough terrain precluded much use of ground vehicles. The Marine Corps which emphasized the importance of close air support after the 1920's fought in the Pacific theater. The effectiveness of close air support there was hampered, however, by the heavy jungle foliage which made targets difficult to find (and exploded contact fuzes above ground). The Japanese made extensive use of cave systems which required direct hits by heavy ordnance (large bombs) rather than by the light close-air-support ordnance of those days.

1945-50: RETRENCHMENT, UNIFICATION, AND RIVALRY

Interservice rivalry revived after World War II because of the deep budget cuts and the competition for nuclear capability. The National Security Act of 1947 was not precise in its "division of labor" among the services; so, in 1948, the Secretary of Defense held conferences with the Joint Chiefs of Staff to negotiate mission assignments. Out of these meetings came the Key West agreement which, in the main, gave the Air Force primary charge of strategic air and the Navy control of the seas. Each service was assigned support missions: the Air Force, for example, was to furnish close air support to the Army, and the Army, conversely, was assigned the ground defense of the air fields.

In the tradition of the services, however, these support missions continued to be funded in the budget of the supporting service.

KOREA--1950-53

There was little close-air-support capability in the Armed Forces when the North Korean invasion began in June 1950. The Air Force Tactical Air Command had been dismantled in 1948 and was not resurrected until December 1950, 6 months after the war began. Meanwhile there were critical deficiencies in close-air-support training, equipment, and manpower in the Army and Air Force. Many Air Force pilots were untrained, so that strafing and rocket firing had to be learned in actual combat. Air-to-ground communication was a major problem in coordinating close-air-support missions.

In 1952, in the middle of the Korean War, Army Secretary Pace and Air Force Secretary Finletter signed an agreement which limited Army fixed-wing aircraft to 5,000 pounds but which enlarged the Army's role in transport and medical evacuation in and near the battle zone. There was one loophole: no weight limitation was placed on helicopters. It would be imposed later, in 1957. By December 1952 the Army had over 700 helicopters in its inventory of nearly 2,600 aircraft.

Marine Corps air support in Korea generally was very good. The Corps had learned well its coordination and communications lessons of the World War II Pacific campaigns. Marine air response was much quicker; the strike aircraft stayed over the battle area longer, and ordnance was delivered much closer to the front line.

Opinions of high-level officers about close air support were divided after the Korean conflict. But regardless, the Armed Forces performed superbly in that conflict. When all is said and done, the North Korean People's Army was effectively destroyed within 4 months of its invasion; the Chinese Volunteer People's Army was fought to a standstill within 8 months of its crossing of the Yalu River.

PRELUDE TO VIETNAM

After Korea, as after World War II, the Army and Air Force close-air-support system was dismantled and trained personnel dispersed; with the exception of a short academic

course and some joint exercises, there was little or no air-to-ground training in the 1950's.

During the latter 1950's the U.S. nuclear capability and massive retaliation policy made such missions as close air support seem out of date. The new administration of 1960, on the other hand, desiring options other than the "all or nothing" use of nuclear weapons, began to reintroduce conventional equipment and tactics for limited war contingencies.

The Army air fleet was authorized 102 aircraft for each infantry division in 1962, when the Army's Howze Board was convened to study the possibility of increasing troop mobility by substituting still more helicopters for ground vehicles. The Board's recommendations supported the air-mobility concept and also called for a large number of attack helicopters to provide close-in support with guns, rockets, and missiles. DOD Directive 5160.22 issued in March 1957, which forbade the Army from engaging in close air support and which limited helicopter empty weight to 20,000 pounds, was waived (this directive was canceled in March 1971).

Within the Air Force, the Strategic Air Command continued to dominate. When the Secretary of Defense warned the Air Force to concentrate on developing its close-air-support capability or lose it to the Army, a school was set up at Eglin Air Force Base, Florida. Pilots were trained in the nearly lost arts of strafing, low-level navigation, skip bombing, and other close-air-support tactics.

THE WAR IN SOUTHEAST ASIA

As hostilities in Vietnam began to heat up, the Armed Forces were not well prepared to carry out close-air-support missions there. One reason was that Vietnam proved to be a different type of war than that of World War II or Korea, for which the United States and other Western forces are effectively geared. It is war by stealth and ambush; there is no front or rear; there are nibbling attacks, and there are few or no "human wave" onslaughts to be shattered by massive firepower as in Korea. For another thing airpower is frustrated in its fundamental requirement; that is, targets must be found first before they can be effectively destroyed from the air.

The guerrilla, using few vehicles or radios, seeks to provide no signature, no track, no trace; he shifts positions often, carrying his austere supplies from one cave or tunnel to another. These storage places, like himself, offer little or no clue to firepower observers. Thus targets not only are few but also are very difficult to find.

BATTLES WITH THE NORTH VIETNAMESE REGULARS

The North Vietnamese Army, on the other hand, has attempted some mass assaults only to be defeated by air-to-ground opposition. In quest of another Dien Bien Phu, the North Vietnamese, together with guerrilla forces, suffered substantial losses, for instance, at Quang Tri City, Con Thien, Khe Sanh, and Hue.

At Khe Sanh in 1968, where some 6,000 marines and Republic of Vietnam rangers were surrounded by 20,000 North Vietnamese, the U.S. Air Arms unloaded 95,000 tons of bombs in 73 days. The Air Force, alone, expended three quarters of a million rounds of ammunition. Air support was probably decisive in this conventional battle, which might have been a Dien Bien Phu under other circumstances. The enemy is said to have lost 12,000 men, the defenders, 200. In concurrent battles at Quang Tri City and Hue, a full division of North Vietnamese reportedly lost half its strength, 5,000 men.

ANTIGUERRILLA TACTICS

But against those small fleeting bands of jungle "phantoms" who refuse engagements that do not clearly favor them, it is very difficult to deploy airpower. Again, in order that aerial fire or, indeed, artillery fire may be delivered effectively, targets must first be identified and located.

To suppress this elusive but omnipresent enemy, bombing and strafing is done when enemy presence is strongly indicated, and, in some cases, free fire zones into which fixed-wing and rotary-wing aircraft deliver fires are designated after clearance with the native province chief and are monitored by the forward air controller. A ground commander, too, may call for an area strike under these provisions if enemy presence is suspected in a particular location.

Friendly troops on patrol, seeking to capture or destroy the enemy, are likely to be ambushed if the guerrillas have a superior position or greater numbers; close air support may be quickly needed before the enemy closes in to preclude the air strike or before he fades away at the sound of approaching aircraft. These and other engagements which the guerrilla enemy accepts seldom last more than minutes, and he will break off "to live and fight another day," believing that time is on his side.

Troop-carrying helicopters escorted by gunships may be used in a surprise assault on a suspected enemy position or may be used to reinforce a defense point. First the landing area is cleared by bombing, and then the gunships--helicopters and fixed-wing aircraft--deliver suppresive fires while the assault troops regroup on the ground. But those tactics can be frustrating, too, since the enemy will seek to fade away in the difficult terrain if the assault force is superior and if he sees no clear advantage to accepting the engagement.

COMMAND, COMMUNICATION, AND CONTROL IN VIETNAM

The present system sits Army and Air Force officers together at Army command levels. Together they examine each air strike request, the Army officer for suitability of the tactic (as opposed to artillery fire, for example), the need

of artillery-free corridors for aircraft safety, etc., and the Air Force officer for the availability of pilots and the suitability of planes and ordnance. Only the Army officer can veto the request--if, say, the available air resources are all presently committed to more worthy targets. Each higher liaison group, by silence about the request, signifies approval for it, as it passes up to the next level of command.

Whether on preplanned or immediate missions, the flight or squadron leader, upon arrival in the target area, comes under the direction of the forward air controller, regardless of any difference in rank. The controllers, like the air liaison officers, are Air Force or Marine officers who are assigned to work with the ground commander. No strike near friendly troops may be attempted without coordination with the officer in charge of the ground forces.

CLOSE-AIR-SUPPORT AIRCRAFT

As the need developed for aerial support in Vietnam, it was soon established that, for the most part, the right equipment was not available. Most of the jets lacked effective guns and could not fly slow enough and could not stay long enough for most missions over the terrain. Because of the lack of suitable planes, all kinds of propeller-driven aircraft--such as the T-28 trainer, the World War II C-47 transport, and the B-26 bombers which have a reasonable amount of staying power and payload capability--were pulled out of mothballs. The ancient A-1 Skyraider (probably the most effective of the planes used for support in Vietnam) was borrowed from the Navy, and the O-1 Bird Dog was borrowed from the Army for revival of forward air controlling.

The Air Force decided in 1966 that a specialized close-air-support plane--a follow-on to the A-1--was needed to defend in Europe as well as in permissive environments. That proposed plane, now called the A-X, is presently in the competitive prototype stage.

The UH-1 helicopter gunship was joined by the two-place Cobra in 1967, and that gunship is doing an effective job in Vietnam. The Cobra had been considered as an interim vehicle until the larger and heavier Cheyenne compound helicopter

was fielded, but recent plans calling for a reduced number of Cheyennes include a requirement for Cobras and for Cobras with TOW missiles.

The Chiefs of Staff of the Army and Air Force in April 1966 signed the Johnson-McConnell Agreement which sought to clarify some mission responsibilities. In effect the Army turned over to the Air Force its intratheater fixed-wing transport aircraft and the Air Force relinquished claims for rotary-wing aircraft in intratheater transport, fire support and supply of Army forces.

The helicopter has come into its own, in the permissive environment of Vietnam, at least. In the last 10 years, helicopters have flown over 30 million sorties there and have logged more than 11 million hours in the air.

Marine aviation, which was convinced as late as 1963 that helicopters were ineffective in aerial fire support, has reversed its position and is now using both fixed- and rotary-wing aircraft for close air support. No interservice rivalry encourages the Marine Corps employment of both Cobra helicopter gunships and fixed-wing planes. The use of both types suggests a complementarity between them, at least in the way the Marine Corps uses them in the permissive environment of Vietnam.

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Close air support in the lightly defended environment of Vietnam is quite different from what can be expected in midintensity engagements with a sophisticated, well-equipped enemy. The mission is a complicated one, in any event, and is discussed more fully in the next appendix.

CONDUCT OF CLOSE AIR SUPPORT

The close-air-support mission is to strafe and bomb enemy forces, installations, and equipment; to aid friendly forces on the offensive; or to help repel enemy attack. When friendly forces are on the offensive, the fire must be delivered quickly enough to deny the enemy time to recover or dig in; when the enemy mounts an attack, friendly air support should be so swiftly responsive as to disorganize him, catch his troops in the open, and prevent his closing. Putting the right ordnance on the right target at the right time can be crucial to the success of the ground troops in a particular engagement.

Close-air-support fires are like that of artillery except that the range is extended. The distinct advantages of close air support are its much greater mobility and its flexibility. Close air support is needed when artillery cannot do the job as well; it may be essential in amphibious and airborne assaults when the ground guns are in transit or are being set up; and sometimes the ground commander needs all the fire he can get in attacking a target.

Some air strikes may be preplanned, say on the previous day; or the strikes may respond to immediate call from a ground commander who sees a tactical opportunity or is being attacked. Other important tasks are (1) armed reconnaissance to find the enemy and to report or attack targets as they present themselves, (2) escort of troops moving over land, in the air, and over beaches, and (3) suppression of enemy fire in airborne landing operations.

Normally close-air-support ships--helicopter and fixed wing--work in pairs or groups to protect each other from the enemy's fire, to force him to defend in more than one direction, to attack multiple targets, and to locate targets for each other and sometimes for ground artillery. A monitoring observer, called a forward air controller, on the ground or in an observation plane may also point out the targets.

Fixed-wing ships may dive at targets or make fast low-level runs to bomb, strafe, or drop napalm. Helicopter gunships seek to fly at treetop level or below; they try to take advantage of terrain features to mask their approach from

enemy eyes; then they pop up, fire, and go down again. Both types of aircraft may use suppressive devices, such as electronic countermeasures, to hide their approach.

The singularity of the close-air-support mission is due to the particular battle arena, the close coordination that must be sustained with the ground forces, and the special aircraft characteristics.

The close-air-support mission may be coordinated by a forward air controller who is above the battlefield in an observation plane or is on the ground with the troops. The airborne controller, an Air Force or Marine officer, directs the strike pilots to the targets. In a midintensity conflict where light observation planes may not be able to "live," the strike pilots may be forced to direct each other in the absence of ground or airborne forward air controllers.

CLOSE-AIR-SUPPORT TARGETS

Most major weapon systems of the last 25 years or so have been designed to deter Warsaw Pact countries from making war, or to defend if those nations attack our allies. If hostilities should break out in Europe, most military experts expect a high-intensity or midintensity conflict to ensue in which both sides would fight with enormous amounts of firepower.

For the close-air-support mission against a well-equipped enemy as might be encountered in European, Middle East, or Korean hostilities, the most formidable ground threat to our troops is expected to be the battle tank. Tank-killing capability is considered a must for close-air-support weapon systems.

When not seeking mass engagement, troops and vehicles are transitory and evasive and seek to mask their movements. These targets--along with other less mobile tactical ones, such as command posts and field fortifications--are usually well camouflaged and take advantage of terrain features to hide their presence. When in the open, tanks and other vehicles use smoke and dust to avoid detection. Almost all tactical targets, except in mass movements, are very difficult to see from the air in most terrains.

Some test exercises have shown that the enemy on the ground can usually detect the aircraft well before the pilots and gunners see him and at a longer distance. If the enemy on the ground believes he is outgunned by the aircraft, he may simply remain motionless, relying on his camouflage to blank him out, or he may retreat into fortifications. If he decides to engage, he has the classic battle advantage of getting off the first salvo before the other side is aware of his presence; using modern air defense weapons, he can be deadly.

The target detection problem is compounded in jungle areas. Many jet pilots have not seen a single enemy soldier during their entire tours in Southeast Asia, and helicopter pilots report that they see targets located for them only about 10 percent of the time. In the open terrains of Korea, Western Europe, and the Sinai, though, camouflage and concealment become more difficult, particularly in mobile warfare. Then the attacking or retreating troops must leave their foxholes and expose themselves, often in great number.

APPENDIX III

AIR-TO-GROUND COORDINATION

It is probably evident from the discussion above that air-to-ground actions must be carefully synchronized. On a shifting, transitory battlefield where friendly and enemy "fingers" seek to interlace, the delivery of fire must be very accurate, target identification must be positive, and friendly positions must be well marked. The pilot must know the lethal area of his ordnance and the system error of his ship. A 1965 Marine Corps study says:

> "*** in the vicinity of friendly units, weapons with restricted and well-defined and controlled areas of destruction must be used; likewise, attack profiles must be chosen which insure adequate accuracy and control of weapon effects."

Witnessing the devastating firepower delivered by ever-present close-air-support aircraft boosts the morale of friendly troops and discourages the enemy. Sometimes, in fact, the mere sight of attack aircraft has driven off enemy troops. On the other hand, too many wild shots and the danger of friendly casualties can cause loss of confidence in the air arm, and ground commanders are then reluctant to call in air strikes.

ATTACK AIRCRAFT CHARACTERISTICS

All types of airplanes have been used in close-air-support missions. Many have been indifferent performers because of their design. Some are simply too vulnerable to ground fire to go down low enough to be accurate, and others are simply too fast over the targets.

The ideal characteristics of a close-air-support weapon system are:

1. Immediate responsiveness to the ground commander's call, within 5 to 10 minutes.

2. Capability for a high number of flights to and from the target.

3. Accurate fire without danger to friendly troops.

4. Delivery of sufficient ordnance preselected for the types of targets to be attacked.

5. Minimum vulnerability to almost any counterfire the enemy can put up in the close-air-support area.

6. Easy, quick maintenance to sustain a high ratio of combat-ready aircraft.

7. Ability to operate in poor weather and at night.

A few words about these aircraft characteristics may be helpful here.

Quick response to calls

Engagements between opposing ground forces in guerrilla warfare are a matter of minutes; on the other hand, engagements between sophisticated forces may last for hours, or even days. The enemy seeks to attack by surprise or stealth, so the strike aircraft must respond swiftly and in strength to help arrest the enemy before engagement begins. Or, the friendly ground commander may see a sudden opportunity to attack that requires quick air support.

Clearly, having aircraft staged at airfields hundreds of miles away precludes swift air response to fleeting opportunities. Prompt response may be obtained by airborne alert (air loiter) over the battle area; division of airborne aircraft from lesser priority preplanned attack missions; or "cabstand" alert from forward air stations.

Adequate ordnance

If other things are equal, the more ordnance an aircraft can carry, the more lethal it can be, and sometimes a heavy load of a single kind of ordnance is just what is needed. Small payloads, of course, mean frequent returns to base, thus either more aircraft are required to maintain coverage or more gaps will appear in the close air support provided. But total load is not enough usually; variety and accuracy are important, too. Generally an aircraft that can carry diverse weapons to attack a variety of opportune targets will be more effective than the aircraft that can deliver only iron bombs.

Missiles and guided bombs

These new weapons offer some problems for close-air-support missions. The virtue of guided missiles is that the launch aircraft can fire them from a distance, standing off from enemy weapons; some missile designs also allow the aircraft to veer off as soon as the missile is launched. But these advantages usually are not suited to close-air-support missions because missiles and guided bombs have certain shortcomings.

1. Except in dynamic situations, it is very difficult to detect tactical targets, which are nearly always camouflaged, from missile launch distances.

2. Guided missiles are not yet so reliable that friendly forces are unendangered by wild shots. A homing air-to-ground missile, once it loses its "lock" on the target--for any of a number of reasons, including enemy countermeasures--may land almost anywhere.

3. The launching of some air-to-ground missiles requires compromising attack profiles and exposure times that endanger the aircraft. Attrition during missile launching may be double that of dive bombing with such missiles.

Although guided missiles may be fine for deep air support and interdiction of stationary targets, presently available designs do not seem very suitable for the classic close-air-support mission of delivering ordnance close to friendly troops. There is guidance technology on the horizon, however, which may improve missile capabilities for the mission.

Accuracy of fires

Aircraft accuracy is one determinant of the size and composition of the military forces. The greater the accuracy the more likely it is that a target will be destroyed in the first pass of the aircraft. Fewer passes imply less aircraft attrition, thus a smaller but more efficient force structure is required for a given number of targets.

The other dimension of accuracy in close air support is the proximity of friendly troops. Inaccurate aerial fire, besides causing friendly casualties, may assist the enemy by upsetting the ground commander's plan, demoralizing his troops, or creating openings for enemy forces. This is why close-air-support strikes are not made without prior express approval of the ground commander.

Survivability of the aircraft

Close-air-support aircraft, by definition, cannot avoid a hostile environment. They suffer more attrition than fighters, for example, which fly faster and higher. Survivability is a function of both hit avoidance (maneuverability and high speed) and built-in aircraft design. High speed, however, is usually inimical to accurate ordnance delivery, which is vital in close air support. A highly maneuverable aircraft can minimize both exposure time and the number of hits during exposure. A tough but agile aircraft, whether rotary or fixed wing, appears to be best for close air support.

Aircraft basing

Close-air-support aircraft should be based as far forward as possible to reduce en route time, yet far enough back to prevent their destruction on the ground by enemy rockets and artillery. Forward basing is a trade-off between responsiveness on the one hand and aircraft survivability and maintenance and logistics on the other. Bases deep in the rear are necessary for more complex maintenance and overhaul.

If air superiority has not been attained or if guerrillas or partisans are behind the lines, the aircraft must be sheltered or protected by embankments (revetted) as well as defended.

A large problem with satellite airfields (forward bases) is that they must be kept secret, if that is possible, to foil enemy air attack. Since they will be closer to enemy forces and less heavily defended than main bases, secrecy may best be sustained by planning to shift the aircraft randomly among a number of deceptively reserved forward bases. In European exercises the Army found it almost impossible to conceal a troop unit of 26 helicopters in a bivouac area (about 75 acres) and impractical to conceal them in a woods where snow or mud makes it time consuming and difficult to extricate them.

There may be problems here for all three candidate aircraft.

Maintenance and turnaround

The current design goal for a close-air-support aircraft, whether rotary or fixed wing, is for easy, quick maintenance at austere airfields to get the plane back in the air or to restore its combat readiness. Ordnance reloading, fuzing, through-flight maintenance, and refueling (turnaround) should be quick too. Simple maintenance and fast turnaround maximize time in the air, and combat readiness provides a surge capability so that many planes can cycle into the battlefield when heavy prolonged fire is needed in an emergency.

Night and all-weather operations

It is very desirable to exceed potential foes in the capability to fight at night and in any kind of weather. These capabilities are not now attainable on either side due to state-of-the-art limitations and the nature of most close-air-support missions. There is technology on the horizon, however, which holds some promise.

Most critical close-air-support targets are "point" targets, that is, relatively small objectives such as tanks, armored personnel carriers, and command post entryways, as opposed to area targets such as airport runways and buildings. It is possible to attack most close-air-support targets on clear nights, and it is possible to locate them when the nights are less clear with the aid of flare, laser, infrared, and other systems. But, as a senior RAF officer said:

> "*** no aircraft is yet capable of carrying out an accurate night attack against a small target in a high risk environment. Infra-red, laser and low-light television are bringing the time nearer when this will be possible. However, for some years yet it is likely to remain a universal gap in the armory of tactical airpower. Areas can be attacked with fair accuracy by night, but not pinpoint targets"

On close-air-support missions when friendly forces are nearby, the target must be identified with certainty. The friendly positions must be verified so that they will not be endangered by the hit pattern of the ordnance and the area of destruction.

There is no true all-weather aircraft in the strict sense of the term. There are days in Europe (as during the first few days of the Battle of the Bulge), Southeast Asia, Korea, and elsewhere when all aircraft are completely socked in and nothing can fly. Normally helicopters can fly when visibility is above three quarters of a mile and the cloud cover is above 300 feet. In marginal weather conditions, however, the helicopters may fly inadvertently into reach of enemy air defense weapons. Although the minimum weather

conditions are higher for fixed-wing aircraft, these planes also may find themselves uncomfortably close to enemy fire in minimum or marginal weather. Then too, the capability to fly slowly and penetrate weather involves risk of sudden confrontations at point-blank range with enemy antiaircraft artillery.

TRADE-OFFS IN AIRCRAFT DESIGN

In actual practice the aircraft design ideals must be compromised. Instant response would require many aircraft in the immediate battle area. Too heavy loads of ordnance would hinder aircraft maneuver and evasion tactics. The great variety of target types precludes the preselection of specific ordnances. Thus trade-offs are necessary to get the optimum close-air-support aircraft with adequate capacity, short takeoff, good loiter time in the battle area, maneuverability, and survivability. The ultimate in one capability cannot be achieved, of course, without degrading the other capabilities; for example, increasing the armor and payload while holding costs constant will ordinarily decrease the range and loiter time.

MULTIPURPOSE VERSUS SPECIALIZED AIRCRAFT

The case for using a multipurpose aircraft rests largely on the flexibility of its use. Such an aircraft might do air-to-air combat, interdiction, and close support, depending on which mission becomes the most urgent at any one time. The compromises in design to achieve multipurpose capability, however, make the aircraft less than optimal for any one of the missions.

Advocates of multipurpose aircraft believe that, if war should erupt in Europe, all fighter aircraft should be thrown into the air-superiority battle immediately to interdict enemy airfields, protect friendly ones, and knock opposing fighters out of the sky. A fleet of low-flying, slow-flying support aircraft could be more hindrance than help in an air-superiority contention, in their opinion.

Proponents of a specialized support aircraft would argue, to the contrary, that the quality of the close-air-support weapon system could be a crucial factor in the opening days of such a war to help arrest massive armored drives that might otherwise overrun friendly troops.

Both the Soviet Union and Germany relied heavily on specialized support aircraft in World War II. Germany lost, the Soviet Union won; but the outcome was decided by a number of other factors. The Western Allies also won against

Germany and Japan even though close air support was used rather crudely and, in priority, well behind other air missions; but again, there were many factors contributing to those victories.

If most tactical aircraft are multimission types, the land forces fear that Air Force prime missions will be met first, before ground-support tasks are attended to. (The same Army officials, in fact, believe that there will be little or no Air Force fire support during the early phase of a war in Europe.) High-level Army officers, however, have expressed accord with the Air Force priority of (1) air superiority, (2) interdiction, and (3) close air support.

APPENDIX III

CLOSE-AIR-SUPPORT TRAINING

The sensitive coordination required in the mission, described above, and the history of the mission, discussed in the preceding appendix, indicate that a close-air-support system should be maintained in peacetime. It is perhaps also evident that training of the mission participants should take place before, not after, hostilities begin. Training, in other words, ought to be continuous during peacetime to maintain the sharp edges of the air-to-ground teams.

The close-air-support pilot, for example, has to know a good deal more than just how to fly his plane and drop bombs as in the routine attacks on stationary targets. In close air support, his targets are fleeting, transitory, and evasive; he should understand and recognize (1) ground formations and tactics, (2) how enemy and friendly forces come in contact, (3) enemy defense and countermeasure behavior, (4) the delivery accuracy of his plane and its various weapons, and, of course (5) the air-to-ground communications system.

The ground commander, air liaison officer, and forward air controller must know these things too. Close-air-support actions are fast-moving operations, and one engagement is seldom like another. There are still so many variables and subtleties in the coordination effort that only long and arduous training together as a team will weld ground troops and air troops into a truly effective tactical force.

RESOURCE LIMITATIONS ON THE MISSION

To provide close air support sufficient to meet any contingency would require tens of thousands of aircraft and pilots, and support facilities in great numbers, and would obviously be beyond the Nation's resources. The assets to be employed then are scarce resources. As a North Atlantic Treaty Organization (NATO) commander puts it:

> "It is often asked why a certain Army formation, say a battalion, cannot have a parallel air force formation, say a squadron, directly allotted and in direct communication ***. The answer

> unhappily is that there will never be enough squadrons to go around ***. This is nothing new. It is just the same with divisional or corps artillery."

With the small number of aircraft available, it follows that close-air-support missions must be parceled out to those commanders who need them most. The judgment as to the most pressing needs must be made at higher levels--division, corps, or army--to the ultimate dissatisfaction of those front-line commanders whose requests are vetoed or delayed in favor of more urgent ones. A disappointed close-air-support customer may believe, at the time, that people at higher levels are too far away to really understand his immediate tactical situation, and several such disappointments may convince him that the close-air-support mission is poorly conducted in this particular war. As a British Air Marshal said:

> "*** there is not just one soldier asking for help and demanding attack on targets. There will be dozens, probably hundreds of them; and there will never be enough aircraft to allow engagement of all the targets nominated. There will always be disappointed customers, so it is essential that there is some form of adjudicatory system to allot priorities as between the importance and urgency of the targets submitted for attack."

There are fewer complaints heard from Marine Corps ground commanders about the quality of the air support given them. One reason is that traditionally close air support is very much a speciality of the Marine Corps. We are not aware of any dissatisfaction within the Marine Corps about the quality of the air support provided or within the Army about its own helicopter support, but, if there is, it remains submerged within the services. But, when the support is interservice, the grievances are likely to surface, loud and clear. This public airing may well be one of the benefits of interservice rivalry whose manifestations often keep the rivals "on the ball," as it were.