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TECHNOLOGY TO ENHANCE SPECIAL OPERATIONS FORCES

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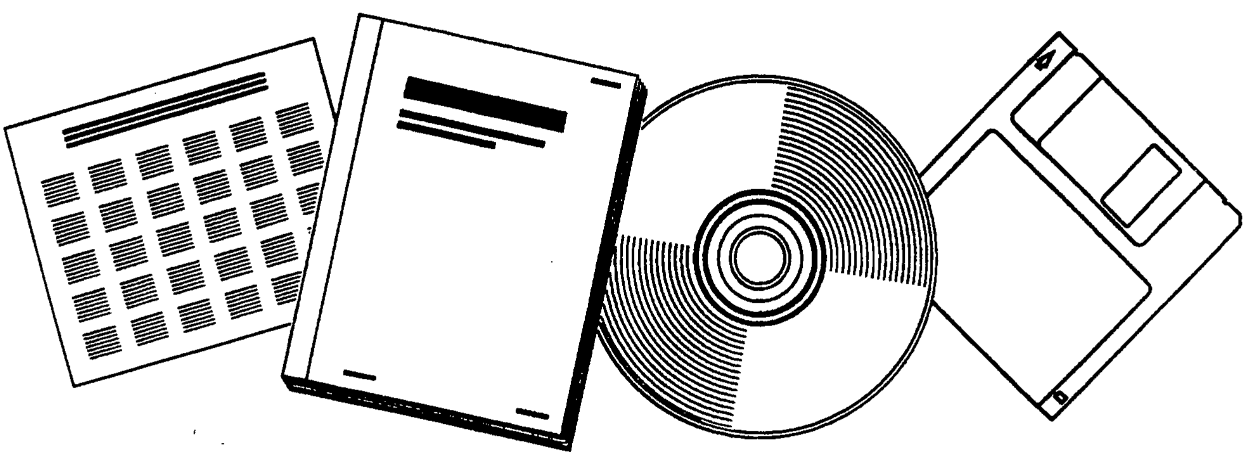

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Special operations forces, though small in number relative to conventional forces, offer national utility along the full spectrum of conflict. Army, Navy, and Air Force special operations forces conduct military missions such as conterterrorism, hostage rescue, humanitarian assistance, foreign internal defense, counterinsurgency, stability operations, unconventional warfare, and direct support to conventional forces. Technology requirements for special operations forces flow from the need to satisfy the missions assigned to these forces. This report focuses primarily, but not exclusively, on Air Force missions and technology requirements.

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TECHNOLOGY TO ENHANCE
SPECIAL OPERATIONS FORCES

Committee on Technology to Enhance
Special Operations Forces
Air Force Studies Board
Division of Military Science and Technology
Commission on Engineering and Technical Systems
National Research Council

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List of Acronyms

AFMC	Air Force Materiel Command
AFSOC	Air Force Special Operations Command
SOCRATES	Special Operations Command Research, Analysis, and Threat Evaluation System
SOF	special operations forces
TENCAP	Tactical Exploitation of National Capabilities
TF/TA	Terrain Following/Terrain Avoidance
USCINCSOC	Commander in Chief, US Special Operations Command
USSOCOM	United States Special Operations Command

Executive Summary

Special operations forces, though small in number relative to conventional forces, offer national utility along the full spectrum of conflict. Army, Navy, and Air Force special operations forces conduct military missions such as counterterrorism, hostage rescue, humanitarian assistance, foreign internal defense, counterinsurgency, stability operations, unconventional warfare, and direct support to conventional forces. Technology requirements for special operations forces flow from the need to satisfy the missions assigned to these forces. This report focuses primarily, but not exclusively, on Air Force missions and technology requirements.

The effectiveness of special operations forces depend on superior training, tactics, and equipment. In order to enhance the capability of U.S. special operations forces, particularly the Air Force component, the Commander, Air Force Systems Command (now Air Force Materiel Command), requested that the Air Force Studies Board examine and evaluate the technology requirements for special operations forces, and propose methods to enhance the process[1] of addressing these technology areas in order to effectively field equipment for such forces. In response to this request, the Committee on Technology for Special Operations Forces/Low Intensity Conflict was formed to carry out the following tasks:

- Examine the special operations forces/low intensity conflict technology requirements.
- Evaluate the state of the art in applicable areas in Air Force technology programs.
- Identify deficiencies and opportunities in these technology areas for application to special operations forces/low intensity conflict.
- Propose methods to address these deficiencies and opportunities.

The committee, with the sponsor's concurrence, determined that limiting the study to the low-intensity end of the spectrum of conflict was short sighted and

[1] At the initiation of this study, the sponsor clarified his objective saying he did not want a lengthy list of technologies to pursue but needed instead to improve the *process* of Air Force technology application to SOF problems in the areas of greatest need.

agreed to look at technologies and processes that support Air Force special operations forces across the full spectrum of conflict.

TECHNOLOGY REQUIREMENTS

Air Force Special Operations Command (AFSOC) technology needs are derived from its mission, which is to organize, train, equip, and maintain special operations forces for worldwide assignment to unified commands. Two fundamental requirements of Air Force special operations forces are (1) to air deliver and extract people and equipment while maintaining the element of surprise and (2) to provide armed reconnaissance and fire support, primarily with the AC-130 gunship aircraft. To effectively fulfill these tasks, AFSOC depends on aircraft and helicopters specially equipped with sophisticated fire-control, communication, and navigation systems.

Requirements and Problems

The committee examined and identified several technological opportunities that complement the AFSOC mission. These include, but are not limited to, low-altitude terrain-following/terrain-avoidance navigational systems, aircraft signature reduction, covert communications, advanced simulation techniques, and technologies associated with the acquisition of new special operations forces (SOF) platforms.

There is considerable concern about the terrain-following/terrain-avoidance (TF/TA) systems on current aircraft, primarily because these systems require active radar emissions that are vulnerable to detection and tracking by hostile forces.

The large radar cross section of most SOF aircraft poses another difficulty, even though it can sometimes be alleviated by electronic countermeasures or masking the aircraft behind prominent terrain features. A related, but separate, problem is that the expected proliferation of sophisticated anti-aircraft systems, particularly surface-to-air missiles, will further limit SOF aircraft utility unless redressed by technological advances and tactics.

SOF communication requirements place almost contradictory demands on communications technology. Voice and data volume and frequency of transmission increase simultaneously with the need to reduce the risk of detection. There is an increasing need to exchange near real-time intelligence, warning, and command-and-control information while remaining undetected—yet communicating increases the risk of detection by hostile forces. These demands pose serious challenges to those who must develop, acquire, and employ communication equipment.

With respect to possible new aircraft, the AC-130 gunship will be increasingly vulnerable to the predicted proliferation of advanced anti-aircraft weapons. Imaginative technological and tactical responses are needed to retain its present capability to support special operations forces. Otherwise it will be relegated to the least threatening operational environments. There are conflicting opinions whether or not a CV-22 (a proposed variant of the V-22 "Osprey") can satisfy SOF needs. The committee believes that, even if the CV-22 can provide some interim capabilities not now available, the need for a future low-observable aircraft has not diminished, and AFSOC and U.S. Special Operations Command (USSOCOM) should provide for this need in their long-range plans. Although it is not feasible for USSOCOM to fund a tactical transport with all desired characteristics (payload, full vertical operations, stealthy signature), a combination of reduced requirements and complementary technology insertion could combine to achieve an affordable system.

Similarities Between Special Operations Requirements and Conventional Requirements

The committee believes there is considerable commonality between special operations requirements and conventional requirements and the technology programs that can help satisfy them. Technologies that would enhance survivability of SOF aircraft may be readily adaptable to transport aircraft of the Air Mobility Command and tactical fighters of the Air Combat Command. This commonality should encourage deeper Air Force involvement in formulating and satisfying AFSOC/USSOCOM requirements.[2]

REQUIREMENTS PROCESS

Congress granted the Commander in Chief, U.S. Special Operations Command, (USCINCSOC) head-of-agency acquisition authority, which gave him service-like authority for science and technology development and system acquisition. USSOCOM also has agreements with the services on how they will cooperate to assure SOF readiness. USSOCOM works with AFSOC but lacks formal relationships with the Air Force Materiel Command (AFMC).

Unified Commanders and the Joint Special Operations Command have an important influence on special operations requirements. Their requirements and

[2] The committee recognizes that, while there may be common needs, in reality there will often be considerable differences in priorities. Technologies, even those with common benefits, may be so low on other major commands' priority lists that they do not make the Air Force technology funding cut—even though they are *not* "special-forces peculiar."

analysis planning focuses primarily on the short- to mid-term, resulting in little emphasis on long-range technology needs.

AFSOC submits special operations unique requirements to USSOCOM for approval; those that have general application (i.e., that are non SOF unique) go to the Air Force to compete for funding.

Major Force Program-11 Implications

Major Force Program-11 is the unique funding category that accompanied the formation of USSOCOM. It provides specified funds for missions, force capabilities, and readiness for special operations—similar to the way funds are provided for each service. Congressional intent was to assure that USSOCOM had resources to meet its responsibilities.

The services can apply the label "special-forces peculiar" to proposed budget items and request that they be funded by USSOCOM's limited budget. Congress itself has removed items (and funds) from service budget submissions by applying the same label, but Major Force Program-11 is not large enough to afford a research, development, test and evaluation budget adequate for all SOF technology requirements, and USSOCOM still depends on the services. USSOCOM cannot afford major items (e.g., aircraft development) and does not appear to have significant leverage in service programs.

There is little likelihood that the basic legislation will be changed. Thus, a special effort by the commanders of USSOCOM and AFMC will be necessary to coordinate and jointly support common-interest science and technology programs before the Congress.

Establishment of Requirements

USSOCOM components establish requirements lists that are prioritized; validated; approved by USCINCSOC, and incorporated in the Major Force Program-11 Research, Development, and Acquisition program. The process is necessarily complex and could benefit from support from interactive engagement and force modeling and from systematic collection and analysis of actual operational data.

USSOCOM's top priority requirements for Air Force technology were identified from the Advanced Technology Transition Demonstrations and critical experiment ratings, which presumably flowed from USSOCOM's estimates of its most pressing needs. The highest-rated programs appeared to fill valid near-term requirements; however, the committee observed neither prioritized long-term requirements, nor a system to establish them.

For example, it is possible that USSOCOM and AFSOC have no long-term communications requirements. However, given the extensive communications work underway in the Air Force, it is likely that there are technologies and programs with SOF utility. Two specific examples that the committee noticed were aircraft-to-aircraft wideband covert communications and wideband video direct to aircraft cockpit. While USSOCOM is funding the Joint Advanced Special Operations Radio System, there is still a dearth of long-term vision for its more specialized future needs.

The committee found the USSOCOM requirements section competent but inadequately staffed. At both USSOCOM and AFSOC, very small staffs were devoted to establishing requirements, and neither command had a chief scientist—someone with recognized ties into the high-technology community network. Both USSOCOM and component headquarters could profit from better sources of technological advice—perhaps available in the form of a resident group of science advisors.

The committee believes that a lack of adequate ties with the Air Force technology community is detrimental to special-operations capabilities.

LINKAGE WITH AIR FORCE TECHNOLOGY

The committee is convinced of the following: (1) that SOF and conventional forces requirements have much in common, (2) that one unintended result of the creation of USSOCOM was a separation of special operations from the services' robust technological resources, and (3) that both the Air Force's technology management process and specific technologies have considerable potential to benefit SOF users—particularly in the long term.

USSOCOM lacks the management, budget, and infrastructure that supports Air Force research and development. It appears also that AFSOC, although designated a major command, lacks the influence of the established major commands such as Air Combat Command or Air Mobility Command. The committee believes that USCINCSOC's direct involvement in the technology resource and allocation process, along with improved tools to measure effectiveness, could result in greater attention being paid to AFSOC/USSOCOM inputs. With improved coordination and cooperation, USSOCOM could take better advantage of Air Force technology opportunities.

The committee did not conduct an exhaustive examination of Air Force Technologies with SOF potential; however, there were several technologies that seemed to be readily applicable.

Simulation technologies now offer powerful opportunities by improving long-term perspective for the staffs that generate requirements and plan technology. These technologies also provide additional options for short-term tasks. Just a few of the existing opportunities are those to simulate specific threats, operational missions, and force-level exercises. Air Force and other Department of Defense facilities offer a broad range of options to evaluate people, units, technologies, and systems for special operations forces.

The committee believes it would be highly useful for the Air Force to make existing simulations available to AFSOC and USSOCOM and to actively participate in the simulations with them. This would help provide an operationally oriented perspective for discerning future needs, evaluating technological opportunities, and establishing technology requirements.

Space exploitation offers a range of extremely useful technologies—communications, remote sensing, precision navigation, mapping, reconnaissance, and surveillance—to improve SOF capabilities. The Air Force is uniquely qualified in the development and operation of such systems, which offer opportunities for cooperation and mutual benefit with USSOCOM.

The U.S. advantage in *night vision equipment*, vital to SOF operations, is being eroded as potential adversaries acquire similar devices. The committee believes the solution, in addition to enhancing current sytems, is three-fold: (1) exploit weather as well as darkness by developing weather-penetrating systems (based on, for example, millimeter-wave technology); (2) reduce the effectiveness of the adversary's systems by passive signature reduction of U.S. forces; and (3) use active systems against the adversary's night vision equipment.

CONCLUSIONS AND RECOMMENDATIONS

The committee observed that USSOCOM, by tradition, necessity, or a combination of both, has adopted a near-term horizon for its equipment acquisitions. Because of this, it has been unable to take full advantage of advanced technologies that could help assure future successes. The committee concludes that there are significant opportunities available in Air Force technology programs and processes that complement SOF requirements and that have great potential to enhance future SOF capabilities.

Finding 1: The committee found that the creation of a separate research, development, test and evaluation funding provision for USSOCOM resulted, contrary to the likely intent of Congress, in separating special operations from the robust technological resources available to the services. A major opportunity exists for the Air Force, with its progressive, long-range planning orientation and developed management tools, to help provide USSOCOM the necessary perspective to better invest in leveraged technologies for future SOF weapons systems. These assets could help USSOCOM and AFSOC define their future technology needs and provide, over time, the technological foundation to meet those needs. The committee further concludes that the current process (which does not directly link AFMC and USSOCOM) is not working. Therefore, a new process is needed.

Recommendation 1: The Commander, AFMC, with concurrence from the Air Force Chief of Staff and Air Force Acquisition Executive, should work directly with USCINCSOC, to establish a new process to ensure that future SOF technology needs can be defined and satisfied. To accomplish this, the following should be considered:

- The Air Force process, by which the investment priority for all technology projects is established, should be modified. The modification would explicitly reveal the relationship of the Air Force process to the USSOCOM priorities so that the Air Force Technology Executive Officer and Air Force Acquisition Executive can better account for SOF needs in their resource allocation decisions.
- The technology program management process, as it relates to AFSOC, and through AFSOC to USSOCOM, should be reviewed and strengthened. It may prove desirable to place an AFMC liaison group directly into USSOCOM headquarters for coordination. Also, joint actions to achieve congressional support for resulting programs should be raised to a high level of management.

Finding 2: The Air Force is in a strong position to provide greatly increased technology-planning perspectives to USSOCOM because of the capability it has for conducting simulations under alternative conditions and technology. Through hands-on simulations, operationally oriented personnel best gain the perspective needed to make good investment decisions and to better balance long-term opportunities available through technology (as opposed to short-term operational demands).

Recommendation 2: Current and planned technologies and facilities should be examined and partnerships selectively formed at appropriate levels to enable a full range of simulation options. This examination and partnership should not be restricted exclusively to Air Force holdings but should cross service and agency boundaries where necessary. The capabilities sought should range from specific technology evaluation to joint, large-scale rehearsal opportunities at all points along the spectrum of conflict.

Finding 3: The AC-130 gunships will, over the next decade, become increasingly vulnerable and therefore less effective. Without special attention and the application of new technology, their ability to support special operations (and conventional) forces will deteriorate. More incidents like the loss of an AC-130 gunship in the Persian Gulf war can be anticipated. Because of the vulnerability of these gunships, special operations forces will, by stages, lose the fire support of this pivotal system.

Recommendation 3: The Air Force should set up a process by which SOF projects could increasingly be aimed at correcting the AC-130 vulnerability issue. In particular, new electronic and optical countermeasures, as well as the protection afforded by standoff (precision-guided) weapons, should be considered to defeat the threat. Potentially useful future technologies (e.g., directed energy and electric gun technology) should be continually assessed for applicability.

Finding 4: The committee, which believes that the mechanical configuration and large rotors of the CV-22s would make it equally detectable as current program aircraft, holds the view that, in the longer term, a "CV-22-like" aircraft may not meet the most demanding mission needs. Instead of investing in improving the CV-22, efforts should be focused on making special-operations aircraft less detectable.

Recommendation 4: The committee strongly recommends that USSOCOM/AFSOC, in conjunction with the U.S. Air Force, include in their long-range plans a low-signature aircraft capable of both delivery and extraction of special-operations personnel. Technologies should be focused on low-signature aircraft structure and materials, as well as passive navigation systems. Advanced short take-off and vertical landing technologies (such as gas-driven propulsive-engine lift concepts) should be developed. The emphasis should be on acquiring a capability to operate undetected at higher (safer) altitudes at night and in varied weather and at higher speeds than are now possible with present rotor-type aircraft. This is an area where it is beneficial to both USSOCOM and AFSOC to develop significant joint capabilities and determine the technology plans to provide these capabilities.

Finding 5: The overwhelming advantage held by U.S. special operations forces in the past, much of which was due to their unique and pervasive use of night vision equipment and extensive night operations, will likely fade in this decade.

Recommendation 5: A broad element of technology planning should be initiated to counteract the likely downward trend in night vision advantage. Measures that should be considered are use of weather in addition to darkness as concealment, passive signature reduction of U.S. forces, and active countermeasures against enemy use of night vision equipment.

Finding 6: Space technology can be foreseen to have dramatically increasing significance and new potentials for both special operations and Air Force capabilities.

Recommendation 6: Although the development of space systems is clearly beyond the current capabilities or assets of USSOCOM or AFSOC, a concerted effort to define and influence space technology, hardware, and supporting terrestrial equipment on behalf of special operations forces is in order. This is an area where it is mutually beneficial to USSOCOM, AFSOC, and the other Air Force commands to define the joint capabilities provided by advanced systems and to determine the technology road maps by which to provide these capabilities.

1

Introduction

BACKGROUND

Special operations and the forces specifically designated to conduct such operations are an integral part of U.S. national security policy and strategy. The roles and missions of special operations forces are established not only by military policy and doctrine but are also codified in federal law. Simply stated, the U.S. military structure consists of ground, naval, air, and special operations forces.

Special operations differ from conventional operations. They have unique characteristics and often occur in operational environments ill-suited for conventional military operations. Likewise, the design and execution of special operations may dictate different applications of the principles of war. These operations usually differ from conventional operations in their degree of risk, operational techniques, mode of employment, relative independence from friendly support, and dependence upon operational intelligence and indigenous assets.

Special operations have been a part of the military heritage of the United States since the Revolutionary War—perhaps "Roger's Rangers" were the genesis of this country's special operations force (SOF) lineage. In modern military history, the U.S. Army Rangers, Merrill's Marauders, and the Office of Strategic Services of World War II are well-known special operations forces. The Vietnam War brought prominence to the Army Special Forces, Navy SEALs and Air Force Air Commandos. The lineage and legacy of these forces continues into the special operation forces that are now a part of the U.S. military structure. Special operations forces played a major role in military operations in Grenada, Panama, the Persian Gulf, and Somalia. Today there are special operations forces employed worldwide. They are engaged in activities ranging from relief operations for the Kurds in northern Iraq to training indigenous counter-drug forces in Peru. Special operations forces provide the United States with options and opportunities to respond to international crises at a reasonable cost and risk to U.S. interests.

Special operations are generally categorized as the following:

- unconventional warfare (e.g., guerilla/partisan warfare, underground activities);
- direct action (e.g., raids, "surgical" strikes, sabotage);
- foreign internal defense (e.g., stability operations, counter-insurgency);
- special reconnaissance (e.g., target acquisition, area assessment, and post-strike battle damage assessment);
- counterterrorism (e.g., hostage rescue, recovery of sensitive material, attack on terrorist infrastructure);
- civil affairs (e.g., humanitarian assistance); and
- psychological operations (e.g., inducing an enemy to surrender, creating a favorable image of U.S. forces)

In 1987, the U.S. Special Operations Command (USSOCOM) was established as a unified command to provide the structure and the command and control necessary to ensure that special operations forces were fully capable and ready to conduct special operations missions. The special operations force of each service is under the operational control of USSOCOM. These forces are designated as Army Special Operations Command, Naval Special Warfare Command, and Air Force Special Operations Command (AFSOC). The Joint Special Operations Command is also assigned to the USSOCOM. USSOCOM prepares these forces to conduct special operations in support of a contingency under the direction of a unified combatant command like the European Command, Atlantic Command, Pacific Command, or Central Command. Also, USSOCOM, at the direction of the President, may plan and execute special operations.[1]

To better accomplish the mission of preparing special operations forces for their assigned missions, Congress gave USSOCOM the authority to develop and execute its own program and budget—an authority granted to no other joint command. This authority covers research and development as well as procurement. To implement the acquisition aspects of this authority, USSOCOM has established the Special Operations Research, Development and Acquisition Center and appointed a civilian acquisition deputy to USCINCSOC. These entities, as well as the requirements development process, have significant implications on the subject of this study: technology to enhance special operations forces.

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[1] USCINCSOC can be more than a provisioner of forces. The President, through the Secretary of Defense and the Chairman, Joint Chiefs of Staff, may direct USCINCOC to conduct independent operations in the designated operating area of any unified command.

STATEMENT OF TASK

The Commander, Air Force Systems Command, now Air Force Materiel Command (AFMC), requested that the Air Force Studies Board of the National Research Council form a committee to:

- examine the technology requirements process for special operations forces/low intensity conflict;[2]
- evaluate the state of the art in applicable areas of Air Force technology programs;
- identify deficiencies and opportunities in these technology areas for application to special operations forces; and
- propose methods to address these deficiencies and opportunities.

Two overall objectives of this study were prescribed at its outset:

1. to examine and evaluate the *technology requirements* for special operations forces; and
2. to propose methods to enhance the *process*[3] of addressing these technology areas in effectively fielding equipment for special operations forces.

The Committee on Technology to Enhance Special Operations Forces was formed to conduct this study on Air Force special operations forces. It first met in June 1991 in Washington, D.C. Subsequent meetings included discussions with commanders and representatives of USSOCOM and AFSOC and a cross-section of other Department of Defense personnel involved in special forces operations and technology development. (See Appendix A for complete list of meetings.)

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[2] At the outset of this study the committee questioned the combination of the term "special operations forces" with "low-intensity conflict". Special operations forces refers to specially trained military forces, whereas low-intensity conflict applies to a segment at the lower end of the spectrum of conflict. In initial discussions with the sponsor, the committee determined that this report should *not* artificially restrict consideration of special operation forces to the low-intensity end of this spectrum. SOF responsibilities and their requisite technologies span the entire spectrum—from peacetime to full-scale nuclear conflict. Therefore the committee agreed to eliminate this restriction and deal with the full range of special-forces requirements.

[3] The Commander, AFMC, addressed the committee chairman early in the study and asked that the committee emphasize mission needs and *Air Force processes* for selecting research priorities. This discussion clearly deemphasized providing "lists of technologies." AFMC's primary objective was for recommendations on how the process could be improved to meet Air Force mission needs. This guidance is reflected in this report.

2

Technology Requirements

MISSION NEEDS

Technology requirements for special operations forces flow from the need to satisfy the missions assigned to these forces. This report focuses primarily on Air Force missions and technology requirements. Hence a closer look at AFSOC's mission is in order.

AFSOC's mission is to organize, train, equip, administer, and maintain Air Force special operations forces for worldwide deployment and assignment to unified commands. These forces would conduct all categories of special operations noted in Chapter 1, from unconventional warfare and special reconnaissance to counterterrorism and psychological operations.

Many AFSOC missions require the capability to deliver and extract forces while avoiding detection. It is not enough for the aircraft to survive; they must be able to penetrate and extract from the objective area while maintaining the element of surprise for the forces they deliver and otherwise support.

There are a number of technological opportunities important to the future capabilities of SOF aircraft. Some apply to enhancing current capability, such as those that enable terrain-following or terrain-avoidance at low altitudes, survival in the face of formidable anti-air threats, covert communication and aircraft signature reduction to avoid detection, and accurate navigation to reach a desired location. Other technologies would be more applicable to acquiring new platforms for special operations. Representative technology requirements, problems associated with them, and their similarities to some foreseeable needs of conventional forces are discussed below.

REQUIREMENTS AND PROBLEMS

Special Operations And Systems

SOF aviation includes both Air Force and Army fixed-wing and rotary-wing assets. The Air Force special operations aircraft program is intended to provide a mobility force consisting primarily of AC-130, MC-130, and HC-130 aircraft, plus MH-53 and MH-60 helicopters. The AC-130 Spectre aircraft are essential components of the program, providing close air support, armed reconnaissance, and independent surgical strike capabilities.

Other Air Force aircraft, such as the C-141, C-5, KC-135, and KC-10, although not permanently attached to SOF units, provide essential transport and air-refueling support. EC-130, RC-135, EA-3, and EF-111 aircraft are additional examples of Air Force assets that provide specialized support to special operations forces but are not assigned to AFSOC.

AFSOC fixed-wing aircraft and helicopters have been specifically adapted for special operations and are capable of all-weather operations. They were chosen for their relatively high payloads and long ranges, particularly their ranges at low altitudes. They must penetrate air defenses without being detected and tracked. To do this, they depend on air worthiness in very low level flight and on active radar systems that permit terrain- following/terrain-avoidance (TF/TA) flight along routes selected to mask the aircraft from hostile radars.

The committee was informed that there are grounds for considerable concern centering on the TF/TA systems. The concern involves both the aircraft now in squadrons and those being delivered. The primary problem is that the TF/TA radars' emissions are too vulnerable to detection and tracking by hostile passive systems; another is that the systems, although improving, still do not fully meet desired performance goals.

An additional problem is that the tactic of terrain masking is obviously ineffective over flat areas (such was the case in much of Iraq and Kuwait), where aircraft with large radar cross-sections can be detected at long range by hostile radar systems. It is probably impractical to reduce the radar cross-sections of current special operations aircraft sufficiently to avoid detection in areas with little terrain relief. The operational utility of current aircraft is therefore dependent on (1) the ability to employ terrain masking and (2) the availability of reasonably capable search radars in the regions and nations where special operations might be conducted. Where such radars are present, and the tactic of terrain masking is infeasible, mission capability will be severely reduced.

Electronic countermeasures, provided primarily by other than special operations forces, may in some circumstances redress the vulnerability of the special operations aircraft. There are, however, limits to the efficacy of jamming and other forms of electronic countermeasures. Eventually the intrinsic problem of the large radar cross-sections of existing primary special operations aircraft will probably have to be solved by redirecting USSOCOM's future- aircraft program. This program will be discussed later in this chapter.

A related, but separate, problem is vulnerability of special operations aircraft, once detected, to surface-to-air missiles. It is reasonable to expect a proliferation of effective tactical surface-to-air missiles in many of the regions and nations in which special operations aircraft may be employed. There is a question of whether self-defense measures of special operations aircraft have kept or will keep ahead of the threat.[1] (This problem applies to the insertion and extraction aircraft mentioned above, but it may apply even more forcefully to the AC-130 gunship, which will be discussed later.)

The expected high end of the air defense spectrum will increasingly restrict the access of current special operations aircraft. Adding defensive avionics will extend the viability of current aircraft for a period of time, but the committee is not aware of defensive avionics capabilities that are sufficiently robust to provide adequate confidence of survival in some expected SOF missions.

Air Force special operations and conventional missions establish a substantial set of requirements on communications systems. A few examples of the capabilities the systems require might include reconnaissance and situation reporting, requests for fire support, coordinating resupply, force extraction, and intelligence updating. Some specific functions may be sensitive to the special operations forces.

Some of the requirements are contradictory in nature, which leads to problems and intricate technology issues. For instance, special operations include clandestine missions, and communications are inherently antithetical to clandestine operations. Given a choice, special operations forces would simply not communicate. However, special operations also include missions that involve precise navigation to avoid threats and accomplish successful insertion or extraction on a first pass, at night, and in adverse weather. As concepts and tactics for the conduct of these missions are developed, requirements emerge for near-real-time situation data, real-time threat data, the means to communicate the data, and the in-flight means to coordinate with other units and take advantage of the data (e.g., regarding alternate flight paths). There is also the need to communicate some of this information between force elements in the course of operations—all this needs to be done while remaining undetected. Measurably improving the probability of success requires combining imaginative tactics and innovative technologies.

This highly stressing environment leads to requirements for communications equipment that include, among other things, low probability of intercept and detection; jam resistance; service interoperability (and sometimes compatibility

[1] There are currently large differences in air defense capabilities in the various areas where SOF aircraft may be required to operate. Responsible planning must consider the high end of the threat spectrum (e.g., densities equal to or greater than that found in Iraq, with continuing modernization of equipment to approach the capability represented in the former Soviet Union).

with allied nations); real-time surveillance, intelligence (e.g., threat-warning information), terrain elevation, and navigational data; night capabilites; cold, hot, and foul weather capabilities; simple, modular, rugged, reliable, and maintainable hardware; and lightweight and microsized equipment. This list, though not a complete inventory, is representative of the challenges to the development and acquisition process and to operations.

New Platforms

When the committee asked the USSOCOM what its requirements were for delivery and extraction of SOF units, the response was that, in addition to the array of aircraft being acquired in the current program for the AFSOC and the Army Special Operations Aviation Brigade, only a "CV-22[2]-like" aircraft with vertical takeoff and landing was needed. The CV-22-like aircraft would, the committee was told, extend the effective range at which SOF ground units could be inserted and extracted. Responses emphasized an aircraft with "some of the desirable characteristics of the CV-22," but not necessarily the CV-22 itself, as there was concern about final range, payload, and survivability of this particular aircraft when and if its development is completed. The committee was not made aware of any analysis of the essential vulnerabilities or the survivability of the CV-22 in future threat environments; however, it was clear that there was concern at the operational level about detection and survivability in the future.

The helicopters now in inventory or being procured are air-refuelable and therefore capable of flying very long distances. However, because of relatively low speeds, their effective ranges on insertion and extraction flights into heavily defended territory are frequently constrained by the hours of available darkness. (Daylight flights are not considered survivable in well-defended airspace—this will be addressed later in this report.) In principle, a CV-22-like aircraft that is twice as fast as the helicopters would have almost twice their effective range (i.e., during a given period of darkness). Such capability (to complete flights in defended airspace during limited hours of darkness) would be less important at the lower end of the special forces' operating spectrum when operations are taking place over lightly defended territory, but it is critical at the high end.

The committee was also informed that the CV-22's range is likely to be so shortened and its speed so reduced by the weight and drag of additional essential special operations systems—such as the electronic warfare suite, guns, and defensive missiles—that its specified operating radius will not be met. The payload-range problem will be exacerbated if the special operations requirements

[2] The CV-22 is a proposed SOF derivative of the controversial V-22 "Osprey" program, which has been terminated and resuscitated repeatedly. It is a twin-engine aircraft with characteristics of both a helicopter (vertical takeoff and landing) and fixed-wing aircraft (300 mph cruising speed and long range).

expand to include transportation of a ground vehicle. Experience in Operation Desert Storm demonstrated the value of ground vehicles to special operations forces operating behind enemy lines, but transportation of such vehicles was not included in the CV-22's original specifications.

While the CV-22's speed, equating to additional effective range, is a valuable characteristic, it would still share a problem common to all the special operations tactical aircraft currently being acquired. They are all potentially so highly detectable by radar that, unless modified substantially, their operational viability for many missions may not last far beyond the mid-1990s. The CV-22's overall configuration and large rotors add considerably to its detectability and will require continuation of the very low level, night flying tactics now used by Air Force special operations forces to avoid detection. Such missions become even more hazardous at the higher airspeeds necessary to avoid detection, interception, and engagement.

Over the longer term, a completely new special operations platform could offer improved performance and signature reduction. For example, there might be a future requirement to develop stealth aircraft for special operations. However, the major acquisition problem is cost. Without sizeable increases in funding, USSOCOM cannot afford the development and production of a stealth tactical transport that has size and ruggedness comparable with the C-130, H-53, and H-60 variants in the current program. But if some requirements (such as payload, completely vertical takeoff, and the degree of signature reduction) can be relaxed, and if robust countermeasures can be installed, then a sufficient degree of stealth might be affordably achieved. Even a 20–30-dB improvement can make a considerable difference in detection range. Incremental reductions of aural and visual signatures can also make an important contribution toward minimizing detectability. Development of requirements that are affordable will require a series of trade studies specific to SOF missions. Since the special operations forces can often pick the time of the mission and carefully plan the ingress and egress routes, there is often more flexibility available than is common for general purpose forces. This flexibility must be explicitly considered when trading combinations of reduced observables (radar, infrared, visual, and emissions—both acoustic and radio frequency), active countermeasures, decoys (there is excellent potential here for SOF missions), and penetration tactics.

The committee believes that the affordability of a new platform acquisition for USSOCOM has been an issue in the past and is likely to remain an issue for the foreseeable future. However, some of the illustrated performance improvements could also apply to other, non-SOF, Air Force mobility needs. (The committee will elaborate on this point later in the report.) The committee believes that, while the CV-22 may provide some interim capabilities not now available, the need for a future low-observable/improved-performance aircraft has not diminished. AFSOC and USSOCOM should provide for such an aircraft in their long-range plans. These plans should be based on the results of trade-offs described earlier, with emphasis on technology demonstrators to assess feasibility before committing to major engineering, manufacturing, and development efforts.

Gunship Vulnerability

The loss of an AC-130 in the Persian Gulf war did not occur in the performance of a special operations mission. Nevertheless, it underscores the problem of the AC-130's present and future vulnerability in its primary mission of close air support for special operations forces on the ground (e.g., forces in operations similar to those in Panama [1989] and Grenada [1983]).

The AC-130 gunship aircraft must be ready for use in increasingly complex scenarios. The future environment could reasonably include an enemy equipped with excellent night vision equipment, anti-aircraft batteries, and surface-to-air missile threats, as well as possible helicopter and airborne interceptors.[3] These realistic possibilities suggest the need to consider increased standoff range and effective threat warning and countermeasures for the AC-130 while minimizing both target engagement and threat exposure times. Good tactics are an essential element of the survivability equation, but they must be complemented by the imaginative use of technology, e.g., standoff precision-guided munitions, longer-range direct-fire weapons such as electric cannon, improved target acquisition systems, low-probability-of-intercept/detection communications gear, and real-time intelligence and planning capabilities. Otherwise, the usefulness of the AC-130 (and other special operations aircraft) may be short-lived or limited to relatively benign environments—leaving decision makers with fewer options at the higher-risk points along the spectrum of conflict.

SIMILARITIES BETWEEN SPECIAL OPERATIONS AND CONVENTIONAL REQUIREMENTS

At first, the committee believed that Air Force special operations forces might require, or could only benefit from, a number of unique technologies with unique applications. However, after extensive discussions with AFSOC, USSOCOM, and AFMC officials, the committee came to believe that many technologies could assist both special operations forces and conventional forces.

[3] The general concept for gunship operations from the time of the Vietnam war to the recent past has been that they have operated where total air supremacy is in force. In addition, intelligence has been expected to supply the locations and engagement envelopes of both anti-aircraft batteries and surface-to-air missile threats. These conditions have alleviated the AC-130's inherent vulnerability due to its size, slowness, and tactics of loitering for extended periods in a limited area. However, even with total air supremacy, which may not be achievable under certain conditions, the increasing availability of more modern and effective shoulder-fired surface-to-air missiles can limit the AC-130's fire-support potential. Also, intelligence-supplied threat-location data has been inadequate in many cases.

Clearly, there may be financial, technical, or training reasons why only special operations forces are able to take practical advantage of some new technological opportunities.[4] Nevertheless, where there is viable commonality, it should be better exploited.

Although there are important variations in specific assignments, special operations and conventional forces often contend with similar threats and operational imperatives. The value each places on certain characteristics will influence the judgements made on cost versus effectiveness. Yet reducing the probability of detection/interception of friendly communications could be useful to both. Both special and conventional forces could profit considerably from technology that provides secure, low-probability-of-intercept/detection communication equipment. Other similarities are shown in the following comparison of requirements in two important areas: (1) insertion and extraction of forces through denied air space and (2) protection of close air-support aircraft from anti-air weapons.

Insertion and Extraction of Forces Through Denied Airspace

Air Force special operations forces have an established requirement to penetrate anti-air defenses in order to deliver or extract ground forces. This requirement goes beyond ensuring survivability to preventing detection of the flights and compromise of sensitive operations.

Such operations have long depended on low-level, TF/TA flight, making maximum use of terrain masking to avoid search, acquisition, and fire-control radars. But, as discussed previously, the TF/TA systems employing radars and other emitters are themselves increasingly detectable by passive systems. There is need to reduce the risk of TF/TA emitters being detected and used to track special operations aircraft. Combined Global Positioning System/inertial navigation technology is one example which appears to offer opportunities.

On the conventional forces side, there appear to be circumstances in which general airlift will profit from similar (if not identical) systems. It seems likely that future operations by conventional forces (such as elements of tactical airlift

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[4]All forces would like, and many could use, equipment that offers markedly improved performance. The difference is that conventional forces may find certain technologies too expensive, too complex, or not available in needed quantities, especially in the early stages of development, whereas special operations forces may overcome these constraints more readily. Equipping relatively small, highly trained special operations force with such technologies enables these units to apply force in a highly leveraged manner. These high-leverage opportunities can arise at any point along the spectrum of conflict. It is here that the special operators' combination of skills, tactics, and technologies can be employed most effectively. Also, employment of advanced technologies with special operations forces can be viewed as a relatively inexpensive, small-scale operational test. When feasible, appropriate items could then transition to the larger, conventional forces.

units) may require flight profiles and aircraft defensive measures that, until recently, have been almost exclusively used by special operations forces. This will be particularly true if state-of-the-art aircraft detection and anti-aircraft weapon technology from the former Soviet bloc becomes readily available at bargain prices—a predicted trend.

The difference between SOF and conventional technology requirements for undetected insertion and extraction capabilities seems to be one of timing and relative emphasis rather than one of content. The special operations requirement may have very high national political significance and therefore more immediacy. But in the near future, conventional mobility aircraft may need to apply similar characteristics, derived from the same technology.[5] At that point, special operations forces will probably be seeking and acquiring even more advanced technologies to maintain their qualitative edge and high-leverage capabilities in the projected operational environment.

Protection of Close-Support Aircraft

It is easy to foresee a number of future circumstances in which the AC-130's arsenal could not be used or could only be used with less freedom and flexibility than today. These restrictions reflect the balance between the sophistication of enemy air defenses and the AC-130's active and passive defensive systems. The risk to the AC-130 gunship (which traditionally remains over the target for extended periods of time) makes improved protection essential if this aircraft is to survive as the threat increases. Tactics, and the availability of adjunct support such as fighter escort, will remain essential parts of the equation.

Conventional close-air-support platforms face similar problems of vulnerability. It appears likely that the most frequent future employment of conventional forces will be in regional conflicts. In such conflicts, as in the Persian Gulf war, operational imperatives will include minimizing collateral damage, preventing noncombatant casualties, and avoiding mistaken attacks on friendly forces. (The difficulties of such operations will be exacerbated when they are conducted in built-up areas, as in Panama and Grenada.) These operational imperatives will tend to increase the vulnerability of conventional close-support aircraft because they will demand that aircraft spend more time over enemy forces potentially equipped with increasingly effective anti-air sensors and weapons. The

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[5] Here again, the committee recognizes that although the Air Mobility Command (AMC), for example, would benefit from low-probability-of-intercept (LPI) TF/TA technology development, it is not likely that they would rank it as high on their list of technology needs as would AFSOC. The problem is one of differing priorities for limited resources. There is also the difference of degree, with AFSOC requiring an LPI TF/TA capability which is more stressing that required by the AMC. One result is that AMC's priority for further technology development will drop before AFSOC's needs are met.

degree of difficulty, and risk, is scenario dependent; however, one previous advantage enjoyed by conventional support aircraft—minimum time in the target area—would be eroded under these conditions.

Thus, it is likely that AC-130s and conventional close-support aircraft will face similar threats. If they are to remain useful in the close-support role, both will require measures to reduce their vulnerability. Some, if not many, of these measures will be derived from the same core technology programs, which special operations forces could effectively pioneer.

Concluding Observations

In addition to the above specifics, there are other instances where AFSOC's technology requirements differ—if at all—only in degree and timing from those of the Air Mobility Command and the Air Combat Command. Enhanced pre-mission planning and situational awareness, which can be used to improve overall mission success; night vision devices that enable U.S. special forces to "own the night"; and other capabilities (e.g., communications, which have already been discussed) present technology requirements that have parallel needs to many foreseeable conventional Air Force missions. In short, although there are differences, technology needs driven by special operations requirements have the potential to prove equally useful to conventional forces. In fact, although there may be some technology requirements that are unique to special operations forces, the committee did not find any.

These findings suggested to the committee that, while there is not perfect congruency, there is considerable common ground between the requirements of special operations forces and those of conventional forces and among the technology programs that can help satisfy those requirements. This commonality was a central theme that the committee found during its visits, observations, and discussions throughout the study, and it was an important factor in leading the committee to encourage deeper Air Force involvement in formulation and satisfaction of AFSOC/USSOCOM requirements.

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Requirements Process

OVERVIEW

Public Law 100-180 gives USCINCSOC, authority to develop and acquire equipment, supplies, and services peculiar to special operations. The commander has acquisition authority similar to that of agencies such as the Army, Navy, or Air Force. In that capacity, USSOCOM has service-like authority for science and technology development and system acquisition. USCINCSOC executes this authority through his Deputy for Acquisitions and the Director, Special Operations Research and Development Acquisition Center; however, in most cases, and on larger programs, acquisitions of Air Force-type equipment are executed by the Air Force under agreements requested for each separate program and with oversight by USSOCOM. USCINCSOC's unique authority has distinct advantages and disadvantages.

USCINCSOC participates in the Defense Resources Board process, which also includes the major theater commanders and service chiefs. The commander and the services have concluded a series of agreements on how they will work together to provide special operations forces with the resources and support needed to ensure their readiness. The Committee on Technology for SOF/LIC noted that, in spite of these agreements, direct formal working relationships between AFMC and USCINCSOC headquarters did not exist. Instead, all science and technology, as well as acquisition, requirements are handled through AFSOC.

The relationship between USCINCSOC and the other heads of agencies (service secretaries and their acquisition executives) are delineated in the Department of Defense directives for acquisition. It is not clear that these "formal working relationships" need additional documentation. However, the committee believes that, within these formal guidelines, there are opportunities for developing more and better lines of communication between the users, those who define requirements, and those able to provide new technological options.

The needs of theater commanders-in-chief and the Commander, Joint Special Operations Command, determine special operations requirements. Their identification of requirements stems from joint mission analysis; from component or unit equipment shortfalls, exercises, and "lessons learned" analyses; from recognition of threat changes; and from recognized opportunities to enhance operational capability by advances in both tactics and technology. Their requirements analyses and planning focus primarily on the short-term to mid-term requirements directed at modifying current equipment. There is less emphasis on long-term SOF mission analysis and future requirements and, therefore, on long-term technology needs. The committee elaborates on this point later in the report.

AFSOC states requirements that are SOF-unique and submits them to USSOCOM for approval. In addition, AFSOC forwards to the Air Force requirements for systems or development that are not unique to special operations forces (i.e., those that have general application to other Air Force requirements); these requirements then compete with other Air Force programs for funding. The dialogue related to Air Force special operations technologies takes place between the AFMC and AFSOC, not between AFMC and USCINCSOC.

MAJOR FORCE PROGRAM-11 IMPLICATIONS

The legislation governing the USSOCOM created a funding category known as Major Force Program-11, making USSOCOM unique among unified commands by providing it with specified funding for functions distinctive to special operations missions, forces, capabilities, and readiness. In addition, the status of USCINCSOC as a head of agency gives the command unique authority to manage acquisition of materiel required by special operations forces.

USSOCOM therefore has implied authority for planning, programming, budgeting, and execution similar to that of the Army, Navy, and Air Force. The intent of Congress in setting up the funding category was to assure that the new organization would have the resources to provide the capable and ready force required to meet national missions.

After study of the legislation, Major Force Program-11 was created by the Department of Defense as the most appropriate way to provide resources for special operations. (In the scheme of Department of Defense resource management, there are ten other categories of force programs, which include strategic forces and general purpose forces.) The intent of Congress in providing separate resources for the centralized special operations command was to ensure that requirements peculiar to special operations forces would not have to compete with more robustly supported Department of Defense and service programs for funds. Congress may not have intended that the funding, now managed as Major Force Program-11, would have to pay for all (or even most) SOF requirements.

Since the legislation was not more specific in the designation or use of the separate funds, other interpretations have evolved. The services now often apply the term "special operations forces peculiar" to move funding requirements out of their programs and budgets and into Major Force Program-11.

Major Force Program-11 can have unintended effects on technology development for special operations forces. Program-11 is simply not large enough in aggregate to afford a research, development, test and evaluation budget adequate to meet all SOF technology development needs. USSOCOM management admits this and continues to rely on the services to develop those technologies it cannot afford.[1] Yet its process for transmitting its requirements are weak. USSOCOM cannot afford the research, development, test and evaluation bill for large-ticket items (such as aircraft development) and does not appear to have had significant leverage in service programs. The result is that special operations units must either accept (or modify) service aircraft, or do without.

The committee believes that the creation of Major Force Program-11 should not separate the Air Force organizational element of USSOCOM—AFSOC—from Air Force research, development, test and evaluation support. As an Air Force major command, AFSOC should, in principle, receive the same level of Air Force parent support in research, development, test and evaluation as the other major commands. AFSOC should not have to "buy" all its technology as is now generally perceived to be necessary because of the prevailing interpretation of Major Force Program-11.

The committee was told that if AFSOC needs an item developed for its use, Major Force Program-11 development funding is often required by the Air Force as a condition of proceeding with development, *even though the item may have a broader Air Force application*. It seemed to the committee that developments with broad application should be pursued jointly, with regard to cost and effort allocated by negotiation between USSOCOM and the Air Force.

The Air Force argues that, when it has tried to share costs, congressional budget monitors have disallowed its support. The same treatment was reported by the Defense Advanced Research Project Agency but not by the Army or Navy. Some congressional staffs have identified equipment or technology "peculiar to special operations forces" as inappropriate for Air Force expenditures. They believe such service support of SOF needs can be a contrivance supporting inappropriately funded research or a device to gain access to Major Force Program-11 funds to support service-unique needs.

It was hard for the committee to believe that Congress would take such a narrow view of funding technology development for special operations forces. Nevertheless, it seems beyond dispute that Major Force Program-11 has had

[1] According to Senate Report 102-408 (September 17, 1992, p. 311), USSOCOM budget expenditures on behalf of science and technology programs are approximately $17 million per year. This amount includes approximately $3 million in special operations technology development and $14 million in development of advanced technologies. In a command whose total acquisition budget approaches $1 billion, it can only be concluded that the emphasis on science and technology is relatively small, probably because immediate operational requirements predominate in a command that, in USCINCSOC's words, is constantly on a war footing. It should be noted that, in terms of the percent of total budget, USSOCOM places as much *emphasis* on science and technology as the Air Force—about 1.7 percent. The Air Force's budget is nearly 100 times larger, with a correspondingly larger budget for science and technology.

negative effects on the program support provided by the Air Force, and presumably by the other services, for special operations.[2]

Special effort appears warranted to highlight joint programs that are important to both USSOCOM and the Air Force. Further, special attention by high levels of Department of Defense management appears warranted to seek (and ensure) support of such programs by Congress.

The matter of the relationship between USSOCOM and the services is of serious concern although there is little open friction. USCINCSOC, in a manner unique among unified commanders, has a certain independence by virtue of Major Force Program-11. The services can broadly interpret what is "peculiar" to special operations and argue for separating anything given that label from their own programs and consigning it to the inadequately funded Major Force Program-11. Thus, Major Force Program-11, in the area of research and development funding at least, may not be serving the best interests of SOF programs. On the other hand, since the funding category was created by Congress through legislation that is not likely to change fundamentally, the committee believes that special effort must be made by the commanders of AFMC and USSOCOM to coordinate and jointly support common-interest science and technology programs before Congress.

While the working relationships between USSOCOM and the services, not to mention Congress, could be interpreted as outside the committee's charter, the committee believes it to be an important element in the overall process—an element that must be considered and addressed at the policy level.

ESTABLISHMENT OF REQUIREMENTS

In broad terms, the Department of Defense process for establishing requirements for systems development and acquisition has two roots. The first is operational necessity, stemming from a recognition within the operational chain of command that some portion of the force's mission cannot be accomplished with sufficient probability of success, or at acceptable cost, due to some change in the threat or operational environment. The second root is recognition by the operational chain of command—or its scientific-technical advisors—that exploitation of new technology, or adaptation of existing technology, could significantly improve the probability of success or reduce the cost of mission accomplishment.

In general, the two roots converge in an analysis of the possible technological remedies to shortfalls in, or potential improvements to, a current system. This analysis produces a prioritized list of potential technology-derived

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[2] For example, both the Air Force and (Defense) Advanced Research Projects Agency have had SOF-supporting budget items removed by congressional action because they were identified as "SOF specific."

capability enhancements and their cost. The list forms the basis of the particular force's research, development, and acquisition program.

During visits to the operational headquarters, the committee was informed that USSOCOM follows this Department of Defense requirements process. Each USSOCOM component—Army, Navy, Air Force, and the Joint Special Operations Command[3]—establishes its list of requirements. These requirements are screened by USSOCOM headquarters and prioritized by boards on which each component is represented. The prioritized list is then validated and approved by USCINCSOC, and incorporated in the Major Force Program-11 research, development, and acquisition program. (Presumably, some operationally valid requirements have insufficient priority to be included in the funded program.)

The committee notes that, to be effective, the USSOCOM requirements process requires objective and comprehensive analysis of a very broad range of mission needs, operational requirements, and technological solutions and opportunities. The process is necessarily complex. It is far from straightforward to assess the relative increased marginal utility of investment in, for example, a stealthy transport aircraft, as opposed to an anti-missile defense system for a patrol ship. USSOCOM must make these judgements, relating the relative utility of component commands' different systems to the anticipated spectrum of conflict situations, threats, and varying operational environments.

To ensure comprehensive and objective treatment of all essential factors; the requirements analysis could profit from support from interactive engagement and force modeling, from simulations, and certainly from systematic collection and analysis of actual operational data. These tools will help to clarify issues, despite the fact that differential evaluation of mission needs and technological capabilities complicates cooperation.

Top Priorities

USSOCOM's top priority requirements relative to Air Force technology were identified from the Advanced Technology Transition Demonstrations and critical experiment ratings. The committee was informed that these ratings flowed from USSOCOM's estimates of its most pressing needs.

The programs receiving the highest ratings were Quiet Knight II, Coherent Directional Infrared Countermeasures Techniques, Integrated Cockpit/Avionics for Transports, 14-Inch Strategic/Tactical Optical Disk System, and Electronic Combat Situational Awareness. Each of these programs is summarized below.

[3] Note: The Joint Special Operations Command also has a separate, specialized list of requirements, which can be funded at the JSOC commander's discretion. This sub-program represents a small fraction of the total USSOCOM program.

- *Quiet Knight II* is a passive TF/TA program that will provide for low probability of detection and for avoidance of threats and passive obstacles. It also includes the use of on-board and off-board threat-location data for in-flight route replanning and threat avoidance. This program is funded by Balanced Technology Initiative[4] resources and managed by Wright Laboratory.
- *The Coherent Directional Infrared Countermeasures program* provides directional infrared threat detection and destruction. It is integrated with other electronic warfare systems. This program is funded by USSOCOM and managed by Wright Laboratory.
- *Integrated Cockpit/Avionics for Transports* provides integration of avionics for AFSOC. This program supports Quiet Knight II and situational awareness initiatives. It is funded by the Air Force and managed by Wright Laboratory.
- *The Strategic/Tactical Optical Disk System* provides storage memory for in-flight mission planning and situational awareness. This program is also funded by the Air Force and is managed by Rome Laboratory.
- *The Electronic Combat Situational Awareness program* addresses awareness needs in part by combining information from constant source and tactical information broadcast systems. Situational awareness information needs to be transferable to aircraft systems. Such information includes real-time in-flight threat updating, monitoring friendly aircraft, and identifying friendly personnel. The program is funded by the Air Force and by USSOCOM and is managed at AFMC.

In the committee's estimation, each of these programs, when implemented, will improve near-term operational capabilities. This emphasis is important. However, the committee did not discern among these top priorities any focus on long-term requirements that might be associated with special operations forces. Neither did the committee observe the ingredients of a process for establishing long-term technology requirements.

Requirements in General

In its efforts to assess the process for establishing requirements, the committee took note of the staffing devoted to requirements. The committee also reviewed the requirements generated by these staffs in a key technology area—communications and electronics.

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[4] Balanced Technology Initiative is a program mandated by the Senate Armed Services Committee to benefit conventional weapon technology across the services, partly as a counterpoint to the presidentially-mandated Strategic Defense Initiative. In fiscal year 1993, the Balanced Technology Initiative was substantially dismantled, and funding for Quiet Knight II was transferred directly to USSOCOM, and from there to the Air Force Materiel Command's Wright Laboratory in order to continue development.

The committee found that within USSOCOM and AFSOC, very small staffs are dedicated to establishing requirements, examining potential technology alternatives, and exploring what the future might provide. At USSOCOM, approximately two individuals were identified by the committee to be responsible for understanding and exploring the potential of advanced technologies. In AFSOC, approximately five individuals were identified who are associated with future technologies and requirements. Neither USSOCOM nor AFSOC has a chief scientist—someone who is recognized for contributions and expertise in the high-technology community. The committee believes that a strong tie to the high-technology community is essential.

The committee found that the USSOCOM-headquarters requirements section (in the SOJ3 directorate) although staffed by able and dedicated people, has inadequate resources and support to perform such complex analytical functions. Similarly, the committee believes that USSOCOM headquarters needs greater access to competent, objective technological advice, possibly in the form of a resident group of science advisors.[5] The USSOCOM component headquarters probably should have similar resources to support the analytical development of their individual requirements.

These small staffs have done a good job of canvassing a very broad set of possibilities. However, the limited staffs necessarily create a significant constraint on what can be done. For example, the special operations focus has been on a few relatively near-term operational requirements for communications.

Specifically, the committee learned that, out of approximately 100 SOF programs to upgrade and develop new capability, 35 were in the areas of communications and electronics. The committee found that, in communications, only two requirements have been validated. These are the Joint Advanced Special Operation Radio System, sponsored by USSOCOM, and the SOF Interplane Laser Communication, sponsored by AFSOC and validated by USSOCOM. Both are relatively near-term in character. Few new communications requirements are under consideration and none for the longer term.

It could be that USSOCOM and AFSOC have no long-term communications requirements. But, given all the work on communications that is underway in the Air Force—some of which could be of use to future special operations forces—the committee believes that the staff limitations, and the lack of established relationships with the scientific community, are the root cause of the near-term focus. The committee's research did reveal some examples of long-term

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[5] There are various approaches to the size and content of a scientific advisory group, and possible examples can be found in the Operations Research Group of the Commander in Chief, Pacific Command; the Supreme Headquarters, Allied Powers in Europe Technical Center; or the Organization of the Joint Chiefs of Staff J-8. For a very small command, such as USSOCOM, the implementation raises issues about the funding and size of the group and the resultant quality of people and advice. A resident group may be inappropriate, but a science advisory group that meets periodically to review science and technology programs, needs, and requirements—while they are being formulated—may prove both useful and feasible.

communications needs that have not shown up as requirements. Two illustrations are (1) aircraft-to-aircraft wideband covert communications and (2) wideband video direct to aircraft cockpit. Although USSOCOM is funding the Joint Advanced Special Operations Radio System, a low-probability-of-intercept system, it has not developed long-term views of its more specialized future needs. What appears to be missing is a substantial process by which USSOCOM taps into the body of Air Force knowledge, assimilates it on behalf of potential future SOF capabilities, and makes known its long-term technology needs.[6] More will be said about this problem later.

The committee's perception is that part of the problem may be cultural. As stated before, there seems to be a tendency to focus on operations and performance in the near term. Devoting more attention and energy to technology and provisioning the force should pay important long-term dividends—one objective of Major Force Program-11 was to enable this type of leveraging.

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[6] The committee notes one mechanism by which more advanced technology has been addressed for USSOCOM. AFSOC has provided input to the AFMC on the Advanced Technology Transition Demonstration candidates submitted by the Air Force laboratories. (These are projects designed to demonstrate a significant new military capability in the field through the integration of maturing research results in a user-supported field experiment.) Some of these involved communications and received high scores from AFSOC. However, the committee found that the process of identifying technologies for demonstrations has not comprehensively addressed SOF needs or potentialities. Air Force technology demonstrations appear not to be derived from or closely tied to (1) requirements generated by special operations forces or (2) any SOF visionary process.

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Linkage with Air Force Technology

The committee found in Chapter 2 that special operations had significant technology requirements and considerable commonality with conventional Air Force technology requirements. In Chapter 3, the committee found that the creation of a separate research, development, test and evaluation funding provision for USSOCOM resulted, contrary to the likely intent of Congress, in a separation of special operations from the robust technological resources available to the services. Further, the USSOCOM staffs that were generating requirements and staying abreast of technologies were found to be relatively small. The result appeared to be a near-term focus.

In this chapter, the committee explores aspects of the Air Force technology management process that relate, or could relate, to USSOCOM. Air Force technologies that could prove beneficial to special operations forces, particularly over the long haul, are also identified.

TECHNOLOGY MANAGEMENT

Two major changes in the Air Force technology management approach have occurred in the past two years. They are (1) the consolidation of the Air Force laboratory structure into four major "super labs" and (2) the institution of new evaluation and management systems for more than 5,000 research and development projects. These actions could be positive factors for ensuring that the Air Force technology base programs are able to meet the technology needs of AFSOC and USSOCOM.

USSOCOM does not have the most important ingredients required to meet its own needs. These are the research and development laboratory infrastructure, the experienced research and development staff, and the necessary budgets and management systems to allocate resources according to USSOCOM priorities. The Air Force has all of these plus, the committee believes, multiple common interests with USSOCOM requirements. The committee believes the entire process would benefit from AFMC requesting that AFSOC develop a plan or "road map" to guide (science and technology) resource allocation decisions at AFMC and Headquarters U.S. Air Force Acquisitions (USAF/AQ).

If the Air Force and USSOCOM could work together more closely, it could be possible to take advantage of these Air Force assets. For example, technology projects could be tailored so they might easily transition to sponsorship by USSOCOM in an engineering development program funded by USSOCOM.

Two elements of the new Air Force management approach, which are taken directly from the principles of "Total Quality Management," may be particularly helpful in drawing out the mutual technology interests of the Air Force and USSOCOM. First are the institutional procedures set up by the Air Force to place the operational community (AFSOC and USSOCOM) directly in contact with technology planners during the technology planning cycle. Second is the emphasis on "scoring" in a quantitative manner the candidate technology projects.

The committee reviewed the perceptions of these processes, which had only been in force for one year at the time of the initial review. The points of view were those of Headquarters USSOCOM at MacDill Air Force Base; AFSOC at Hurlburt Field; and the former Air Force Systems Command, through the Technology Executive Officer.

Even with the new user–developer interchanges, the committee found that the focus of Air Force technology planning, as it related to AFSOC and USSOCOM, was near term and specifically aimed at the Advanced Technology Transition Demonstrations. Although AFSOC and USSOCOM staffs are invited to participate in planning sessions for technology phases earlier than advanced development, these inputs do not appear influential in determining either Air Force or USSOCOM requirements and resource allocations. The committee believes that even though AFSOC is assigned Major Air Command status, its influence in this area does not compete well with large, established commands such as Air Combat Command or Air Mobility Command.

In the spirit of the total quality management aphorism that states: "If you can't measure it, you can't manage it," appropriate measures of effectiveness could be instituted into the Air Force technology area planning activity. Direct involvement by USCINCSOC in reviewing these measures of effectiveness may provide additional attention to, and result in greater emphasis on, AFSOC/USSOCOM inputs. That activity could help quantify the level of satisfaction of SOF requirements in the technology program. It could also highlight the effectiveness (or ineffectiveness) of efforts to gain support in Congress for joint Air Force-SOF technology projects. The committee believes that measures of merit for SOF technology program requirements should be established. One example of such a measure of merit would be the number ("how many") of the top 25 USSOCOM priorities that are funded by Air Force Science and Technology.

The committee reiterates that one serious problem strains the relationship on both sides. If AFSOC ranks a proposed Air Force advanced development project at the highest level, it is labeled "peculiar to special operations forces" by Air Force planners. Then USSOCOM is asked to fund the project from Major Force Program-11 funds. A more progressive approach would be for Air Force and USSOCOM to jointly fund such projects. This is not to imply that every high-priority SOF project deserves joint funding. The cost-sharing ratios would presumably reflect the best estimate of long-term (operational lifetime) benefit to each contributor's mission. A reasonable outcome would require good-faith representation and negotiation on both sides as to how they value technology alternatives.

The planning and evaluation process should be made sensitive to joint funding opportunities and be sensitized to avoid, where possible, the bureaucratic response historically and currently observed by the committee and the SOF community.

BENEFICIAL TECHNOLOGIES

The committee did not conduct an exhaustive search of Air Force technologies that could prove beneficial to USSOCOM (e.g., non-lethal, incapacitating technology is an option not pursued but that may be worth considering). Nevertheless, in the general survey, there were several key technology areas that seemed to have ready applicability to special operations forces. The committee believes the key technologies addressed below have considerable potential to fulfill major SOF needs.

Simulations

Simulation technologies (USSOCOM/AFSOC unique, Air Force, and Department of Defense[1]) could be powerful assets to support the SOF mission. First, they could provide an improved long-term perspective for special operations staffs involved in requirements generation and technology planning. This is especially valuable because simulations could be conducted under conditions that employ variable advanced capabilities. The results could help these staffs understand the values (in terms of increased effectiveness) of a range of long-term technological enhancements. Second, simulations can make special operations forces aware of additional options for task accomplishment in the near term. Recently there have been fast-paced developments in modeling and simulation techniques, equipment, and procedures with the resulting promise of realistic, but low-cost, network-based simulations to facilitate time-critical operations. The committee believes that opportunities exist to strengthen this aspect of modeling and simulation support—attractive options for coordinated and joint exploitation of modeling and simulation. In addition to simulated operations among Army, Navy and Air Force SOF units, there are opportunities to develop fruitful training

[1] The Air Force central simulation office is the recently created Headquarters U.S. Air Force Simulation Directorate (HQUSAF/XOM). At the Department of Defense level, the Defense Modeling and Simulation Office (DMSO) fulfills this function.

and mission rehearsal programs between AFSOC and the Air Combat Command and those Army, Navy, and Marine conventional units being supported by these Air Force SOF and conventional units.

The committee is aware of several hands-on simulation facilities now in operation, as well as additional planned systems soon to be operational. These are the Air Force Theater Air Command and Control Information Facility, the National Test Bed, the Force Operations Readiness/Combat Effectiveness Simulator, and special test facilities. Brief descriptions of each follow.

- *The Theater Air Command and Control Simulation Facility* was developed to address specific air defense and command-and-control issues. Located at Kirtland Air Force Base, New Mexico, the facility is the world's largest man-in-the-loop air defense simulator. It was developed by the Office of the Secretary of Defense over a 10-year period at a total cost of $150 million. It has been operated for the last two years by the Air Force, with Army participation. It is available for use by U.S. or allied agencies.
- *The National Test Facility* is a program created as part of the Strategic Defense Initiative to perform test and evaluation of very complex systems that would otherwise be prohibitively expensive to test or could not be tested in a peacetime environment. The National Test Facility includes a computer system with extensive access to data needed to simulate basic missions. Additional functions include information collection, retrieval, and storage during mission exercises; interactive command-and-control exercises; research and development support through high-fidelity simulation; and integrated system test (currently in the concept definition phase). The Air Force plans to create a Joint Warfighting Center at the National Test Facility as a center for modeling and simulation operations.
- *Force Operations Readiness/Combat Effectiveness Simulator* (FORCES) is a mature simulation support environment that has been developed and successfully applied to support design, development, and evaluation of military command, control, communications, and intelligence components, subsystems, systems, and architectures. FORCES incorporates state-of-the-art features and paradigms. It has been used to examine various aspects of joint military operations involving space, air, naval, and ground units and systems, with thousands of complex objects being represented in real-time, interactive scenario executions.
- The Air Force maintains and operates a variety of *special test facilities*, some of which include advanced threat systems. These threat systems include a combination of actual foreign systems and simulators that functionally replicate the best estimate of threat system capabilities.

In addition to increasing special operations participation in periodic force-level exercises, there could also be merit in running particular tests at special facilities to replicate missions and threats likely to be encountered in future special operations missions. The objective of these processes and technologies is to develop and validate models and simulations that can be used to assess capabilities and deficiencies and make informal assessments of the benefits derived from alternative technology requirements.

Force-level exercises could also contribute to development of tactics and doctrine and mission planning. In this context, it is possible to consider the synergistic benefits of combined forces in a mission context rather than place the entire burden of mission success on one special operations platform. The networking of special operations simulators, with emphasis on common visual data bases, at Kirtland Air Force Base is a step in the right direction. Emphasis should be placed on expanding that network to other special operations locations.

Through simulations, it is also possible to identify particular high-leverage technology requirements that enable performance of critical missions. If these requirements cannot be met with off-the-shelf technology, then a sound planning basis can be established to develop the necessary enabling technology in a stable, orderly, long-term science and technology program.[2]

It is not unreasonable to postulate that, in the long term, both the Air Force and SOF aviation will encounter a worldwide increase in the sophistication and density of air defenses. Such defenses would increasingly restrict the access of special operations forces to denied areas due to the vulnerability of its current aircraft mix. Defensive avionics could extend the timing of operational impacts by these factors but not eliminate them. Eventually, a new signature-controlled platform might be required. These are the types of problems that it would be useful to examine through the process of simulation.

The committee believes there is merit to USSOCOM, AFSOC, and the Air Force initiating a series of simulations to examine this vulnerability issue. Various scenarios could be simulated. Such simulations would serve several purposes: (1) to confirm or refute the postulate of eventual vulnerability, (2) to determine whether the vulnerability merely complicates the overall operations or makes them infeasible, (3) to determine the life-span extension afforded by electronic countermeasures support, and (4) to assess alternatives to the programmed aircraft mix that would be effective well into the twenty-first century (e.g., new aircraft).

Modeling and simulation of specific platform performance and systems could be used to project new designs. But the simulation of special operations tactical mobility need not be confined just to aircraft. It could also include ground and naval vehicles in order to determine, for example, the potential benefit of stealth technologies for each. The relative utilities of air, surface, and subsurface platforms could be assessed, as could the enabling technologies for each. In that

[2] An example is a comprehensive set of technologies to enable the future development of an affordable vertical takeoff/land infiltration/exfiltration stealth aircraft. The set might include convertible propulsion and mechanical transmission for a lift fan system, as well as advanced, lightweight structural materials for the airframe. Lightweight ceramic armor might protect vital parts of the aircraft against small arms fire, and a Global Positioning System-based TF/TA system might be developed as an avionics adjunct.

way, an overall cost and effectiveness estimate could be made to aid future special operations planning.

Other Technologies

Special Operations Command Research, Analysis, and Threat Evaluation System (SOCRATES)/Tactical Exploitation of National Capabilities (TENCAP)

There are several other Air Force technical arenas that offer opportunities for cooperation and mutual benefit with USSOCOM. For example, the combined exploitation of such programs as the SOCRATES[3] and TENCAP[4] could bring about improvements in SOF command, control, communications, and intelligence that will ultimately result in enhanced situational awareness.

During the Persian Gulf war, much experience was gained by conventional forces in the fusion and dissemination of all-source intelligence data that could be used to support the goals and roles of SOCRATES. Remote sensors, low-probability-of-intercept-and-detection communications systems, and tactical data fusion, for example, were combined to provide useful information. This information was transferable to aircraft systems in the form of real-time in-flight updates, where it was immediately available for in-flight planning. This information was useful in reducing the possibility of fratricide between and among aircraft and ground forces.

Additional Uses of Space-Based Technology[5]

Space technology in the form of reconnaissance and surveillance assets, precision navigation satellites, weather satellites, covert (secure, low-probability-of-detection/interception) space communications, and a range of other potential

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[3] SOCRATES provides considerable intelligence support to special operations forces. Based in the USSOCOM Intelligence Directorate, it includes: access to all-source real-time and near-real-time intelligence sources; a data base relevant to special operations; analytical functions (including analyst-to-analyst dialogue within the intelligence community); communications and rapid data transmission between users such as USSOCOM headquarters, the component headquarters, theater special operations commands, and—prospectively—all deployed SOF units. It provides the intelligence inputs—correlated, annotated, and formatted—for mission planning systems such as the Special Operations Forces Planning and Rehearsal System. It has proven highly effective in rapidly assessing sources and transmitting tactically essential intelligence (such as annotated imagery) in numerous operations, most notably Just Cause and Desert Storm.

[4] TENCAP is an Air Force project where advanced techniques are applied to exploit deep reconnaissance information collected from a variety of nationally controlled sensors that, in general, is not otherwise obtainable; that information is then provided to tactical commanders.

[5] the term "space-based technology" is meant to include essential and complementary ground-based supporting systems, not just the orbiting elements.

remote sensing technologies could form the basis for vast improvements in both special operations forces and Air Force mission success. For example, overhead assets could prove particularly useful in improving situational awareness in the planning and execution of covert missions. The Air Force is uniquely qualified in the development and operation of such systems. Possible uses of these assets follow.

- With proper exploitation and analysis of intelligence data from such assets, not only could the "cover of darkness" be used to advantage but also the "cover of weather" and technology "blind spots" could provide the advantages that night vision offered in the past.
- Multiple space assets, cued with terrestrial features, could be used to improve the effective concealment of special operations forces. For example, environmental satellites may aid Navy SEALS by allowing submersible vehicles to avoid detection during the execution of a mission.
- Real-time satellite reconnaissance can optimize the number of "mission corridors" in denied areas and provide information on enemy actions and intentions, resulting in improved situational awareness, mission planning, and execution.

The needs for real-time threat, navigation, and mission planning data make it apparent that communications will move more toward computer-to-computer techniques and less toward person-to-person. The need for faster data transfer will continue to grow.

Space systems have obvious, immediate application and even greater future potential for providing high-capacity communications during clandestine operations. Technology developments in the domain of secure, directional electromagnetic feeds and antennae, and high-speed electronics, will be important. Transmissions from operational aircraft image-creating technologies, such as forward-looking-infrared systems, could be valuable to command-and-control functions. Systems that would permit special operations messages to be buried in other traffic could be helpful. Highly directional, high-data-rate optical communications may become important.

The Global Positioning System contains a selective availability feature that provides highly precise data to military users (denied to commercial users). There was more demand for Global Positioning System receivers than there was supply during the Persian Gulf war. This point drives home the necessity to plan future space systems together with the potential users and to address simultaneously the technology and provisioning of both the space and the deployed field hardware.

On behalf of special operations, Global Positioning System technology and capabilities improvements could be explored for use in defining terrain-masked navigation paths. They could also aid covert terrain following or terrain avoidance.

Special operations forces may find the maps of some potential operating locations to be old and out-of-date. To correct this deficiency, multispectral imagery satellite systems were used during the Persian Gulf war to provide up-to-date maps. Space systems became vital for the provision of maps for all purposes—to a level of precision consistent with Global Positioning System data. Similar results could be obtained for other areas of operational interest to special operations forces.

Next-Generation Advances on "Owning the Night"

In another arena, the night vision advantage that U.S. special operations forces now have will continue to erode as potential adversaries acquire night vision equipment of their own. The committee believes that, in addition to enhancing the capability of existing systems, there are three basic technical approaches that should be considered to maintain our nation's significant advantage.

The first approach is to operate under cover of weather as well as darkness. This would require the development of weather-penetrating sensors. One of the possible technologies that has already shown promise is passive millimeter-wave imaging. Another is the use of active millimeter-wave imaging using synthetic aperture technology. Both techniques will benefit from development of conformal millimeter-wave antenna arrays. Development of this technology offers a good potential for imaging landing areas, obstacles (e.g., wires), personnel, and weapons. Effective exploitation of this approach will require accurate weather prediction and lead time for mission planning.

The second approach is to reduce the effectiveness of the adversary's night vision devices by passive signature reduction of U.S. forces. Since the principal spectral bands of these devices are known, it is possible to develop coatings that can offer some degree of protection in the particular bands of interest. A general body of expertise has been developed by the Department of Defense for reduction of passive signatures, and this expertise can be applied to exploratory and advanced development programs with this more focused objective.

The third approach is to reduce the effectiveness of the adversary's night vision devices through the use of active countermeasures. One such countermeasure involves destroying the enemy sensors with large amounts of in-band energy. Obtaining sufficient energy will typically require directional specificity, so the enemy systems must first be located. Effective countermeasures might also be obtained at lesser power levels by creating image blooming within enemy sensors. This approach has one notable deficiency—the lack of covertness. However, it may be possible tactically to combine the second and third approaches in sequence to deal with limited numbers of enemy night vision devices.

CONCLUDING OBSERVATIONS

The committee believes it would be highly useful for the Air Force to make existing simulations available to USSOCOM and AFSOC and to participate in the simulations with the USSOCOM. Such participation would help provide an operationally oriented perspective for discerning future mission needs, evaluating the benefits of technology opportunities, and establishing technology requirements. It could also assist in the near-term planning of specific special operations missions.

The committee reviewed representative technologies and concluded that there is ample opportunity to improve support to U.S. special operations programs. The committee believes there is a way to improve significantly the sharing of Air Force technology know-how with USSOCOM, both through AFSOC and more directly. For a period of several years a group of experienced AFMC technology experts could be assigned to work directly with USSOCOM and AFSOC. This group should become familiar with USSOCOM's and AFSOC's current and future mission requirements. Given this group's resident acquaintance with Air Force technology management techniques, plans, and programs, plus its acquired knowledge of special operations needs, it would recommend new and joint technology plans to benefit both USSOCOM and the Air Force. A resident—or visiting, if deemed more appropriate and feasible—scientific advisory group would provide a complement to this process, offering a potential synergism that would benefit SOF science and technology. Implementation of this approach would help facilitate the transfer of existing Air Force program knowledge into USSOCOM.

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Conclusions and Recommendations

Special operations forces have many technology requirements, but the committee did not find any that are unique only to special operations forces. Rather, the committee concluded that technologies that would benefit special operations missions would also generally benefit one or more conventional military missions. The crucial differences are often in timing, cost, and availability of requisite skills and technologies.

The committee found that USSOCOM, which of necessity is primarily oriented toward operations, has adopted a predominantly near-term horizon for its equipment acquisitions. As a result, USSOCOM's attention to advanced technology (as measured by number of personnel assigned and by budgets allocated) is less than desirable for its future viability. Its requirements are aimed principally at improving specific current areas of weakness or, to some extent, making better use of existing assets. Little work is aimed at creating dramatically new operational capabilities by envisioning systems of the future, establishing a technology and product development road map, and working to assure its comprehensive implementation.

The committee found that the creation of a separate research, development, test and evaluation funding provision for USSOCOM resulted, contrary to the likely intent of Congress, in separating special operations from the robust technological resources available to the services. The committee believes that many Air Force technology programs, if properly directed, could have broad applicability to many requirements for future special operations forces. The committee concludes that existing Air Force technology management skills have great potential for far-reaching influence on future SOF capabilities.

Finding 1: A major opportunity exists for the Air Force, with its progressive, long-range planning orientation and developed management tools, to help provide USSOCOM the necessary perspective to better invest in leveraged technologies for future SOF weapons systems. These assets could help USSOCOM and AFSOC define their future technology needs and provide, over time, the technological foundation to meet those needs. Further, the committee concludes that the current process (which does not directly link AFMC and USSOCOM) is not working to achieve these results. Therefore, a new process is needed.

Recommendation 1: The committee recommends that the Commander, AFMC, with the concurrence of the Air Force Chief of Staff and Air Force Acquisition Executive, work directly with USCINCSOC to establish a new process to ensure that future SOF technology needs can be defined and satisfied. To accomplish this result, the committee recommends the following:

- The Air Force process for determining the investment priority of all technology projects should be modified. The modified process should explicitly reveal the relationship to USSOCOM priorities so that the Air Force Technology Executive Officer and Air Force Acquisition Executive could better account for SOF needs in their resource allocation.
- The technology program management process as it relates to AFSOC, and through AFSOC to USSOCOM, should be reviewed and strengthened. It may prove desirable to place an AFMC liaison group directly into USSOCOM headquarters for coordination. An advisory group—visiting or resident—could complement the liaison group and enhance the overall process. Also, joint actions to achieve congressional support for resulting programs should be raised to a high level of management.

Major Force Program-11 has had, and will continue to have, a profound impact on technology insertion for special operations forces. The relationship between USSOCOM and the Services and Congress needs to be addressed in order for technology insertion to proceed efficiently.

Finding 2: The committee concluded that the Air Force is in a strong position to provide greatly increased technology planning perspectives to USSOCOM because of the capability it has for conducting simulations under alternative conditions and with technology as an independent variable. The committee believes that, through hands-on simulations, operationally oriented personnel best gain the perspective needed to make good investment decisions and to better balance long-term opportunities available through technology investment with short-term operational demands.

Recommendation 2: The committee recommends that current and planned technologies and facilities be examined and partnerships selectively formed with appropriate cross-service agencies to enable a full range of simulation options. The capabilities sought should range from specific technology evaluation to joint, large-scale rehearsal opportunities at all points along the spectrum of conflict.

Finding 3: The AC-130 gunships will, over the next decade, become increasingly vulnerable and therefore less effective. Without special attention and the application of new technology, their ability to support special operations (and conventional) forces will deteriorate. More incidents like the loss of a gunship in the Persian Gulf war can be anticipated. Thus, special operations forces will, by stages, lose the fire support of this important system.

Recommendation 3: The committee recommends that the Air Force set up a process by which SOF projects could increasingly be aimed at the AC-130 vulnerability issue. In particular, new electronic and optical countermeasures, as well as the protection afforded by standoff (precision-guided) weapons, should be considered to defeat the threat to survival and operational flexibility. Potentially useful future technologies (e.g., directed energy and electric gun technology) should be continually assessed for applicability.

Finding 4: Believing that CV-22's mechanical configuration and large rotors would make it as detectable as current-program aircraft, the committee holds the view that, in the longer term, a "CV-22-like" aircraft may not meet the most demanding SOF mission needs. The committee believes that making special operations aircraft less detectable may hold greater long-term promise for a majority of SOF missions.

Recommendation 4: The committee strongly recommends that USSOCOM and AFSOC, in conjunction with the U.S. Air Force, include in their long-range plans a low-signature aircraft capable of both delivery and extraction of special operations personnel. Both fixed and rotary-wing aircraft should be considered, perhaps in combination. Technologies should be focused on low-signature aircraft and materials, low-probability-of-intercept communications and navigation, and passive navigation systems. Advanced short-takeoff and vertical landing technologies (such as gas-driven propulsive-engine lift concepts) should be considered. The emphasis should be on acquiring a capability to operate undetected at higher (safer) altitudes at night and in varied weather, and at higher speeds than are now possible with present rotor-type aircraft. This is an area where it is mutually beneficial to develop significant joint capabilities for the services and determine the technology plans to provide these capabilities.

Finding 5: The committee finds that the overwhelming advantage held by U.S. special operations forces in the past, much of which was due to their unique and pervasive use of night vision equipment and extensive night operations, will likely fade in this decade.

Recommendation 5: The committee strongly recommends that a broad element of technology planning be initiated to counteract this likely trend in night vision advantage. Measures that should be considered are use of weather in addition to darkness as concealment, passive signature reduction of U.S. forces, and active countermeasures against enemy use of night vision equipment.

Finding 6: Space technology can be foreseen to have dramatically increasing significance and new potentials for both special operations and Air Force capabilities.

Recommendation 6: Although the development of space systems is clearly beyond the current capabilities or assets of USSOCOM or AFSOC, a concerted effort to define and influence space technology and hardware on behalf of special operations forces is in order. This is an area where it is mutually beneficial to USSOCOM, AFSOC, and the other Air Force commands to define the joint capabilities provided by advanced systems and determine the technology road maps by which to provide these capabilities.

Appendix A

MEETINGS

DATE/SITE	PURPOSE
June 13, 1991 Washington, D.C.	Planning Meeting
August 7-8, 1991 USSOCOM, MacDill AFB, FL; AFSOC, Hurlburt AFB, FL	USSOCOM, AFSOC
September 10-11, 1991 Washington, D.C.	ASD SOLIC; DARPA; AFSC DCS/Technology
October 4, 1991 Washington, D.C.	Dr. Cooper, Gen. Stiner, Gen. Moore
December 11-12, 1991 Washington, D.C.	Executive Session/ Report Outline
January 29-31, 1992 Washington, D.C.	Orientation; Full Committee Meeting
May 12-14, 1992 Irvine, CA	Final Draft Report