About Project AIR FORCE at RAND

Project AIR FORCE is the only federally funded research and development center (FFRDC) charged with studies and analysis for the United States Air Force. The mission of Project AIR FORCE is to conduct an integrated program of objective analysis on issues of enduring concern to Air Force leaders.

Established in 1946 at Douglas Aircraft Company, Project AIR FORCE originally was known as Project RAND. It was a pioneering effort of the then-Army Air Forces to retain and extend the considerable benefits of civilian scientific thinking that had just been demonstrated during World War II. In 1947, the United States Air Force became a separate service. In 1948, The RAND Corporation, known today as RAND, became an independent nonprofit institution that seeks to improve policy and decisionmaking through research and analysis. The original Project RAND changed its name to Project AIR FORCE in 1976.

On the World Wide Web, RAND can be found at http://www.rand.org, and Project AIR FORCE can be found at http://www.rand.org/organization/paf. Sections of this annual report will be available on the Project AIR FORCE Web site in 1998.

Project AIR FORCE

1997 Annual Report

50th Year
RAND
A NATIONAL RESOURCE
1948 - 1998

Director's Message

A TIME FILLED WITH CHALLENGES AND OPPORTUNITIES

As the world continues to evolve in the post–Cold War era, we see myriad challenges. Simmering ethnic rivalries suppressed for years have begun to boil over. The call for U.S. and allied forces to quell disturbances, to maintain the peace, and to fight has come with increasing frequency. At the same time that deployments are increasing and lasting longer, force structures have been drawn down in response to decreasing defense budgets. There is no longer a well-defined adversary against which planning and modernization can take place. Domestic and foreign investment in key technologies—for example, satellite communications—is increasing at an incredible rate, affecting not only daily life but also how the military modernizes important segments of its force structure.

Instead of viewing all this uncertainty with alarm, we should look upon it as a great opportunity. Rarely in the last several decades has the United States had such a manageable margin of risk. Now is the very time that we should assess where the U.S. armed forces, and the Air Force in particular, should be headed. Now is the time for making the decisions to revise strategy and to modernize force structure.

As the world stands poised on the brink of a new millennium, the United States is the world's sole global power. Enormous responsibilities come with this exalted status. We must marshal resources to face unprecedented and unpredictable challenges, such as eliminating weapons of mass destruction, enforcing peace agreements, fighting terrorism, and halting regional and asymmetric aggressors. Our adversaries have become more scattered and our objectives less clear. Strategies, technologies, forces, analytic methods, and military doctrine are all undergoing revision to respond to the challenges of

the 21st century. And as defense budgets continue to shrink, everything the Air Force and the other services do must be done with greater efficiency, innovation, affordability and cost-effectiveness.

During the past year, Project AIR FORCE has been proud to assist the Air Force in preparing for the challenges ahead. To help shape the role of the Air Force in joint operations, we assisted the Air Staff with contributions to the Quadrennial Defense Review and the Deep Attack Weapons Mix Study. In response to a growing OPTEMPO/PERSTEMPO problem in the Air Force, we devised and analyzed options for managing heavy workloads and maintaining combat readiness. In response to emerging tensions with respect to U.S. Air Force operations in Turkey, we helped the Air Force understand the root causes of the issues and their potential ramifications. Using our contacts within both the Turkish civilian and military establishments, we helped "paint a picture" to give the Air Force better insights, which led to revised policies and procedures.

In our regional military research, we continue to analyze global hot spots—from Southwest Asia to the Korean peninsula to an ascendant China and locations in between—to help the Air Force prevent and prepare for conflict. Our research into new systems and technologies, from unmanned air vehicles to new ground attack concepts to advanced space communications, helps lay the groundwork for an Air Force that is more expeditionary in nature. Our research on infrastructure will help the Air Force extract as much money as possible to apply to force modernization. And our research on business practices—including contracting, outsourcing and privatization, and new business strategies to maximize the utility of commercial satellite communications while minimizing cost—will help the Air Force position itself as competitive in today's fiscally constrained environment.

Just as important as our research, we continue to strengthen and expand our relationships with all facets of the Air Force to better understand its needs and to suggest improvements. The Air Force Fellows Program has been expanded and now consists of six lieutenant colonels who work as members

of research teams during their one-year assignments. We have begun joint efforts with the School of Advanced Airpower Studies and the Air War College. We continue to benefit from and enjoy our close working relationships with the Air Force Studies and Analysis Agency and with other elements of the Air Force around the world. Our interactions with the Air Force Scientific Advisory Board are very important, as are those with other boards on which we serve. As important as our interactions with the Air Force are, so, too, are those with the Office of the Secretary of Defense and with the other Services. A broad perspective is key to serving the Air Force well as we approach our analyses of complex, multidisciplinary problems.

During the past year, the membership of the Air Force group that oversees Project AIR FORCE research changed. The group is still chaired by the Vice Chief of Staff, and the membership now comprises primarily Deputy Chiefs of Staff. Through personal management, this new Air Force Steering Group, formerly the Air Force Advisory Group, works with Project AIR FORCE to develop and guide the research agenda. The research agenda is organized around themes that are of enduring concern to the Air Force.

In 1997 the Air Force celebrated its 50th anniversary, a milestone marking a history of service to the nation and the world. But Air Force leaders are the first to recognize there is no room for complacency. Old assumptions have no place in this new world. We have a window of opportunity right now to rethink and revise how we respond to future challenges. That window will close all too quickly. We in Project AIR FORCE and RAND, working together with the U.S. Air Force, intend to make the most of this exceptional opportunity.

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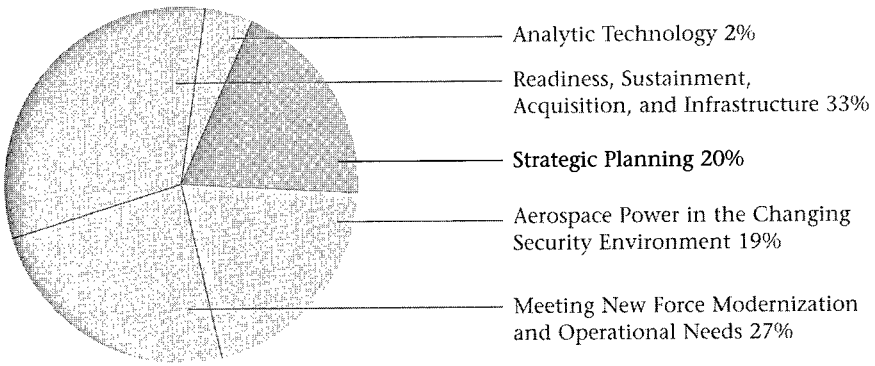


Strategic Planning

The contributions of Project AIR FORCE (PAF) are not limited to technical studies on specific topics of current interest. PAF also conducts integrated analyses of future operating environments and their needed capabilities. Cutting across many dimensions (economic, political, etc.), such analyses are critical to force planning. During FY97 PAF helped to shape Air Force contributions to the Quadrennial Defense Review in several ways: ensuring that scenarios accurately reflected aerospace power, evaluating budget-constrained approaches to fighting and winning two simultaneous major theater wars, assessing alternatives to continued U.S. overseas presence, specifying modernization requirements to maintain air superiority, and identifying opportunities for savings at Air Force installations. PAF assisted the Air Staff with contributions to the Joint Deep Attack Weapons Mix Study by assessing campaign models, locating the sources of differences between models, and working to ensure that contributions of aerospace power were represented accurately. PAF worked with the Air Force Wargaming Institute to design, execute, and document the Global Engagement '97 game, intended to demonstrate to a broad audience the contributions of aerospace power in joint and coalition operations in the next cen-

tury. Finally, PAF continued to work with the Air Force Director of Strategic Planning on the development of a long-term planning framework. We provided analysis, reviewed methodologies and planning documents, and hosted seminars to discuss the important issues facing the Air Force. ◆

Support for U.S. Air Force Participation in the Quadrennial Defense Review (QDR)

THE CHALLENGE: U.S. military forces face growing challenges as demands for peacetime operations abroad continue and as potential adversaries gain new capabilities. Meanwhile, the U.S. defense community does not appear ready to capitalize on the potential of advanced firepower and information systems. These trends could lead to a situation in which U.S. forces lack the ability to defeat aggression without risking unacceptably high casualties and costs. Moreover, peacetime deployments might become primary future drivers of force size; failure to account for this phenomenon could create serious stresses on the force—in terms of people and equipment.

RAND'S RESEARCH: This project produced assessments and recommendations regarding four key aspects of U.S. defense planning:

- *Scenarios.* The research developed and assessed a generic regional conflict scenario that incorporates many of the most important challenges that adversaries might pose to U.S. and allied interests over the next twenty years, such as high-speed offensives, longer-range missiles and weapons of mass destruction, and more-capable anti-ship weapons.

- *Alternative approaches to theater warfare.* Traditional and historical conceptions of warfare focus on the close battle, for various reasons. However, breakthroughs in firepower and information technologies can enable rapidly deployable forces to play a far greater role in halting invasions, thus requiring a reexamination of U.S. approaches to the critical early days of a conflict.

***Breakthroughs** in firepower and information technologies can enable rapidly deployable forces to play a far greater role in halting invasions.*

- *Transparent assessments.* Traditional theater simulation models are complex, and models designed to adjudicate close combat do not represent situations with few defending ground forces. This project developed and applied a new methodology for assessing the capabilities of joint firepower systems to halt an invading ground force.

- *U.S. overseas posture and operations tempo.* Fighter units and support aircraft are flying up to 50 percent of their total flight hours overseas. Pre-QDR fighter units could support only about half a squadron more than the level demanded. Without reductions in overseas demands, QDR-mandated cuts in fighter forces will leave these forces almost no backup capacity.

SPONSOR: Air Force Office for the Quadrennial Defense Review

DAWMS/OMA: Achieving and Maintaining Theater Air Superiority

THE CHALLENGE: In 1995, the Joint Chiefs, Secretary of Defense, and U.S. Congress ordered a study of the deep attack systems of all the services—the Deep Attack Weapons Mix Study (DAWMS)—to determine the appropriate force size and mix. In February 1996, President Clinton directed the Department of Defense to expand the study to explore the possibility of consolidating or restructuring the deep attack force structure given growing

inventories of attack weapons. Recommended force structures would likely also affect missions other than deep attack. Therefore, in July 1996, the Secretary of Defense requested assessments of five other mission areas (OMA), giving the Air Force the lead in assessing the air superiority mission. The Air Force asked PAF to help determine the impact of changes in the air superiority force structure on the ability of U.S. and coalition forces to achieve and maintain air superiority.

RAND'S RESEARCH: PAF worked with the Air Force Studies and Analysis Agency (AFSAA) to analyze the effectiveness of air superiority force structure options for fighting two simultaneous major theater wars (MTWs). We compared the AFSAA's Tac Thunder campaign model results with TACWAR results for the same scenarios, identifying assumptions that led to different conclusions. We examined scenario alternatives, including warning times, basing rights, the time between the two MTWs, and the use of weapons of mass destruction.

PAF examined additional scenarios, placing stress on the air superiority force structure, estimating the effects of peacetime commitments and military operations other than war, and gauging the impact of each option on multiple objectives and measures of effectiveness. We also determined the impact of force structure reductions on the ability of U.S. and coalition forces to achieve and maintain air superiority in a "near-peer" scenario.

SPONSOR: Air Force Office for the Quadrennial Defense Review

Support to Global Engagement '97

THE CHALLENGE: The Air Force's *Global Engagement '97* war game employed joint and combined forces in an attempt to demonstrate the unprecedented leverage available to national leaders through global situational awareness, the ability to orchestrate military operations theaterwide, and the ability to

deliver intensive firepower over global distances within hours to days. PAF was asked to help design, prepare, conduct, and document the game so that it would achieve its purpose: to illustrate to a broad audience the important contributions aerospace power can make in protecting and advancing the nation's interests today and into the next century.

RAND'S RESEARCH: PAF worked with the Air Force Wargaming Institute (AFWI) to define game objectives, to design a game to meet those objectives, to create a credible scenario for the game, and to identify issues for pregame analysis, such as the depiction of space capabilities, information operations, mobility, and logistics. PAF also worked with AFWI, other agencies, and contractors to analyze the scenario, to prepare game materials, and to execute a pregame and the game itself. Finally, PAF contributed to the documentation of the game's conduct and outcomes.

SPONSOR: Commander, Air University

Air Force Long-Range Planning Process

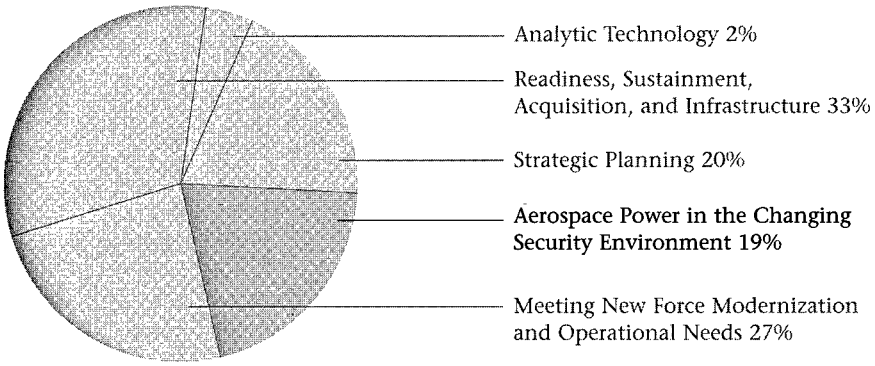
THE CHALLENGE: In 1995, the Chief of Staff determined that Air Force corporate planning processes needed to link more strongly to those of the Department of Defense while complementing internal Air Force planning processes. In 1997, the Air Force established the office of Director of Strategic Planning and asked for PAF's assistance to develop a long-range planning framework, to refine the implementation of key planning initiatives, and to make available the results of relevant PAF research.

RAND'S RESEARCH: PAF has helped the Air Force define, implement, and revise a planning framework that builds on the RAND-developed strategy-to-tasks framework and expands it by including both operational and functional tasks. The framework has been linked to other planning initiatives within

the Air Force as well. The research team maintained frequent contact with the Director of Strategic Planning, assisting with briefings, developing scenarios, participating in analytic exercises, reviewing preliminary papers, and analyzing methodologies. This project arranged for a number of briefings on related RAND research and has delivered relevant PAF and RAND documents. Activities have focused on long-range technology planning and the transition to a 21st-century aerospace force.

SPONSOR: Director of Strategic Planning, Office, Deputy Chief of Staff (DCS)/Plans and Programs

Research Highlights



Aerospace Power in the Changing Security Environment

Broad global and regional developments invariably affect Air Force operations and occasionally drive Air Force and overall U.S. military strategy. PAF analyses of the changing security environment support Air Force long-range planning activities. In FY97, PAF began an analysis of Chinese defense modernization, analyzed terrorism and counterterrorism, and examined U.S.-Turkish security cooperation, all of which bear important implications for the application of U.S. air and space power. More comprehensively, PAF investigated new theories of aerospace power for the 21st century and analyzed the operational, institutional, organizational, and functional challenges of integrating air and space operations. ◆

Chinese Defense Modernization

THE CHALLENGE: China is emerging as a regional power that will affect U.S. foreign policy well into the 21st century. A better understanding of China's interests and strengths will help prevent crises and avoid war. The Air Force asked PAF to investigate China's strategic and cultural direction, military capabilities, and political, economic, and military vulnerabilities. The purpose is to understand the likely demands and constraints on Air Force operations during potential crises in East Asia.

RAND'S RESEARCH: Multidisciplinary research, combined with our relationships with the Chinese military, have helped to build at RAND a center of excellence on Chinese defense matters. We have examined China's strategic, economic, political, and cultural directions, as well as Chinese policies toward key Asian countries, highlighting potential Chinese responses to strategic initiatives by other regional actors, including the United States. We are focusing on present and projected Chinese military capabilities, including offensive information warfare, space assets, long-range precision strike missiles, weapons of mass destruction, the science and technology base, and military doctrine.

PAF is weighing both sides of the deterrence equation: how China might deter the United States from intervention in the region, and how the United States might deter China from actions inconsistent with U.S. objectives. The research is assessing China's political, economic, social, and military vulnerabilities to identify what must be threatened to deter China and, if deterrence fails, the targets that should be attacked. The implications for U.S. policy and the U.S. Air Force involve regional presence, power projection, modernization programs, and multilateral diplomatic efforts. Emphasis is being placed on China's ability to use asymmetric strategies against the United States and on possible ways for the United States to mitigate the adverse effects.

SPONSORS: DCS/Air and Space Operations; Commander, Pacific Air Forces;
Director of Intelligence, Surveillance, and Reconnaissance, Office, DCS/Air and Space Operations

Terrorism and Counterterrorism

THE CHALLENGE: Terrorism against U.S. personnel in Saudi Arabia highlighted the significant risk to the Air Force and other U.S. forces as well as to U.S. security and interests. The setting, motives, means, and opportunities of terrorists are changing in ways that pose new problems for force protection and for national counterterrorism strategy. PAF was asked to examine the evolution of the terrorist threat, potential ways to reduce Air Force vulnerability, and the role of air and space power as a counterterrorism instrument.

RAND'S RESEARCH: Drawing on a multidisciplinary team and a terrorism database maintained by RAND and the University of St. Andrews in Scotland, we found that a new type of terrorism—more diverse, more lethal, and more highly networked—has emerged as a stand-alone and likely "asymmetric" threat in regional conflict. We examined the potential for terrorist use of weapons of mass destruction against air bases and concluded that on-base or near-base risks remain the most serious problem. Other terrorist attacks could disrupt information systems.

We found that an expeditionary approach to Air Force operations would reduce exposure to terrorism but would place a premium on beyond-the-

The Air Force must look beyond state-sponsored terrorism, must deter and respond to networks of individuals as well, and must make terrorism more transparent through surveillance.

perimeter defense and on area-specific expertise. We developed a national counterterrorism framework with "core," "environment-shaping," and "hedging" strategies, and noted the increasing importance of identifying terrorist network nodes. We concluded that the Air Force must look beyond state-sponsored terrorism, must deter and respond to networks of individuals as well, and must make terrorism more transparent through surveillance.

SPONSORS: DCS/Air and Space Operations; Director of Intelligence, Surveillance, and Reconnaissance, Office, DCS/Air and Space Operations

U.S.-Turkish Relationships

THE CHALLENGE: Turkey is a key U.S. ally, but security cooperation between the two countries has become more difficult in the past two years, complicating U.S. Air Force operations out of Incirlik Air Base. The Air Force Deputy Chief of Staff for Air and Space Operations asked PAF to examine, on a time-urgent basis, the causes of the changing relationship and to suggest steps that the Air Force and Department of Defense (DoD) might take to improve matters.

RAND'S RESEARCH: Based on visits to Turkey; meetings with Turkish military leaders, foreign ministry officials, and parliamentarians; and discussions with U.S. diplomats, PAF proposed a strategy to improve military-to-military relationships with Turkey. The strategy focused on the strategic importance and location of Turkey for future national security—especially for U.S. energy security. Results were briefed to the Air Force Chief of Staff and to other senior DoD officials. An important characteristic of our regional analysis is that it be time-sensitive and responsive to real-world events as they unfold.

SPONSOR: DCS/Air and Space Operations

Aerospace Power in the Service of National Security in the 21st Century

THE CHALLENGE: Traditional theories of air power focus on identifying and destroying fixed targets during large-scale conventional conflict. These theories fail to capture other dimensions of air and space power that are increasingly important in peacetime and conflict—for example, rapid global mobility and information superiority. Traditional theories also may have limited applicability to smaller-scale conflicts and to crises dominated by weapons of mass destruction. A broader construct is necessary to describe and guide the totality of aerospace power's contribution to national security in the 21st century.

RAND'S RESEARCH: The first phase of this research assessed the strengths and weaknesses of past theories, identified future security challenges, explored the integration of air and space power with other instruments of national power, analyzed the role of nuclear weapons in air power theory, compared options to reduce the vulnerability of the Main Operating Base to ballistic and cruise missile attack, and examined the Air Force's role in information operations. In FY97, we also began to interview senior Air Force leadership about the ideas they think are shaping air and space power. In FY98, we will complete these interviews, evaluate air and space power as a coercive instrument, consider alternative basing and deployment regimes for shaping the international security environment, explore the evolving relationship between fire and maneuver, and present an integrated construct that explains how aerospace power can best be used to protect U.S. interests in the early 21st century.

SPONSORS: Assistant DCS/Air and Space Operations; Director of Strategic Planning, Office, DCS/Plans and Programs

Integrating Air and Space Operations

THE CHALLENGE: The October 1996 CORONA meeting emphasized the importance of integrating U.S. Air Force air and space operations to serve the longer-term goal of evolving the Air Force into a "space and air" force. That evolution is complicated by the recent space management reorganization efforts of the Office of the Secretary of Defense. The objective of this continuing study is to help the Air Force develop and implement a strategy for integrating space capabilities into Air Force and joint military operations.

RAND'S RESEARCH: We have assessed the implications of integration for Air Force policy, doctrine, education and training, organization, and resource management. Two extremes emerge for the Air Force: from integrating operations while divesting itself of space system ownership to developing warfighting capabilities from air and space while maintaining space stewardship. Either way, integration requires the Air Force to make radical changes in operations, institutions, organizations, and functions.

Operational changes include new linkages between doctrine and vision, new exercises that involve space from the beginning, and exercises that integrate organizations, command structures, and concepts of operation. Institutional changes include tradeoffs among missions, platforms, personnel, and budgets, along with adjusted career incentives. Organizational changes start with delegating space and air responsibilities and authorities among the Air Staff. Functional changes include common technical specifications and coordinated standards for air and space systems.

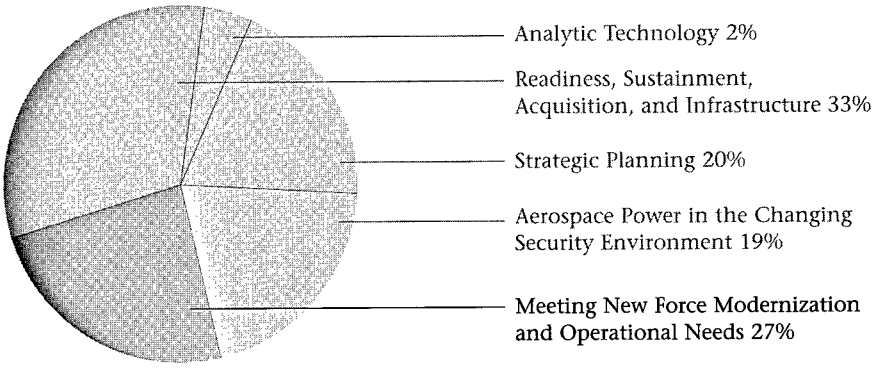
We recommend three ways to overcome major barriers to integration: (1) align vision and function; (2) shift the emphasis from air and space systems to enterprises; and (3) use education, training, and assignment policies to

***Integrating** air and space operations requires the Air Force to make radical changes in operations, institutions, organizations, and functions.*

overcome cultural resistance to integration. We have charted alternative paths the Air Force might take as it determines its enterprises and integrates the resulting air and space functions, and we have plotted timelines for alternative integration paths.

SPONSORS: Assistant DCS/Air and Space Operations; Commander, Space and Missile Systems Center, Air Force Materiel Command; Director of Plans and Programs, Air Force Space Command

Research Highlights



Meeting New Force Modernization and Operational Needs

The Air Force faces great uncertainty about future conflict environments, and it is these environments that will influence how the Air Force must modernize its forces. And although many technological opportunities exist, technological and operational risks also must be evaluated. Finally, the Air Force, along with the other military services, has faced severe budget constraints over the past several years, leading to a significant decline in force structure. Whatever choices are made regarding force modernization and combat employment, they need to be sound ones. There is little margin for error.

This year's research focused on new concepts for ground attack; the degree to which unmanned air vehicles should replace manned aircraft; enhanced Air Expeditionary Forces; an investment strategy for C4ISR (command, control, communications, computers, information, surveillance, and reconnaissance) capabilities; and the exploitation of commercial space systems to augment military space systems. Toward the end of the year, additional research was begun to compare fighter and

bomber force mixes for future scenarios and to analyze reusable launch systems and their effects on military operations. These two projects will be treated more fully in next year's report. ◆

New Concepts for Ground Attack

THE CHALLENGE: The Air Force today has fewer than half as many air-to-ground attack platforms as it had during the Cold War and faces constrained budgets with which to modernize these forces, even though air-to-ground missions are identified as critical to the Air Force's global engagement strategy. The Air Force must find ways to expand its portfolio of attack options to meet future requirements.

RAND'S RESEARCH: The research team examined new technical approaches and operational concepts to maintain or enhance selected ground attack capabilities. The team compared the survivability and weapon delivery effi-

Advances in robotics and cooperative behavior logic, coupled with onboard communications and sensors, can lead to revolutionary new air-to-ground weapon concepts possessing levels of robustness, adaptivity, and effectiveness unmatched by current systems.

ciency of direct attack options and of standoff weapons, the latter delivered from fighters with varying degrees of stealth, from larger aircraft, or from unmanned tactical aircraft. This work illustrated the conditions under which different options enjoyed a comparative advantage.

The research further illustrated how technological advances, such as miniaturized munitions, can greatly reduce the resources needed to attack certain targets. Other research concluded that nonlethal weapon concepts can add to a commander's attack options but cannot replace conventional attack methods. Finally, the research demonstrated how advances in robotics and cooperative behavior logic, coupled with onboard communications and sensors, can lead to revolutionary air-to-ground weapon concepts possessing levels of robustness, adaptivity, and effectiveness unmatched by current systems.

SPONSOR: Director of Operational Requirements, Office, DCS/Air and Space Operations

Implications of Unmanned Air Vehicles for the Future Air Force

THE CHALLENGE: The Air Force is increasingly obliged to search for more cost-effective ways to achieve its objectives. One promising option is the expanded use of unmanned air vehicles (UAVs) to supplement, or perhaps replace, manned aircraft or satellites in some roles. Not only might UAVs be cheaper, but removing humans from air vehicles might offer additional advantages in missions requiring long endurance or high maneuverability. UAVs, however, also pose technical and operational challenges. The Air Force asked PAF to help determine how UAVs can and should replace (or supplement) manned aircraft and other systems—and how the Air Force should invest its resources to facilitate the transition.

RAND'S RESEARCH: This year the research team screened a variety of Air Force missions for potential UAV application, developed a set of preliminary

UAV designs, analyzed their potential performance and cost, and conducted UAV trades against other systems to define the criteria that UAVs must meet to be preferred for each mission. Future work will chart development paths for key technologies and outline an investment strategy for phasing in UAVs while phasing out or curtailing other systems.

We focused our analysis this year on reconnaissance and surveillance, on ground attack—particularly suppression of enemy air defenses—and, to a lesser extent, on communications. These are areas where UAVs appear to offer the greatest potential payoffs. We need to analyze other mission areas, however, in order to make overall force structure comparisons and to present a comprehensive view of where UAVs might fit into the future Air Force. Accordingly, we are continuing our UAV study for a second year.

SPONSORS: Director of Operational Requirements, Office, DCS/Air and Space Operations; Principal Deputy Assistant Secretary of the Air Force for Acquisition

Design and Employment of an Air Expeditionary Force

THE CHALLENGE: To respond to an unpredictable post–Cold War defense environment, the Air Force has developed rapidly deployable packages of air and space power called Air Expeditionary Forces (AEFs) to provide combat power tailored to regional challenges. In future crises, AEFs will be called upon as a flexible deterrent option, often heading off the need for further engagement by virtue of their early on-scene arrival, which will be tailored for the situation, and their demonstration of U.S. resolve. AEFs are still under development, and PAF has been asked to conduct a two-year investigation of issues related to AEF basing, structure, operations, deployability, and supportability to identify and remove constraints on AEF effectiveness.

RAND'S RESEARCH: The research team formulated scenarios to exemplify the range of AEF missions and addressed specific challenges. To support logistics and mobility, PAF formulated ways to estimate supply and demand for fuel,

In future crises, Air Expeditionary Forces will be called upon as a flexible deterrent option, often heading off the need for further engagement by virtue of their early on-scene arrival, which will be tailored for the situation, and their demonstration of U.S. resolve.

munitions, vehicles, and other resources. PAF developed a framework, called the AEF Dynamic Analysis and Planning Tool (ADAPT), to evaluate methods for supplying resources when and where needed. ADAPT will evaluate regional support bases, downsized base support packages, prepositioning options, and force alert statuses. For communications, the study evaluated the effectiveness of a wide range of emerging systems for meeting current and future AEF requirements. And in support of international policy, the study developed strategies to help ensure access to overseas bases. This research concludes in FY98.

SPONSOR: DCS/Air and Space Operations

Investment Guidelines for Information Operations

THE CHALLENGE: Air Force "vision" documents, including *Global Engagement* and *Joint Vision 2010*, call for a collaborative and continuously updated information environment to support future military operations. The objectives of the PAF study are (1) to determine how well the Air Force is positioned to conduct such information operations, and (2) to develop investment guidelines to help the Air Force fulfill its vision.

RAND'S RESEARCH: Air Force information operations are transitioning to an intermediate phase of information age—or "third-wave"—warfare. Whether or not the Air Force embarks on programs to establish and maintain a collaborative and continuously updated information environment, Air Force decisionmakers should focus first on resolving problems with existing C4ISR assets. Only then should decisionmakers tackle the tradeoffs—among weapon systems, alternative levels of C4ISR support, and new concepts of operation—that ultimately will be required to provide the most cost-effective capabilities.

An investment strategy should balance capabilities across the four key information functions of collection, analysis, communications, and integration into the command and control (C2) systems of decisionmakers. For collection, the Air Force should lead the development of onboard, long-dwell-time, imaging radars and of offboard, ground-focused moving-target indication radars—sensor systems needed for interdiction, strikes, theater missile defense, and suppression of enemy air defenses. To overcome a large imbal-

Whether or not the Air Force embarks on programs to establish and maintain a collaborative and continuously updated information environment, Air Force decisionmakers should focus first on resolving problems with existing information assets.

ance between collection and analysis, the Air Force should insert analysts into the real-time data streams of new sensors, develop meta-analysts responsive to the needs of decisionmakers, and help test software for automatic target cueing, automatic target recognition, and smart agents. For communications, investments are needed to ensure the Global Broadcast System and Joint Tactical Information Distribution System disseminate adequate information to weapon system operators. And C2 integration requires investments in three key capabilities: an intelligence, surveillance, and reconnaissance (ISR) planning tool, an information operations planning tool, and common air, ground, and maritime operational and tactical pictures.

SPONSOR: Director of Intelligence, Surveillance, and Reconnaissance, Office, DCS/Air and Space Operations

Supporting Space Operations

THE CHALLENGE: Although the Air Force is developing comprehensive plans to exploit space for military use, providing all the desired capabilities with dedicated military assets is budgetarily infeasible. PAF was asked to identify commercial technologies, systems, and services that might increase the effectiveness or decrease the cost of military space operations.

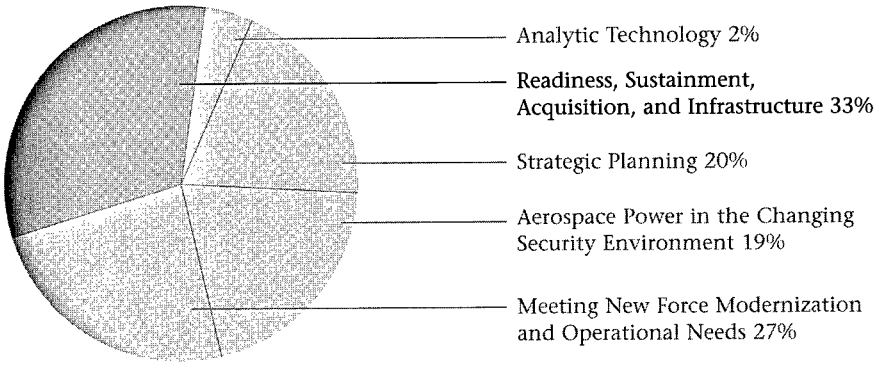
RAND'S RESEARCH: PAF is examining satellite communications as an area where strong growth is expected in both military demand and commercial capacity. Current Air Force MILSATCOM planning anticipates that daily military demand for unprotected, high-data-rate communications may exceed five gigabytes per second between 2005 and 2010. Over the same time, commercial industry intends to vastly increase capacity, virtually reinventing the communications market. It is impossible to know if these expectations will come true. Therefore, PAF is developing investment options adaptable to a range of future conditions. These options—offering a mix of communications capacity, availability, robustness, and cost—included (1) leasing systems

year-to-year, (2) buying systems and paying industry to operate them, and (3) buying large blocks of capacity either from a particular system or from a service provider who obtains capacity from one or more systems.

Four major observations are emerging. First, a mix of system purchases, capacity purchases, and short-term leases might offer the best combination of cost, capacity, availability, and robustness. Second, capacity purchases might offer large savings but also might increase the financial and technical risks borne by the government. Third, whereas some companies could develop proprietary systems, others are proceeding toward more open architectures; therefore, the Department of Defense should promote commercial standards, common ground terminals, and "communications commodities." Finally, to take advantage of emerging opportunities, the DoD should be willing to become a founding customer for systems or services and to change providers if advantageous. We are continuing to examine these and other options during the final year of the project.

SPONSORS: Director of Programs, Office, DCS/Plans and Programs; Director of Plans and Programs, Air Force Space Command; Director, Space and Nuclear Deterrence, Office of the Assistant Secretary of the Air Force for Acquisition

Research Highlights



Readiness, Sustainment, Acquisition, and Infrastructure

Given budget constraints, the Air Force needs to identify policies—related to personnel, logistics, acquisition, and the industrial base—that will maximize the combat effectiveness of weapon systems. PAF has looked at ways to sustain the force that are more cost-effective, more responsive to changing mission needs, and more integrated with deployment planning. The projects described below have explored innovative ways to improve lean logistics, to exploit the commercial industrial base and private sources of support, to assess and maintain readiness, to promote mission preparedness and quality of life, and to relate infrastructure and training needs to the demand for airspace and ranges. ◆

Lean Logistics

THE CHALLENGE: In the past, it has been thought possible to extrapolate logistics plans for a slowly evolving threat based on marginal changes in an existing system's resources, processes, and postures. In practice, the logistics system always relied on ad hoc resource allocations, priority shipments, expedited transportation, and other adaptations to overcome the inherent demand uncertainties that typify wartime and cause startling disruptions even in peacetime. Historically, the logistics system could draw upon its large mass of materiel, facilities, and personnel to meet force needs, even when predictions fell short. Today, that mass is rapidly diminishing. The system no longer can rely on acquiring, prepositioning, deploying, and resupplying an overwhelming amount of resources to meet unpredictable demands. Moreover, accurate predictions are nowhere in sight. Changing force sizes and mixes, geopolitical instabilities, the aging force, and diminishing support resources have exacerbated the demand uncertainties. The Air Force needs a robust logistics system capable of meeting the increasingly unpredictable needs of a flexible, dynamic force.

RAND'S RESEARCH: To help the Air Force approach its lean logistics goals, the research team addressed several facets of the existing logistics system design. The team evaluated the planned wartime distribution architecture for spare parts, building on an earlier analysis of the distribution architecture for fighter engines. When the team found that the architecture could not meet lean logistics goals, it identified alternative architectures and processes that would meet the goals. Future work will extend these two studies to cover more materiel and processes. Working with the Air Force Materiel Command to help depot shops achieve their lean logistics goals, the research team surveyed shop supervisors about the causes of delayed parts and then tested a motivational metric to help shops improve responsiveness and cost-effectiveness.

Moving beyond lean logistics to "agile combat support," the team worked with Air Force agencies and contractors to speed the deployment of Air

Expeditionary Forces. The analyses recommended innovations in billeting troops, fueling equipment, and delivering munitions; addressed the logistics system structure; and highlighted other actions needed before and after deployment. Future work will extend this effort to other resource groups.

Finally, the team outlined a concept for managing aging aircraft. Building on a study from the Air Force Scientific Advisory Board, the team found that the Air Force needs to review the supportability of aging aircraft, to revise inspection intervals, to speed inspection times as inspection intervals decrease, and to develop a comprehensive modernization plan for aging aircraft.

SPONSOR: DCS/Installations and Logistics

Enhanced Air Force Use of the Commercial Industrial Base

THE CHALLENGE: The Department of Defense is encouraging the services to reduce weapon system procurement costs and increase reliability and performance through greater use of the commercial industrial base. This project assesses the costs and benefits of increased civil-military integration (CMI) for Air Force acquisition and develops implementation strategies. To identify risks, the work focuses on market failures, such as monopoly pricing or "failure by existence" (the latter implies that products or services are not available at all). The project proposes policy initiatives and program structures—such as improved contracts—to take advantage of CMI's potential while minimizing risks.

RAND'S RESEARCH: Although CMI strategies and contract instruments are being developed in a variety of Air Force and DoD pilot programs, numerous uncertainties and risks remain. We are developing a model to help identify the optimal contract structure. Whereas many pitfalls can be avoided by adopting commercial approaches, more pilot programs should be initiated

to help resolve uncertainties. Such pilot programs should include the following:

- *Greater cost- and risk-sharing with the contractor.* In the commercial world, the seller pays all R&D costs and accepts all developmental risks. Contractors for major defense systems are unlikely to accept this arrangement because of greater market uncertainties and only one buyer. Nonetheless, contractors can be encouraged to share more cost and risk as a means of controlling R&D cost and encouraging greater use of commercial parts and technologies.
- *Maintaining competition as long as possible throughout R&D.* Greater cost sharing with contractors permits the government to prolong competition, which helps control costs and brings numerous other benefits.
- *Maximum flexibility in contracts and program structure.* Contractors should be able to propose a variety of contract packages, including tradeoffs among price, warranty, support, and other factors.
- *Full implementation of current acquisition reforms.* CMI cannot be exploited fully without acquisition reform, including acceptance of contractor configuration control and change authority, elimination of military specifications and intrusive regulatory and oversight measures, use of broad mission requirements, and emphasis on cost as an independent variable.

SPONSOR: Principal Deputy Assistant Secretary of the Air Force for Acquisition

Improved Operations Through Enhanced Access to Private Sources of Support

THE CHALLENGE: One way to generate funding for Air Force modernization is to streamline the support infrastructure. Improved contracting for external support can reduce cost, enhance performance, and provide access to better external sources. Improved outsourcing and privatization also can

motivate internal sources to compete and can provide access to better external sources when internal sources fail to compete. Such policies would help streamline the infrastructure without compromising agile combat support.

RAND'S RESEARCH: The research examined two areas in which contracting and outsourcing are increasingly important: facility management and depot-level maintenance. Based on literature reviews of commercial practices and on interviews with executives and senior managers at about 40 sites, the research team found that innovative commercial users and providers have found ways to increase performance over time while controlling or reducing cost.

The Air Force can exploit many of these innovations through ongoing efforts to adopt commercial-type standards and contracting methods and to implement acquisition reform. Moreover, innovative commercial firms are developing methods that extend well beyond current Air Force efforts to change. The research team expects to find additional ways to introduce commercial innovations into Air Force contracting and outsourcing policy and practice.

SPONSORS: DCS/Installations and Logistics; Director of Programs, Office, DCS/Plans and Programs

Force Mix, Capability, and Readiness

THE CHALLENGE: Budget reductions and a hectic pace of operations have decreased the number of available forces, reduced training opportunities, and thinned support resources, all of which imperil readiness. The Air Force has asked for comprehensive reviews of its total force mix and of methods for assessing and maintaining readiness.

RAND'S RESEARCH: The research team examined the effects of war plans, peacetime operations, and basing and personnel policies on the total force mix, including active, guard, and reserve units, full-time and part-time military personnel, and civilian and contractor personnel. Preliminary

results indicate limitations in shifting active forces to the guard and reserve forces, but potential overstatements of total manpower needs.

PAF recommends that readiness assessments examine various contingencies, measure the preparedness of collections of similar units rather than individual units, and concentrate on resource management. In this regard, a new computer model promises an analytical breakthrough in relating the training resources of flying squadrons to their operational capabilities. Early results indicate that declining experience levels might require 20 percent or more flying hours for some fighter squadrons to maintain mission qualifications.

SPONSORS: Director of Operations and Training, Office, DCS/Air and Space Operations; Director of Programs, Office, DCS/Plans and Programs

What Helps and What Hurts: How Ten Activities Affect Mission Preparedness and Quality of Life in the U.S. Air Force

THE CHALLENGE: For about ten years, Air Force leaders have suspected that an increased pace of activities has jeopardized mission preparedness, reduced quality of life, and driven many individuals to leave the service. While personnel has been cut 37 percent, peacekeeping operations and other duties have expanded. Air Force research to isolate the problem has focused mostly on pilots and peacekeeping operations. PAF was asked to consider a broader spectrum of personnel and activities in order to identify which activities enhance or degrade mission preparedness and quality of life.

RAND'S RESEARCH: PAF surveyed nearly 500 Air Force supervisors to compare the effects of ten activities on all personnel at three diverse bases. The results indicate that all personnel are experiencing stress and that peacekeeping operations are not the only source of the problems. In particular, according to respondents, inspections and their associated wing exercises often lack relevance to mission preparedness, consume large amounts of time, degrade

***The similarity** of responses across all personnel groups at three diverse bases points to inspections and wing exercises as problems that might exist across the entire Air Force.*

professional growth, and damage personal and family life. The activities rated most positively are routine peacetime operations and local training. The similarity of responses across all personnel groups at three diverse bases points to inspections and wing exercises as problems that might exist across the entire Air Force.

Fortunately, the Air Force "owns" these activities and can do something about them. In fact, the Air Force already has taken several steps, supported by the PAF survey, to deal with these problems. The Air Force has (1) combined inspections with deployments, where possible, and combined military and civilian inspections for medics; (2) recruited more security police, whose work often gets consumed by inspections and wing exercises; (3) requested an additional PAF study to include headquarters' staffs; and (4) convened an Air Force conference to develop strategies to track the implementation of these initiatives and future recommendations.

SPONSOR: Commander, 8th Air Force

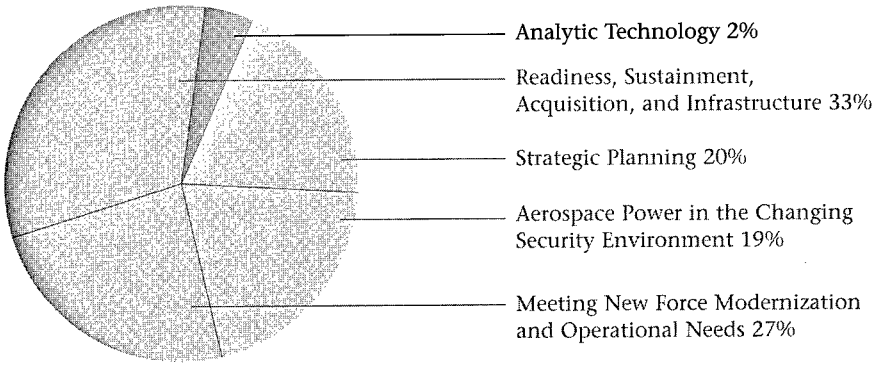
Relating Mission and Training Requirements to the Demands for Airspace and Ranges

THE CHALLENGE: Facing competition for airspace and ranges from commercial, community, and environmental interests, the Air Force must justify its needs for training purposes. Historically, only weak links have connected national military strategy and Air Force operational capabilities with training requirements and infrastructure needs. As a result, the Air Force has difficulty justifying new or existing assets and has lost several legal challenges regarding use of land for range operations.

RAND'S RESEARCH: We found no explicit documentation of linkages between Air Force training requirements and operational requirements. We also found that current lists of national and Air Force operational requirements—for example, the Uniform Joint Task List and the Air Force Task List—follow a ground conflict model that does not fully represent how aerospace power can support national objectives. Therefore, PAF developed a Joint Mission Framework linking missions, objectives, and tasks—including 84 tasks that are further linked to training and infrastructure requirements. We constructed a relational database to cross-reference our lists with the Ready Aircrew Program, which specifies upgrade and continuation training requirements for Air Force flying units. We will use the relational database to generate a statement of range and airspace requirements for training purposes explicitly linked to national objectives. Later stages of the research will relate requirements to resources and identify deficits and surpluses.

SPONSORS: Director of Operations, Air Combat Command; Director of Operations and Training, Office, DCS/Air and Space Operations

Research Highlights



Analytic Technology

The Air Force faces a wide spectrum of decisions that are complicated by major uncertainties, crucial details, and interactions among decisions. Fundamental to all these decisions is finding better ways to demonstrate the contribution of aerospace forces to joint operations, prompting PAF to explore improved methods of analysis. Analytic innovation is part of our research projects generally, but this year we focused on two new analytic technologies: advanced distributed simulation (ADS) and exploratory analysis. ADS examines the components of modeling tools, and both technologies offer alternative modeling techniques that can be useful in decisionmaking. Exploratory analysis, in fact, has been applied directly to our research on enhancing aircraft survivability. ◆

Improving Air Force Analysis with Advanced Distributed Simulation

THE CHALLENGE: Pioneering ADS analyses—such as airborne laser tests at the Theater Air Command and Control Simulation Facility—are under way, yet technological challenges have interfered with credible analysis. Initial efforts have been limited to hooking the distributed components together, rather than obtaining reasonable analytic insights. There is a great need to improve the utility of ADS for the Air Force in general and for the analytic community within the Air Force in particular.

RAND'S RESEARCH: PAF has identified several areas where decisionmaking could benefit from ADS and where improvements are still necessary. ADS has great potential for increasing the effectiveness, scope, and depth of analysis. In combination with traditional methods, ADS can represent human interactions more credibly. Traditional methods can examine a greater breadth of cases and refer to those conditions where ADS is essential. These benefits will not be achieved, however, without overcoming a variety of technical, operational, and administrative challenges in hardware, software, analysis, and management. Deficiencies in the decision logic, which simulates human decisions in computer-generated forces, are major impediments to establishing a synthetic battlefield.

To reap the benefits of ADS, interoperability among models must be achieved. We need to establish commonly accepted methods of representing combat elements, document the models and standards used, develop trusted implementations through frequent and wide usage, and provide easy access to the models. Further research is needed if ADS is to become an oft-used and credible vehicle for analysis. Given that ADS is often best used in conjunction with traditional simulations, investments also must be made in traditional models and their analytical methods.

SPONSOR: Director of Command and Control, Office, DCS/Air and Space Operations

Exploratory Analysis

THE CHALLENGE: Are there other ways to enhance modeling, simulation, and analysis to improve Air Force decisionmaking? Instead of examining only what models contain, can exploratory analysis improve how models are used?

RAND'S RESEARCH: To demonstrate the differences between exploratory analysis and traditional sensitivity analysis, we studied a problem of interest to the Air Force—the weapon mix problem—using both approaches and comparing the results. With traditional sensitivity analysis, the preferred weapon mix changed in nonintuitive, seemingly erratic ways given marginal changes in weapon reliability, sortie rate, and deployment schedule. These results could imply a faulty model or errors in the data, leaving us with little confidence in the outcomes. The real problem is that the traditional analytic approach itself—how the model and data are used—is incomplete and therefore misleading.

The traditional approach finds only a small number of weapon mix options, whereas exploratory analysis discovers a far richer set of options. Exploratory analysis can determine the full range of successful weapon mix trades, demonstrate the impact of additional constraints (such as cost or risk), select a weapon mix robust across contingencies, and reduce or neutralize the risk of uncertainties.

SPONSOR: Director of Command and Control, Office, DCS/Air and Space Operations

Options for Enhancing Aircraft Survivability

THE CHALLENGE: Attrition of airborne platforms and weapons has a major impact on how they contribute to a military operation, but most examinations of aircraft survival concentrate on just one or two options for the

offense or defense. Thus, a more comprehensive assessment is needed. Options to improve survivability include signature reduction, electronic combat, speed, maneuver, standoff distance, and lethal and nonlethal suppression of enemy air defenses (SEAD)—alone and in various combinations. The effectiveness of these options must be considered along with their cost, risk, and long-term durability against countermeasures. This analysis will help the Air Force make investment choices to enhance survivability and force effectiveness.

RAND'S RESEARCH: We have completed Phase I of a study that builds on our DAWMS Attrition Database Study and demonstrates the use of exploratory analysis to examine tradeoffs among low observability, electronic combat, and SEAD. We have completed a description of the methodology, a test of the methodology, and an analysis of one-on-one surface-to-air missile engagements, including the advanced SA-10C. Using criteria from Desert Storm, we have constructed threat avoidance routes. We are completing our examination of SEAD tactics and of the ground-based air defense command and control system. And we have begun to analyze these options as they affect survivability at the mission level. Subsequent phases will analyze alternative SEAD concepts; additional defense characteristics; weapon survivability and effectiveness; survivability enhancement options for air-to-air combat; and the risks, cost, and durability of these options.

SPONSOR: Principal Deputy Assistant Secretary of the Air Force for Acquisition

A Look Ahead

Beginning with fiscal year 1998, PAF research will be organized around themes, and the research plan will comprise a two-year rather than a one-year framework. The thematic organization will sharpen the focus of research on enduring Air Force policy problems, while the two-year perspective will allow more time to explore complex issues fully.

For fiscal years 1998 and 1999, research will be organized around 11 broad themes developed in collaboration between PAF and the Air Force Steering Group that oversees PAF. The themes, along with their respective Air Force sponsors, are listed below:

FY98 / FY99 RESEARCH THEME	**AF SPONSOR**
A. EXTERNAL CHALLENGES What major external challenges and opportunities are likely to affect Air Force operations in the future?	AF/XO
B. GLOBAL ENGAGEMENT How can *Global Engagement* best be imbedded within Air Force operations in the future?	AF/XPX
C. REPRESENTING AIR AND SPACE How should air and space forces and capabilities be represented in joint force games, assessments, and models?	AF/XOC
D. INTEGRATING AIR AND SPACE What are the key points of leverage for integrating air and space and operationalizing space?	AF/AXO

E. REBALANCING POWER PROJECTION CAPABILITIES — AF/XOO

How should the Air Force rebalance its power projection forces and capabilities, including nuclear, in the post-QDR/National Defense Panel (NDP) environment?

F. AIR EXPEDITIONARY FORCE (AEF) — AF/XO

What is needed to implement an effective AEF capability?

G. INFRASTRUCTURE — AF/LX

How can the Air Force infrastructure meet the challenges of both *Global Engagement* and budgetary constraints?

H. WEAPON SYSTEM COSTING — SAF/AQ

What is needed to provide the Air Force with weapon system costing and acquisition best practices?

I. TOTAL FORCE MIX — AF/XPX

How should we think about and evaluate the Total Force mix or the 21st-century Air Force?

J. WORKFORCE — AF/DP

How should the Air Force organize, integrate, manage, and train the future active, reserve, civilian, and contractor workforce?

K. SURVIVABILITY — SAF/AQ

What are the most affordable and enduring design and operational options for enhancing aircraft survivability across a range of scenarios, combat situations, and enemy defenses?

Briefings

Briefings ensure ongoing collaboration and up-to-the-minute communication between PAF and the U.S. Air Force regarding the direction of research projects and their emerging conclusions. For each major division of research listed below, the first list identifies the briefing titles and briefers, while the second list identifies senior Air Force personnel and others briefed during the year. In many cases, key audience members attended several briefings. Through these briefings, the Air Force receives continuous policy guidance reflecting a broad range of expertise, and PAF maintains regular and important contact with the Air Force.

Strategic Planning

TITLES AND BRIEFERS

Institutionalizing Long-Range Strategic Planning: A Functional and Organizational Laydown (Leslie Lewis and C. Robert Roll, Jr.)

Development of a Common Air Force Strategy-to-Tasks Resource Management Framework (Leslie Lewis)

Building a Long-Range Plan for the Air Force (Zalmay Khalilzad, David Shlapak, et al.)

Defining the Air Force (Glenn Kent, David Ochmanek, David Shlapak)

Winning the Halt Phase of Future Theater Conflicts: Exploiting Advances in Firepower (Ted Harshberger and David Ochmanek)

Changes Ahead: Future Directions for the U.S. Overseas Military Presence (Richard Kugler)

Air Superiority Mission Area Assessment: 2006 Near-Peer Scenario
(Donald Stevens)

Air Superiority Modernization: RAND's Perspective on DAWMS Phase II
(Donald Stevens)

KEY AUDIENCES

Lt Gen Lawrence P. Farrell, Jr., AF/XP

Maj Gen Charles D. Link, AF/QR, and staff

Maj Gen David W. McIlvoy, AF/XPX

Maj Gen John W. Handy, AF/XPP

Maj Gen Gregory S. Martin, AF/XOR

Maj Gen Charles R. Henderson, AF/XOC

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Brig Gen Charles F. Wald, AF/QR

Brig Gen Daniel M. Dick, ACC/XP

Brig Gen Joseph H. Werhle, Jr., AF/XPP

Brig Gen William A. Peck, Jr., ACC/DR

The Honorable Edward L. Warner III, ASD/S&R

Dr. Clark Murdock, AF/XPX

AF/XO and AF/XP staff members

Col Thomas Allen, AFSAA/CC, and staff

Roundtable at RAND, November 1996

Staff, National Defense Panel

Aerospace Power in the Changing Security Environment

TITLES AND BRIEFERS

Air and Space Power in the Service of National Security in the 21st Century: Toward the Development of Effective Theories (Alan Vick)

Integrating Air Power with Other National Instruments (Ian Lesser)

Toward an Air Power Theory for a Disorderly World (Carl Builder)

Keepers of the Strategic Flame (Carl Builder)

Nuclear Weapons and the Future of Air Power (Glenn Buchan)

Ideas that Shaped Air Power (Carl Builder)

Countering Ballistic and Cruise Missile Attacks on USAF Theater Main Operating Bases (John Stillion)

Chinese Military Modernization and the USAF (Zalmay Khalilzad, Abe Shulsky, David Orletsky, David Shlapak)

The New Geopolitics of Terrorism (Ian Lesser)

Information Age Terrorism and the USAF (John Arquilla)

Terrorism and Counterterrorism: Implications for the USAF (Bruce Hoffman)

Terrorism and National Counterterrorism Strategy: Implications for the USAF (Ian Lesser)

Integrating USAF Space Operations (Dana Johnson, Ken Reynolds)

Integrating USAF Space Operations: Space Control and Information Operations (Dana Johnson, Ken Reynolds)

KEY AUDIENCES

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Brig Gen H. Marshal Ward, AFSPC/DR

Brig Gen Thomas J. Scanlan, Jr., USSPACECOM/J3

Mr. Richard McCormick, SAF/SX

Dr. Clark Murdock, AF/XPX

Air Force Steering Group

Col Andrew Corso, USAF, and AF Force Protection Working Group

Col Kevin Higgins, AF/XPXX, and Pentagon and MAJCOM representatives, USAF FY97 Modernization Planning Process Meeting

Col Thomas Allen, AFSAA/CC, and visiting analysts

Interagency Conference on Terrorism and Export Controls

Meeting New Force Modernization and Operational Needs

TITLES AND BRIEFERS

Implications of Unmanned Air Vehicles for the Future Shape of the Air Force (Glenn Buchan)

Non-Lethal Weapon Concepts and Applications for Ground Attack (Gerald Frost)

Proliferated Autonomous Weapons: An Application of Cooperative Behavior (Dave Frelinger and Joel Kvitky)

New Concepts for Ground Attack (William Stanley)

Enhancing the Effectiveness of Air Expeditionary Forces (Paul Killingsworth)

Investment Guidelines for Future Information Operations (Myron Hura)

C4ISR Implications of TMD Missions (Gary McLeod, Rich Mesic)

C4ISR Implications of Interdiction Missions (Gary McLeod, Myron Hura)

Supporting Space Operations: Exploiting Commercial Communications Systems (Tim Bonds)

Fighter and Bomber Force Structure Options for Future Military Operations (Donald Stevens)

KEY AUDIENCES

Lt Gen John P. Jumper, AF/XO

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Brig Gen William A. Peck, Jr., ACC/DR

Dr. Clark Murdock, AF/XPX

Dr. Gerald Kauvar, Deputy AF/XPM

Readiness, Sustainment, Acquisition, and Infrastructure

TITLES AND BRIEFERS

End-to-End Analytic Framework (Ray Pyles)

End-to-End Distribution Study: Outcomes (Ray Pyles)

Aging Aircraft Fleet Management (Jean Gebman, Laura Baldwin)

Motivational Metrics for Depot Shops (Lionel Galway)

Wartime Distribution for Lean Logistics (Ray Pyles)

Lean Logistics: End-to-End Analysis Framework and an Example (Ray Pyles, Hy Shulman)

Toward a Planning Process Compatible with EXPRESS (Louis Miller)

Strategic Sourcing: One Tool in the Revolution in Business Affairs (Frank Camm, Nancy Moore)

Strategic Sourcing in DoD: Lessons from Best Commercial Practices (Frank Camm)

Contracting for Depot Maintenance: The Key to Successful Outsourcing (Mary Chenoweth, Kenneth Reynolds)

Commercial Outsourcing: Patterns and Practices (Nancy Moore)

Consolidation, Competition, and Innovation: Lessons From History (Mark Lorell)

Enhanced Air Force Use of the Commercial Industrial Base: Year 2 Initial Findings (Mark Lorell)

Comparison of Wartime Manpower Requirements and Peacetime Manpower Authorizations (Craig Moore, Richard Stanton)

Readiness Assessment Concepts and Tiering (C. Robert Roll, Jr., Carl Dahlman, Bill Taylor)

What Helps and What Hurts: How 10 Activities Affect Readiness and Quality of Life at Three 8AF Wings (Lt Col Tom Fossen, Larry Hanser)

Flying Training Readiness and Resources (Bill Taylor, Craig Moore)

KEY AUDIENCES

The Honorable Sheila E. Widnall, SAF/OS

Gen Ronald R. Fogleman, AF/CC

The Honorable Robert Hale, SAF/FM

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Lt Gen John P. Jumper, AF/XO

Lt Gen Roger G. DeKok, SMC/CC, and staff, SMC-RAND Day

Lt Gen George K. Muellner, SAF/AQ

Dr. Helmut Helwig, SAF/AQR

Lt Gen William P. Hallin, AF/IL, and staff (Management Offsite on Outsourcing and Privatization)

Lt Gen Phillip J. Ford, 8AF/CC

Lt Gen Howard W. Leaf (USAF, Ret.), AF/TE

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Brig Gen Terryl J. Schwalier, AF/XOO

Brig Gen Timothy P. Malishenko, SAF/AQC

Dr. Clark Murdock, AF/XPX

Dr. Robert Wolff, AF/ILX

The Honorable John Goodman, Deputy Under Secretary of Defense for Industrial Policy

The Honorable Lou Finch, Deputy Under Secretary of Defense for Readiness

National Defense Panel staff (for review of QDR)

AFMC Strategic Privatization Roundtable

Air Force DO/IL Offsite Meeting

Air Force Logistics Board of Advisors

Air Force Logistics Symposium

ASC Government-Industry Process Action Team Summer Meeting, Wright-Patterson AFB

Brookings Institution Forum on Defense Policy Issues

Operations Group and Squadron Commanders, Moody and Hill AFBs

RAND/Center for Naval Analyses Conference on Resource Management Policy

U.S. Air Force Academy Symposium on the Defense Industrial Base

Analytic Technology

TITLE AND BRIEFER

Alternatives for Achieving Aircraft Survivability: Phase 1—Options and Scenarios (Bart Bennett)

KEY AUDIENCE

Lt Gen George Muellner, SAF/AQ, and staff

Publications

Fiscal Year 1997 Publications with Abstracts

The following abstracts summarize selected PAF publications completed during the past fiscal year. All of the publications identified below are available for public release. ◆

MR-388-AF/A, *The Theater-Level Campaign Model: A New Research Prototype for a New Generation of Combat Analysis Model*, R. Hillestad, L. Moore

Many analysts and decisionmakers argue that an order-of-magnitude leap forward in military modeling for the post–Cold War era—particularly in campaign modeling—is essential to improve the quality of analyses, training, acquisition, test and evaluation, and innovative thinking. This research has been a step to ensure that the next-generation campaign models will not be mere rewrites of tools we currently use. We investigated alternatives to four aspects of modeling we think are essential to improving theater-level campaign analysis: (1) how to create more flexible structures to simulate the wide range of future scenarios and their associated uncertainties, (2) how to link to more detailed models in an analytically valid way, (3) how to represent ground forces maneuvering at the theater campaign level, and (4) how to represent adaptive behavior and aspects of command and control better in this type of model. This research provided insights into some of the alternatives and suggested some promising directions. We built the prototype Theater-Level Campaign (TLC) model and used it as a test bed for the different approaches. In many cases, we tried methods and then, finding they were not promising, removed that code and started over in the true spirit of prototyping. We believe this type of prototyping and experimentation is critical to the advancement of the state of the art of campaign modeling and

analysis. The various sections of the report describe the results associated with each aspect of our experimentation and conclude with more general observations and recommendations for the future.

MR-618-AF, *Evolution of the Air Campaign Planning Process and the Contingency Theater Automated Planning System (CTAPS)*, D. R. Gonzales

This report summarizes an examination of the air campaign planning process, including observation of how the process was conducted in recent exercises and a review of how the process was performed during the Gulf War. A number of suggested changes to the process are recommended that, in conjunction with changes to the Contingency Theater Automated Planning System (CTAPS), could improve the process significantly and reduce the time needed for production of the Air Tasking Order from 48 to 24 hours. CTAPS capabilities were examined as a part of this study. The CTAPS 5.0x and planned 6.0 architectures were reviewed and suggestions presented that could enhance the operational capabilities of the system. This report should be of interest to project managers and monitors of CTAPS and related programs, to those interested in the air campaign planning process, and to those responsible for developing Department of Defense or Air Force information system architectures.

MR-623-AF, *Russia's Air Power at the Crossroads*, B. S. Lambeth

This report assesses trends and prospects in Russian military aviation, drawing on the extensive reportage on air power in the Russian defense literature since the onset of glasnost in 1986. Originally intended to examine Soviet tactical air power in strategic perspective, the research changed focus with the end of the Cold War and with the consequent opening up of new sources of insight into the Soviet defense establishment. The report reflects the benefit of first-hand contact between the author and senior Russian Air Force and aviation industry leaders. In December 1989, at Kubinka Air Base, the author became the first American citizen to fly the Soviet MiG-29 fighter and the first Westerner invited to fly a combat aircraft of any type inside Soviet airspace since the end of World War II.

MR-719-AF, *The Next-Generation Attack Fighter: Affordability and Mission Needs*, D. Stevens, B. Davis, W. Stanley, D. Norton, R. Starr, D. Raymer, J. Gibson, J. Hagen, G. Liberson

The Joint Strike Fighter (JSF) is under consideration by the Joint Advanced Strike Technology Program to replace the most numerous fighter aircraft in the Air Force inventory, the F-16. The analysis in this report examines key affordability and mission needs issues for the JSF and is tailored to support the Air Force in developing a Mission Needs Statement and Operational Requirements Document and in evaluating contractor studies. The analysis finds that future budget constraints will doubtless limit options for the JSF, but that an aircraft with a combat radius of 650 n mi, moderate stealth, and a turn rate similar to that of today's multirole aircraft will probably meet most triservice needs in future regional conflicts.

MR-787-AF, *A Composite Approach to Air Force Planning*, P. K. Davis, Z. Khalilzad

After the 1996 Presidential election, the Department of Defense (DoD) conducted the Bottom-Up Review, a major review of national military strategy and the basis of force planning. In preparation for this review, the Air Force considered various issues and planning methods. The authors addressed these questions and noted that there was no single best planning method. Different methods focused on different generic planning activities, and no method stood alone or constituted a complete methodology. It was particularly important to allow and encourage participants to break the shackles of conventional wisdom—not only about current realities, but about the nature of the future and the types and levels of forces allegedly "required."

MR-815-AF, *New Concept Development: A Planning Approach for the 21st Century Air Force*, L. Lewis, Z. Khalilzad, C. R. Roll

Using the economic model of demand, supply, and integration, the authors discuss the elements that shape the demand when attempting to define strategic direction and potential investment strategies in the next 15 to 20 years. There is an emphasis on nonmateriel solutions in the supplying of

new ideas, as well on allowing new concepts to be shared throughout the Air Force. The integration process filters new ideas against demand and enables the Air Force to link new concepts to resource investment processes, such as the PPBS. The linkages to the planning and resourcing processes within the Air Force could be examined in greater detail, however. Some of the issues that should be addressed are how proposed new concepts might be identified as useful, how new-concept development and long-range planning should be functionally and organizationally supported, and how new-concept development and long-range planning might be implemented and sustained.

MR-822-AF, *The Implications of the Possible End of the Arab-Israeli Conflict for Gulf Security*, Z. Khalilzad, D. A. Shlapak, D. L. Byman

This report is intended to help the U.S. military—especially the U.S. Air Force—capitalize on changes in the Middle East security environment that may come about after a comprehensive Arab-Israeli peace. It offers an overview of how the Arab-Israeli dispute has complicated U.S. efforts to defend the Persian Gulf region and details ways in which Israeli participation might aid the U.S. Air Force in future crises if peace reduces the stigma attached to an Israeli security role in the area. The report concludes by noting the implications of the above points for the U.S. military.

MR-826-AF, *Strategic Appraisal 1997: Strategy and Defense Planning for the 21st Century*, edited by Z. Khalilzad, D. A. Ochmanek

This publication brings together the views of several experts in both the process and substance of defense planning. It argues that an ambitious U.S. national strategy of global leadership will be needed to protect and advance U.S. interests and identifies a range of possible future missions for which we need to prepare. Essays in the volume explore key issues that will arise as the United States fashions its military forces for the coming decades. These include the roles of military power in U.S. national security strategy; new approaches to planning and evaluating future military force postures; the nature of future military challenges, both in defeating large-scale aggression and meeting smaller-scale threats; which operational capabilities should

receive the highest priority; what level of forces future budgets are likely to support; and how the Department of Defense should downsize its infrastructure and reform its management practices. This volume will be of interest to professional defense planners and analysts, as well as students of defense strategy and operations.

MR-842-AF, *Preparing the U.S. Air Force for Military Operations Other Than War*, A. Vick, D. T. Orletsky, A. N. Shulsky, J. Stillion

Among the current military operations other than war (MOOTW), ongoing peace operations in Iraq and Bosnia, in particular, are producing an operations tempo unprecedented in peacetime. This optempo is stressing people and equipment, making it difficult for the United States Air Force (USAF) to prepare fully for potential combat operations in major regional conflicts. The objectives of this report are to help the USAF better understand the effects of current MOOTW on training and readiness, to explore some options to reduce those effects, and to propose new concepts of operations to enhance USAF capabilities to accomplish future MOOTW tasks. The report first looks at the types of MOOTW the Air Force and its predecessors have participated in since 1916 (including a database of 869 missions), and the changes in those types since the end of the Cold War. It then analyzes how MOOTW optempo is affecting force training, readiness, and morale, and explores several options for addressing these problems, including a "cop-on-the-beat" operational concept to reduce the size of deployed forces. Next, it discusses the reasons MOOTW have taken on greater importance in the post–Cold War environment, identifies current and future MOOTW tasks that the USAF could be assigned, and presents some new concepts of operation to accomplish these tasks.

MR-865-AF, *Strategic Sourcing: Theory and Evidence from Economics and Business Management*, E. M. Pint, L. H. Baldwin

This report, originally prepared as an annotated briefing, discusses the recommendations of the economics and business management literatures on issues related to outsourcing. It found that organizations should outsource

those activities that can be most effectively managed externally, so that senior managers can devote their attention to activities best managed internally. The economics literature emphasizes that activities involving transaction-specific assets should be managed internally, whereas the business management literature recommends that organizations retain internal control of their core competencies. Organizations can often gain access to superior performance at equal or lower cost by outsourcing other activities. Therefore, it seems prudent for the Air Force to focus its outsourcing efforts on activities that are neither core competencies nor involve great asset specificity, although the business management literature suggests that the Air Force could outsource activities that do involve asset specificity, such as the provision of complex services, if it develops longer-term partnerships with suppliers rather than treating them as arm's-length vendors. Also, past performance information could be used to advantage in outsourcing to develop longer-term relationships and encourage transaction-specific investments.

MR-879-AF, *A Guide for Analysis Using Advanced Distributed Simulation (ADS)*, T. Lucas, R. Kerchner, J. Friel, D. Jones.

This guide is intended to assist those in the vanguard of using Advanced Distributed Simulation (ADS) for analysis. It discusses ADS analysis strengths and weaknesses, the role ADS might play within a broader analysis strategy, experimental design, exercise preparation and management, and post-exercise analysis. ADS today can realistically treat human performance, obtain insights into the cause-and-effect combat drivers, effectively communicate analytic results to decisionmakers, facilitate multidisciplinary research teams, and combine multiple disparate service simulations into a single joint simulation for theaterwide scenarios at a high level of detail. There are, however, significant challenges to be overcome before the potential of ADS can be realized: the complexity of a distributed joint simulation, exclusive use of human-in-the-loop analysis, and the logistical load and expense of distributed simulations, data, and personnel. Interoperability among models is essential, and is the primary obstacle in achieving widespread analytic utility from ADS. The authors believe that ADS is often best used in conjunction with stand-alone constructive simulations.

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