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PROJECT AIR FORCE

## About RAND Project AIR FORCE

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For more than 50 years, decisionmakers in the public and private sectors have turned to the RAND Corporation for objective analysis and effective solutions that address the challenges facing the nation and the world. The mission of RAND Project AIR FORCE (PAF), a division of the RAND Corporation and the Air Force's federally funded research and development center for studies and analyses, is to conduct an integrated program of objective, independent analysis on issues of enduring concern to Air Force leaders. PAF addresses far-reaching and interrelated questions: What will be the role of air and space power in the future security environment? How should the force be modernized to meet changing operational demands? What should be the size and characteristics of the workforce? How can that workforce be most effectively recruited, trained, and retained? How should sustainment, acquisition, and infrastructure be streamlined to control costs?

PAF carries out its research agenda in four programs that represent core competencies:

**Strategy and Doctrine** seeks to increase knowledge and understanding of geopolitical and other problems in the national security environment that affect Air Force operations. PAF maintains expertise in defense strategy; regional analysis; the objectives and tasks of evolving joint operations; and the potential contributions of air and space power to joint operations, defense planning, and requirements for force development.

**Aerospace Force Development** identifies and assesses ways in which technological advances and new operational concepts can improve the Air Force's ability to satisfy a range of future operational demands. This research involves assessments of technology feasibility, performance, cost, and risk. PAF assesses major force components needed in the future and the systems and infrastructure supporting their operations.

**Manpower, Personnel, and Training** concentrates on questions about workforce size and composition and about the best ways to recruit, train, pay, promote, and retain personnel. PAF's research encompasses the total workforce: active duty, guard, reserve, civilian, and contractor personnel.

**Resource Management** analyzes policies and practices in the areas of logistics and readiness; outsourcing, privatization, and contracting; the industrial base; planning, programming, and budgeting; infrastructure; and weapon-system

cost estimating. The goal of this program is to maximize the efficiency and effectiveness of Air Force operations in a resource-constrained environment.

PAF also conducts research on topics that cut across all four programs, and its research staff regularly responds to Air Force requests for help on time-urgent problems.

## Director's Message

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The past few years have seen enormous changes in the global threats facing our nation and the demands they place on the United States military in general and the United States Air Force in particular. U.S. air power and space power are playing critical roles in joint and coalitional counterterrorism operations in Afghanistan, Iraq, and elsewhere. Counterterrorism, counterinsurgency, homeland defense, peacekeeping, and humanitarian operations are adding to the operational tempo. At the same time, the Air Force is shedding aging legacy systems in order to place into service transformational capabilities that enable joint network operations. It is continuing to transform into a leaner and more agile force. Budgetary constraints and the continual demand for training new personnel add to the challenges the Air Force faces. The Air Force has risen to these challenges. However, long-term success will require careful analysis of, and innovative approaches to, a broad range of force structure, operational, technical, fiscal, personnel-related, and strategic issues—all cast in a joint/coalitional context.

RAND Project AIR FORCE (PAF) provides studies and analyses to help the Air Force think through the challenges that it faces now and in the future. This annual report summarizes some of our recent work to address a broad range of critical questions:

### **How can the Air Force make strike operations less vulnerable to attack?**

In the 21st century, U.S. military operations rely heavily on high-capacity communications networks to transmit and receive information to and from the field of operations. A critical application is the transmission of intelligence, surveillance, and reconnaissance (ISR) information to weapons platforms (e.g., fighter and bomber aircraft) for precision targeting and other uses. These systems may be vulnerable to enemy attack, such as jamming. These platforms also risk detection when transmitting large amounts of data. PAF identified new and developing communication technologies that may reduce these vulnerabilities.

### **What is the appropriate role of nuclear forces in U.S. strategy and force posture?**

The end of the Cold War and the emergence of international terrorism as a major threat have provoked new thinking about the role of nuclear forces in U.S. national security policy. PAF examined a range of strategies and force postures that the United States could adopt to make the most effective use of its nuclear forces in an uncertain world. Reducing the risk of nuclear war

due to accidents or mistakes is even more important now than in the past. A much smaller nuclear force than originally envisioned for the Strategic Arms Reduction Treaty III (START III) could potentially fulfill U.S. political and military needs.

**How can the Air Force reduce costs?** The Air Force is adopting widely accepted commercial “best practices” to change the way it purchases goods and services, with the goals of reducing costs and improving performance to better support its missions. Part of this effort involves the implementation of commodity councils. A PAF study of commercial-sector experiences suggests that implementing commodity councils requires a transformation in the Air Force’s procurement workforce.

A large portion of the Air Force’s budget is spent on purchased services. The 2002 National Defense Authorization Act called for the Department of Defense to change its contracting and management practices to reduce the cost of buying services over the next decade. PAF developed a method to measure the Air Force’s progress in meeting these cost-reduction goals. Critical to this method is improved data collection and processing.

Traditionally, the Air Force has written service contracts with detailed specifications about how the work should be performed. That practice is changing. The Air Force is moving toward performance-based practices within its service contracts, with the expectation of improving service quality and reducing costs. PAF research supports the implementation of performance-based practices and suggests that as the Air Force extends this approach, acquisition planners should consider principles derived from best practices in the commercial sector.

The process of test and evaluation (T&E) is a key step in the development of military weapon systems and is an involved and often-lengthy process, accounting for a significant part of development costs. PAF studied T&E costs for recent Air Force and Navy fixed-wing aircraft, tactical missile, and guided munitions systems to identify trends that might affect those costs in the future. The research found that although acquisition-streamlining initiatives may have reduced the cost of individual tests, the proportion of development costs dedicated to T&E has remained relatively constant.

**What mix of personnel is needed for future missions, and how should they be trained?** Changes in the global threat environment, new national security strategy, and budgetary constraints have led to a reassessment of manpower requirements within the Air Force and the types of training needed to shape tomorrow’s workforce. PAF participated in the Air Force’s latest Total Force Assessment (TFA) and developed an improved methodology for estimating

manpower requirements for the types of scenarios the Air Force is likely to encounter in the future.

PAF analyzed the Air Education and Training Command's (AETC) training infrastructure and production capacity and developed a methodology that AETC is now using to make its training pipeline more adaptable to changing national security needs within its budget constraints.

Although Air Force personnel are typically trained to perform jobs in a specific occupational category, during their military careers they may be called upon to perform a variety of jobs. The Air Force has set goals that will require some personnel to acquire skills and competencies in more than one occupational category. To assist the Air Force in this effort, PAF conducted a survey to identify the settings, with some emphasis on deployments, in which individuals learn occupational skills and "universal" competencies outside their primary occupation. We recommend that the development of any system for tracking the learning of occupational skills should incorporate the learning that occurs during deployments.

**How can the U.S. military strengthen its partnerships with Asian countries to avoid future conflicts?** U.S. military relationships with Asian countries are critical to our national security. However, issues have emerged between the United States and South Korea that put their decades-long security alliance under stress. PAF studied the U.S.-South Korea relationship to identify initiatives that can strengthen and improve security cooperation. The study addresses both short-term alliance management issues and longer-term measures to adapt the relationship to new global and domestic conditions.

Additionally, disagreement over Taiwan has put a strain on U.S. relations with China. The United States should by all means continue to pursue communication with Chinese senior defense and military officials while observing and seeking to understand China's development, and the United States and China should continue to cooperate in the global war on terrorism.

**How can the United States take a strategic approach to mitigating and combating terrorism?** PAF conducted several studies to help the Air Force develop a long-term picture of the terrorist threat. PAF identified a wide range of political, economic, and social trends that could pose new threats to Middle East security in the coming years. Instability in this region may strengthen terrorist groups and may foster the spread of weapons of mass destruction. Thus, the United States may need to balance the aim of fostering democratic change with the goal of maintaining political stability in the Middle East. PAF also studied trends throughout the Muslim world and suggested steps that the

United States can take to ameliorate the conditions that foster extremism. Further PAF research focused on the roles of Pakistan and India in the global war on terrorism and the development of a “threat framework” to evaluate terrorists’ intentions and capabilities to harm the United States. This research will help U.S. decisionmakers and military planners to continue to develop effective and proactive counterterrorism strategies.

Not discussed in this public-domain annual report is PAF’s research on topics such as the future mix of ISR forces, the establishment and sustainment of new satellite designs, alternatives for the next generation of gunship capabilities, enhanced air defense capabilities to counter terrorist threats to the continental United States, counterterrorism strategy, and command and control lessons learned in Operation Enduring Freedom. These studies—along with the ones described above—are part of a coherent and comprehensive program of research.

Project AIR FORCE represents an ongoing Air Force investment in objective, independent research and analysis. PAF provides the Air Force with insights derived from nearly six decades of continuous partnership. This close collaboration gives PAF and the Air Force the flexibility to explore new and emerging issues of vital importance to the nation’s security and to apply those insights to the Air Force’s current and future needs.



Natalie W. Crawford  
Vice President, RAND Corporation,  
and Director, RAND Project AIR FORCE

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## **Improving Communications Networks to Support Integrated ISR-Strike Operations**

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In the twenty-first century, U.S. military operations rely heavily on high-capacity communications networks to transmit and receive information to and from the field of operation. A critical application is the transmission of intelligence, surveillance, and reconnaissance (ISR) information to weapons platforms such as fighter and bomber aircraft for precision targeting and other uses.

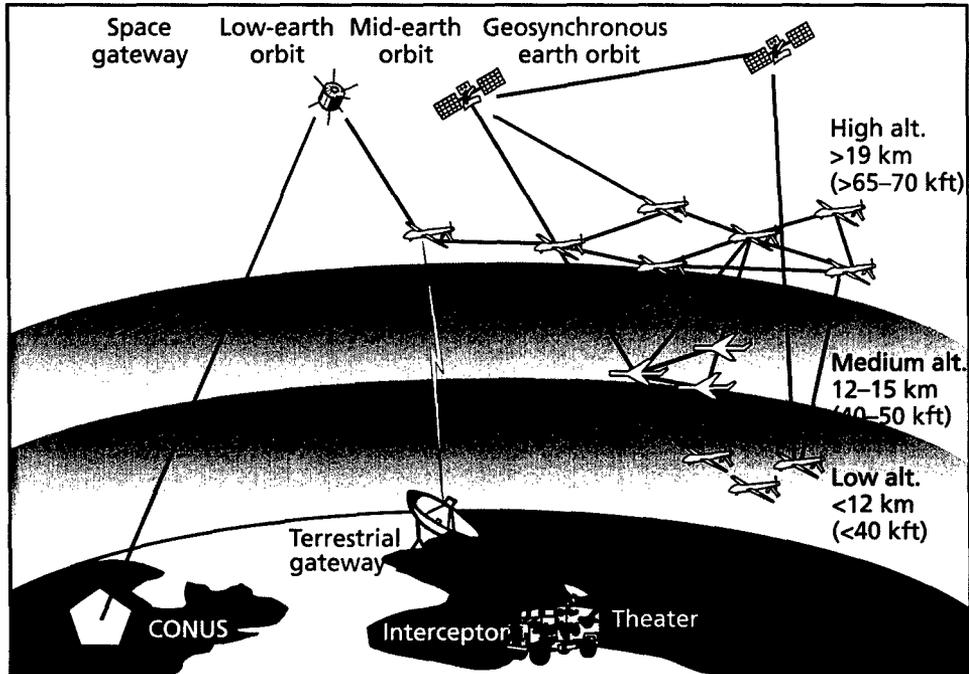
In a hostile environment, U.S. communications networks may be threatened by enemy jammers and signals intelligence (SIGINT) receivers. The challenge is greater for combat systems operating at medium and low altitudes—including fighters and bombers—because enemy systems require less sensitivity to jam or intercept communications (see Figure 1). These platforms also face a higher risk of detection when transmitting large amounts of data. Thus, the U.S. Air Force is interested in developing communications networks that are less susceptible to electronic threats.

### **The Air Force Should Consider a Combination of Options and Solutions**

PAF studied threats to U.S. communications networks and identified options for improving such systems against jammers and SIGINT receivers. Research concluded that different options exist depending on the altitude, range, and data rate of U.S. systems and the potential threats they face. Major findings include the following:

- The current Joint Tactical Information Distribution System (JTIDS) and the planned Joint Tactical Radio System (JTRS) have some jam-resistance capability, but they do not provide the high data rate needed for integrated ISR-strike operations.
- Common Data Link (CDL) programs can provide the sufficient data rate, but they require improvements to survive severe threat environments. Adding nulling capability—the use of auxiliary antennae to cancel jamming signals—would improve jam resistance. Agile, multibeam, low-sidelobe directional antennae would achieve even greater protection against both jammers and airborne SIGINT receivers.

- Laser beams and absorption band—methods of transmission that are less susceptible to jamming and interception—are appropriate for high-altitude platforms, such as ISR systems, communication nodes, and satellites.
- Proliferated platforms with multiple beams may provide more robust, reliable networks than current platforms, but further analysis is needed to examine their effectiveness.



NOTE: ISR and strike platforms operate at various altitudes. The top band represents space, where ISR satellites (e.g., space-based radar or communication satellites) and high-altitude platforms (e.g., U2 and Global Hawk) operate. The middle and lower bands represent medium and low altitudes, where platforms such as fighters, bombers, and smaller unmanned aerial vehicles operate.

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Figure 1—Integration of ISR and Fighter Platforms

Based on these findings, communications technology does not appear to be a major limiting factor in developing future ISR forces. Programmatic action will be required to develop the necessary systems, however, and the costs could be significant. Moreover, the development of new systems together with required platform modifications and new designs raises technology and cost issues that should be carefully examined.

TR-159-AF, *Communications Networks to Support Integrated Intelligence, Surveillance, Reconnaissance, and Strike Operations*, Elham Ghashghai

## Using Game Theory to Analyze Operations Against Time-Critical Targets

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When planning operations against time-critical targets (TCTs), military commanders typically think about how much capability they need to kill enemy forces. However, they also consider how their strategies will affect the enemy's behavior. TCT operations include suppression of enemy air defenses (SEAD), interdiction of moving forces, and attacks against theater ballistic missiles (TBMs). Convincing enemies not to fire surface-to-air missiles (SAMs), not to move their forces, or not to launch TBMs is often a satisfactory short-term alternative to physically destroying enemy systems.

A PAF study shows how military planners can use game theory to understand the effects of U.S. strategy and capabilities on the enemy in TCT operations. Game theory uses mathematics to model human decisionmaking in competitive situations. It is ideally suited for analyzing military situations because it depicts the realistic situation in which both sides are free to choose their best "moves" and to adjust their strategy over time. Military planners can apply these principles to TCT operations through game theoretic analysis. The method consists of the following steps:

- **Determine the tactical options available to each side.** For example, in a simple SEAD operation, the attacker can choose to fly a strike aircraft or a SEAD aircraft. The defender may choose to activate SAMs or to leave them inactive.
- **Assign a numerical value to each possible outcome.** Analysts represent commanders in the field by judging the potential gain or loss of an exchange. These numbers reflect real-world measurements such as the strength of a weapon system and the probability of hitting a target.
- **Calculate all possible strategies and their outcomes.** Intelligent opponents vary their tactics in order to appear unpredictable to the enemy. Thus, a combatant's overall strategy is determined by how often he or she chooses one tactical option over another. Analysts calculate all possible strategies and the net gain or loss to each side.
- **Find each side's optimum strategy.** Experience teaches that as opponents in a game adjust to each other's actions, each player will eventually settle on an optimum strategy. In military terms, the optimum strategy is not necessarily the most desirable outcome (i.e., winning the exchange), but the best that one can do against an opponent of a given strength.

- **Determine the expected result of the game.** Having found each side's optimum strategy, analysts check to see whether the outcome of the encounter favors the attacker or the defender.

Game theoretic analysis enables analysts to see how an intelligent opponent is likely to behave in a given situation and which side is likely to win. If both sides correctly ascertain the situation, then the losing side may decide not to participate. For example, in a simple SEAD encounter, the defender might decide that preserving SAMs is more important than attempting to shoot down strike aircraft if the chances of inflicting heavy losses on the attacker are small. Insights such as these can help military planners to understand how much capability they would need to achieve the best outcome for their side.

DB-385-AF, *A Simple Game-Theoretic Approach to Suppression of Enemy Defenses and Other Time-Critical Target Analyses*,  
Thomas Hamilton and Richard Mesic

## U.S. Nuclear Weapons: Future Strategy and Force Posture

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Since the end of the Cold War, the United States has been reexamining the role of nuclear forces in its national security policy. Traditional U.S. nuclear strategy was primarily intended to deter a Soviet attack against the United States, along with a few lesser objectives. This strategy called for a nuclear arsenal held at constant high alert and a Single Integrated Operational Plan that would make execution of a retaliatory strike as simple, quick, and effective as possible.

Today, the United States faces a more diverse set of potential threats. Political instability in established nuclear states such as Russia and Pakistan is a major concern. The deterioration of military command and control in Russia increases the chances of accidental or unauthorized launch. The possible emergence of new nuclear adversaries poses a further threat because of the wide variety of strategies and capabilities they may present. Nuclear weapons may become instruments of the weak rather than the strong. Weak regimes opposed to the United States may attempt to deliver nuclear warheads on trucks or ships, thus eluding U.S. tactical warning systems. States or groups that embrace radical, anti-American ideologies and feel that they have nothing left to lose may not be deterred by the threat of nuclear retaliation. Long before the current Bush administration took office, it was clear that the United States needed to rethink its fundamental nuclear posture. PAF examined a range of strategies and force postures that the United States could adopt to make the most effective use of its nuclear forces in an uncertain world. Key observations include the following:

- **The need for the United States to retain nuclear weapons is much less compelling than in the past.** Improved conventional weapons can replace nuclear weapons in almost all military roles. Nuclear arms remain unmatched as terror weapons (i.e., arms intended to deter adversaries through threat of retaliation). However, the United States must decide whether it still needs such a capability, particularly in view of the inherent risks and costs of maintaining a nuclear stockpile. Moreover, barring dramatic changes in the world, U.S. nuclear expertise and capability may “wither away” irreversibly over time. If so, then the United States will become less and less credible as a nuclear power no matter what its official policy is.
- **A much smaller nuclear force could fulfill all U.S. political and military needs.** A force of a few hundred nuclear weapons, if operated properly, should be adequate to handle any reasonable application that is likely to

arise in the foreseeable future. The operational force level needed is driven to a somewhat higher quantity both by a future need to plan for contingencies and to assure adequate survivability and by the need to maintain a reserve. Such a force would be much smaller than that originally envisioned for the next round of START III negotiations or currently allowed by the Moscow Treaty. The most effective Air Force contribution to such a force would be air-launched missiles. For military applications that require nuclear weapons, warheads with at least moderate yields would be needed. So-called "mini-nukes" would have little operational value. A survivable and flexible command and control system would be a prerequisite for any future U.S. nuclear force.

- **Reducing the risk of nuclear war due to accidents or mistakes is even more important now than in the past.** During the Cold War, the United States and the Soviet Union had to cope with the threat of a surprise attack because some of their nuclear forces were vulnerable and their command and control systems were fragile. This threat was considered greater than the risk of an accidental launch due to human or technical error. Thus, both sides maintained their strategic nuclear forces on a "hair-trigger" alert, ready to launch on a credible warning of an attack by the other side. Today, the risk of accidental launch outweighs that of a disarming surprise attack. A deterrence strategy based on the threat of punishment does not require prompt retaliation, only sure retaliation. Any military situation that might require the United States to consider using nuclear weapons is likely to take some time to develop. The United States should eliminate any nuclear weapon systems that have to be "used or lost." It should also make sure that its command, control, and intelligence systems are survivable, robust, and capable enough to allow policymakers sufficient time to understand what is going on in a particular situation and to make a reasoned decision about how to respond to it.

MR-1231-AF, *Future Roles of U.S. Nuclear Forces: Implications for U.S. Strategy*, Glenn C. Buchan, David Matonick, Calvin Shipbaugh, and Richard Mesic

## Speeding Acquisition Reform in the U.S. Air Force

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The U.S. Air Force uses contractors to carry out logistics support services such as repairing major weapons systems. Recently, the Air Force began to reform its methods of acquiring such services by implementing best practices from the commercial sector. To complement its other acquisition reform programs, the Air Force launched the Contract Repair and Enhancement Program (CREP) in 1996 to reduce costs and to shorten the time required for purchasing repair services to support major weapons systems. However, Air Force leaders were concerned that reforms were not being implemented as quickly as originally hoped. PAF was asked to identify the organizational levers that could motivate acquisition personnel to adopt CREP reforms more quickly. Analyses of recent Air Force contracts yielded the following conclusions:

- **Training, positive attitudes toward acquisition reform, close partnering with contractors, and consistent leadership appear to encourage reform implementation.** Air Force personnel who received greater training in new acquisition practices implemented more CREP reforms than their counterparts with less training. Similarly, contract teams that viewed reform positively and agreed with the goals of the initiative implemented more reforms in their contracts, as did teams that viewed their contractors as collaborative business partners. Teams that believed management was committed to improving acquisition incorporated more CREP reforms in their contracts.
- **Contrary to expectations, effective teaming and performance evaluation appear to discourage reform implementation.** Contracting teams that brought all key members together early in the contracting process and made decisions by consensus implemented fewer reforms than their counterparts with problematic team interactions. Teams that believed they would be evaluated on their reform implementation performance were also less likely to pursue contract innovations. The researchers hypothesize that smoothly functioning teams may tend to agree on less-aggressive goals, and that the existing performance evaluation criteria may not have been aligned with the service's acquisition reform plans.

PAF recommends that the Air Force continue to use the organizational levers that encourage reform and modify its practices for those levers that discourage reform. Specifically, the Air Force should

- clearly communicate to personnel that senior leadership is committed to contract reform,
- learn how to create effective teams through training in group problem-solving, and
- align performance evaluation criteria more explicitly with reform goals.

The Air Force may use the insights from this study to promote related reforms—such as purchasing and supply chain management, corporate contracting, and performance-based contracting—where behavioral changes are needed to accomplish larger transformational goals.

MR-1711-AF, *Organizational Policy Levers Can Affect Acquisition Reform Implementation in Air Force Repair Contracts*, Mary E. Chenoweth, Sarah Hunter, Brent Keltner, and David Adamson

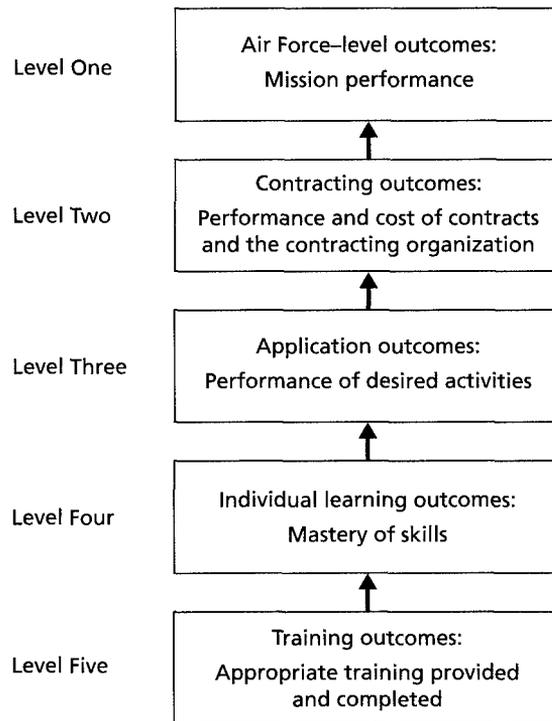
## Adopting New Procurement Methods in the U.S. Air Force: What Skills and Training Are Needed?

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The U.S. Air Force is adopting widely accepted commercial “best practices” to change the way it purchases goods and services, with the goals of reducing costs and improving performance to better support its missions. Part of this effort involves the implementation of commodity councils—teams of technical experts and other stakeholders from different parts of the Air Force who develop corporate-wide strategies for purchasing specific categories of commodities such as medical supplies or computers. This practice is intended to replace the functionally-oriented approach in which consumers, commodity specialists, and procurement professionals work largely in isolation from each other and execute specific purchases rather than taking into account demands across the Air Force. Commodity councils will enable the Air Force to leverage its purchasing power and to manage its contracts more effectively.

A study of commercial-sector experiences with commodity councils conducted by PAF suggests that implementing commodity councils requires a transformation in the Air Force’s procurement workforce. Commodity councils require members who possess a wide range of skills, including the ability to use computers, teaming/interpersonal skills, business skills such as creative problem solving, core purchasing and supply-management skills such as cost analysis, analytical and technical skills such as statistical analysis, and contracting skills. PAF analyzed procurement-training programs in the Air Force and the commercial sector to determine how the Air Force can best prepare its personnel to adopt new purchasing practices. Major findings include the following:

- **Air Force personnel require additional training to develop the skills needed for commodity councils.** Current curricula in the Defense Acquisition University and the Air Force Institute of Technology do not appear to cover the full range of required skills. To remedy these gaps in the curricula, the Air Force should offer new and improved courses and should provide greater opportunities for professionals to attend those courses. The Air Force should incorporate early-implementation lessons to refine the list of necessary skills and continue to improve its training curricula as commodity councils become more widespread. As an alternative to



NOTE: The Air Force uses metrics such as unit readiness scores and weapon-system mission-capability rates to measure its ability to execute missions. Procurement transformation metrics should be aligned with the Air Force's ultimate warfighting objectives because contracting activities and outcomes directly affect mission performance. This study suggests metrics for Levels Two through Five of the hierarchy of transformation outcomes (Level One is affected by too broad a range of factors for metrics to be useful).

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**Figure 2—Hierarchy of Outcomes for Air Force Procurement Workforce Transformation**

developing additional “in-house” training, the Air Force may take advantage of existing courses that are used by well-respected commercial purchasing and supply-management organizations.

- **There is no “silver bullet” template for procurement training.** Different types of training are appropriate for developing different levels of expertise. Approaches may range from structured classroom or web-based learning to formal on-the-job training and mentoring programs. Successful training programs tend to be multifunctional, involving personnel with diverse backgrounds that are relevant to new practices. The Air Force should consider developing multiple tiers of instruction and a variety of approaches to accommodate individual students’ initial competency and the desired level of mastery.

- **Effective metrics link training to practices and outcomes.** The Air Force needs metrics to monitor how changes in procurement training improve the overall purchasing and supply-management system. Appropriate metrics should measure progress at four levels: contract performance and cost, success at implementing purchasing and supply-management activities, individual personnel's mastery of desired skills, and specific training outcomes (see Figure 2).

These insights should enable the Air Force to grow the skills needed to adopt new procurement practices, thereby improving the cost and performance of contracted goods and services.

MG-214-AF, *Air Force Procurement Workforce Transformation:  
Lessons from the Commercial Sector*, John Ausink, Laura H. Baldwin,  
and Christopher Paul

## Estimating the Costs of Future Weapon Systems: Focus on Testing and Evaluation

The process of testing and evaluation (T&E) is a key step in the development of military weapon systems (see Figure 3). It is the primary means of ensuring that a system will actually perform its intended function in its intended environment. T&E is an involved and often lengthy process, accounting on average for 21 percent of development costs for fixed-wing aircraft and 15 percent of development costs for guided weapons.

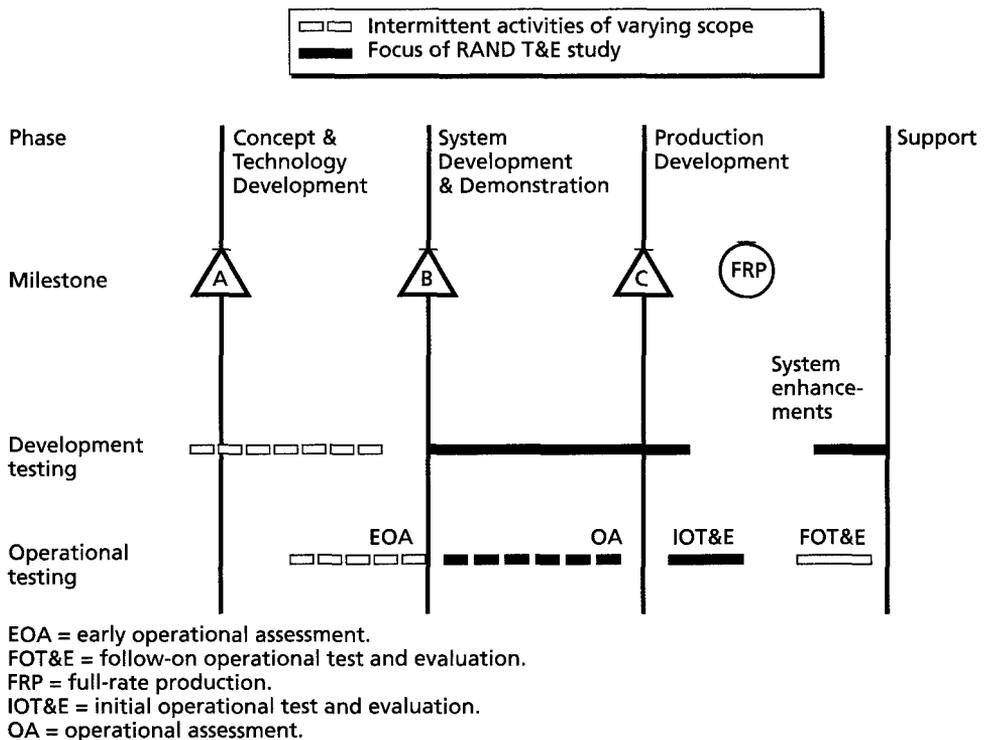


Figure 3—T&E Phases Within the Acquisition Process

Advocates of acquisition streamlining have questioned the scope, duration, cost, and organizational responsibilities of the traditional T&E process. These questions are especially urgent because most T&E expenditures occur later in development, when cost overruns and schedule slips from other activities are

more apparent. Some program managers have suggested streamlining measures, such as relying on modeling and simulation to dramatically reduce the amount of "open air" testing, combining contractor and government testing, and applying total system performance responsibility (TSPR) contracting to shift certain responsibilities from the government to the contractor. In estimating the cost of future acquisitions, decisionmakers need to know whether such measures can in fact achieve their projected savings. PAF studied T&E costs for recent Air Force and Navy fixed-wing aircraft, tactical missile, and guided munition systems to identify trends that might affect such costs in the future. Researchers found that although streamlining initiatives may have reduced the cost of individual tests, the proportion of development costs dedicated to T&E has remained relatively constant. Specific findings include the following:

- **Integrated contractor-government teams can help optimize testing.** Traditionally, contractors and the government have performed separate tests to determine whether a system meets its technical and performance specifications (development testing by the contractor and government) and whether it is operationally effective under realistic conditions (operational testing by the government). Where feasible, combining these tests avoids redundancy, and involving the operational testers in development testing highlights operational issues for early resolution, resulting in both costs savings and shorter schedules.
- **Modeling and simulation are necessary, but they do not preclude the need for live testing.** Modeling and simulation appear to be good investments because they can reduce the number, risk, and often the duration of live tests. However, their usefulness may be limited by the level of fidelity to real-world conditions, the specific range of applicability, the high cost of developing and validating models, and the challenges of integrating various models and hardware. Live testing is still needed to supplement and confirm the results of modeling and simulation.
- **TSPR can reduce government costs, but it may create other problems.** For example, test data may not be available to the government for other uses. Cross-platform integration may not be adequately coordinated, especially in guided-weapon development. TSPR contracts should be carefully planned to avoid these problems.
- **Software-intensive systems have been driving T&E costs higher.** Although advances in computer technology have improved the performance of major weapon systems, software-intensive systems require more complex testing. This is particularly true where multiple systems must be integrated. These issues should receive specific attention in any future T&E estimates.

To further improve their estimates of T&E costs, analysts should have a fuller understanding of what the government actually spends on testing. It is currently more difficult to collect and analyze cost data from government organizations than it is from contractors. Consistent accumulation and reporting of such cost data (to standards similar to those for contractor data) would greatly improve the accuracy of future cost estimates and provide government personnel with better information for planning and management.

MG-109-AF, *Test and Evaluation Trends and Costs for Aircraft and Guided Weapons*, Bernard Fox, Michael Boito, John C. Graser, and Obaid Younossi

## Reducing the Cost of Purchased Services: How Can the Air Force Measure Success?

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Purchased services represent the largest category of U.S. government contract expenditures. The Air Force purchases a variety of services—ranging from groundskeeping to engineering studies—to support its personnel, facilities, and weapons. In the 2002 National Defense Authorization Act, Congress called for the Department of Defense (DoD) to change its contracting and management practices to reduce the cost of buying services over the next decade. PAF developed a method to measure the Air Force's progress in meeting these cost-reduction goals. Researchers found that the Air Force needs to improve its data collection and processing to systematically track and analyze the effects that changes in purchasing practices have on costs. The following steps (shown in Table 1) are most important to meet this goal.

- **Identify a set of services that could benefit from management reforms.**
- **Establish the baseline cost for these services.** This baseline will allow for consistent comparisons of service expenditures over time.
- **Measure the current costs of these services, taking into account management reforms.** Assuming that quality remains constant, analysts must adjust for any changes in services associated with evolving Air Force needs and for any variations in the quantities of services purchased.
- **Estimate the hypothetical costs that would have been incurred without management reforms.** To arrive at the amount that would have been spent under previous management methods, cost analysts should adjust the base-year expenditures to current-year dollars using an inflation index.
- **Calculate the amount of savings that result from improved management practices.** Analysts should subtract the estimated cost of services with management reforms from the estimated cost of services without those reforms for current and future years.

Table 1—Summary of Reporting Requirements and Recommendations

Steps to Estimate Service Cost Savings	Potential Data Source(s)	Implementation Recommendations
1. Establish FY00 cost-savings baseline for procurement of services.	DD350	<p>A. Clearly define the universe of services governed by the Act; choose a set of services for which PBSA<sup>a</sup> and other management innovations are appropriate.</p> <p>B. Sum FY00 expenditures for chosen services.</p>
2. Estimate the amount that will be expended for procurement of services in the current FY.	DD350 ABIDES <sup>b</sup>	<p>A. Adjust for changes in scope.</p> <p>B. Where possible, adjust for changes in the quantity of services purchased.</p> <p>C. Assume that the quality remains constant instead of attempting to adjust prices for quality changes.</p>
3. Estimate the amount that will be expended for procurement of services in the following FY. <sup>c</sup>	ABIDES	<p>A. Establish a link between PSC/NAICS<sup>d</sup> codes in DD350 and EEIC<sup>e</sup> codes in ABIDES.</p> <p>B. Use most current forecast for next FY expenditures for chosen services, adjusted as described above.</p>
4. Establish the "hypothetical" expenditures for the current and following FYs (the amount that "otherwise would have been spent").	DD350  OSD O&M <sup>f</sup> Price Index  BLS <sup>g</sup> National Service Wage Index	<p>A. Establish the hypothetical cost for the current year by adjusting the base-year expenditures to current-year dollars through the chosen inflation index.</p> <p>B. Do the same for the following FY.</p>
5. Estimate the amount of savings in the current FY and following FY that result from improved management practices.		<p>A. Subtract expected expenditures for the current FY from the hypothetical expenditures for the current FY.</p> <p>B. Do the same for the following FY.</p>

<sup>a</sup> Performance-Based Services Acquisition.<sup>b</sup> Automatic Budget Interactive Data Environment System.<sup>c</sup> For the final report, the forecast is for five years into the future.<sup>d</sup> Product Service Code/North American Industry Classification System.<sup>e</sup> Element of Expense/Investment Code.<sup>f</sup> Office of the Secretary of Defense Operation and Maintenance.<sup>g</sup> Bureau of Labor Statistics.

PAF researchers are also exploring whether the data currently collected by DoD adequately represent the Air Force's service expenditures. Together, these research efforts will allow the Air Force to gauge its success in reducing the cost of purchased services in the coming years.

MR-1821-AF, *Measuring Changes in Service Costs to Meet the Requirements of the 2002 National Defense Authorization Act*, Chad Shirley, John Ausink, and Laura H. Baldwin

## Applying Performance-Based Practices to Installation Support Contracts

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Traditionally, the U.S. Air Force has written service contracts with detailed specifications about how the contracted work should be performed. That practice is changing. The Air Force is implementing performance-based practices within its service contracts with the expectation that they will improve service quality and reduce costs. A buyer-provider relationship based on performance-based practices differs greatly from the Air Force's traditional, arms-length directive relationships with many service providers who were chosen because they were the lowest bidders. Performance-based contracts describe a desired outcome rather than how to perform the work, evaluate performance based on measurable standards, specify procedures for reducing fees or prices when services do not meet contract requirements, and may include positive incentives for good performance. The Air Force goal is that at least half of all service acquisitions should be performance-based by 2005.

Previous PAF research supports the implementation of performance-based practices in contracts related to Air Force weapons systems and installation activities; recent contracts incorporate some of these practices. This study suggests that as the Air Force extends its use of performance-based practices to contracts for food and facilities services, acquisition planners should consider principles derived from best practices used in the commercial sector.

- **The Air Force should encourage frequent, two-way communication between buyers and providers.** This communication should include face-to-face discussions involving senior leaders and managers.
- **Air Force contracts should provide broad statements of need rather than detailed directions on how those needs should be met.** Outcome-oriented contracts may encourage providers to innovate, thereby reducing costs.
- **The Air Force should select a moderate number of performance metrics to enhance communication between buyers and providers.** The Air Force already has a metrics-oriented culture. The challenges will be to limit the metrics to those that reflect the most important aspects of the service and to include more qualitative measures such as customer satisfaction. Each metric should contribute relevant information to justify the extra data collection costs and management attention.

- **Benchmarking can improve the evaluation of proposals and performance.** The Air Force could begin benchmarking the cost and performance of installation support services within and across its major commands, then expand to other military services and commercial firms. Special data collections may be necessary in the short run. In the long run, provider data systems could supplement Air Force data.
- **Formal and informal incentives can help motivate providers to meet Air Force buyers' needs.** For example, the Air Force is already using formal contractual incentives that tie the length of the contract to performance. Increased use of past performance in source selection can be an effective informal incentive as well.
- **Contracts that are flexible in terms of the description of services, metrics, pricing, and other terms and conditions can help providers better meet buyers' needs.** This flexibility is important because the Air Force's needs for facilities and food services change over time.

MR-1812-AF, *Defining Needs and Managing Performance of Installation Support Contracts: Perspectives from the Commercial Sector*,  
Laura H. Baldwin and Sarah Hunter

## Managing Cost and Capacity Data in the Air Force's Air Education and Training Command

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The combat capability of the U.S. military is directly affected by the quantity and quality of its trained personnel. In the Air Force, the Air Education and Training Command (AETC) is responsible for recruiting, training, and educating professional airmen. Despite the fact that AETC has the second-largest aircraft fleet among the major commands and the largest number of people passing through its gates, it has the smallest budget. Managing costs and maintaining the necessary training capacity present considerable challenges. AETC must be able to rapidly build up its capacity in response to changing national security needs and to reduce the pipeline when such demands taper off. To meet these goals, AETC managers require access to high-quality cost and capacity data from its bases as well as analytic tools to use such data in decisionmaking. For example, knowing the actual number of spaces available in training facilities helps policymakers to gauge the need for additional infrastructure, set recruitment rates, and modify the training curriculum.

**AETC lacks the capability to accurately tap into cost and capacity data at the unit level.** This problem is especially the case in the area of technical training, which prepares enlisted personnel for non-pilot jobs such as aircraft maintenance and air traffic control. Most data needed for informed decisionmaking in AETC exist at the direct training and lower management levels and do not flow up to the strategic management and corporate levels. Moreover, strategic management responsibilities are split among multiple organizations including the Air Staff, HQ AETC, Second Air Force, and the individual wing organizations at each base. As a result, data requests and decisions overlap, and there is confusion about who needs certain data, who should get those data, and who should be responsible for manipulating and maintaining the data.

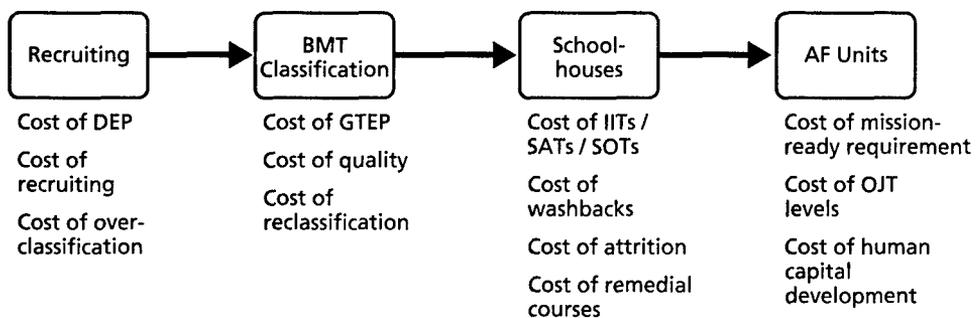
PAF studied training management systems in the Air Force, other U.S. armed services, and the private sector to identify ways to improve the flow and usage of technical training data within AETC. The Air Force should take the following main steps:

**Consolidate strategic management functions under one organization.** Many of AETC's data flow problems would be resolved if the responsibility for strategic management of technical training were clearly assigned to one organi-

zation. This office would clarify who has source data, who has the responsibility to input and process these data, and who needs to receive the aggregated information for decisionmaking.

**Develop methodological tools to analyze cost and capacity data.** PAF has begun to design simulation tools to help AETC examine capacity constraints and to perform economic analysis of technical training policies. Such tools will not only improve strategic decisionmaking in the long run but will help AETC identify the kinds of data it needs in the short run. Such tools might include the following:

- **A technical-training schoolhouse model** can help identify constraints and the marginal costs of increasing capacity in schoolhouses. The latest version of the model analyzes variables such as the number of instructors, class size, assigned dormitory capacity, dining-hall capacity, number of classrooms, number and availability of training devices (e.g., simulators), shift policy, weekend policy, and syllabus sequence. The goal is to understand the cost of producing an airman in a particular specialty code and to identify the factors that contribute to this cost.
- **An end-to-end training model**, illustrated in Figure 4, would clarify the effects of policy decisions on various aspects of recruitment and training. Decisions about what takes place in the schoolhouse can affect the cost and capacity of recruitment, basic military training, and on-the-job training. This model would enable decisionmakers to understand these effects and to compare various policy choices.



NOTE: An end-to-training model would capture and articulate the effects of strategic training management and policy choices. Each of the model's major areas (shown in the boxes above) contain submodels that can track the flow of airmen through the system and capture various measurements (listed below each box), such as costs.

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Figure 4—End-to-End Model Schematic

These proposed measures would complement current Air Force efforts to develop a Decision Support System/Technical Training Management System architecture, which tracks information such as scores and student status and will improve AETC's ability to train airmen effectively and efficiently.

MR-1797-AF, *Air Education and Training Command Cost and Capacity System: Implications for Organizational and Data Flow Changes*,  
Thomas Manacapilli, Bart Bennett, Lionel Galway, and Joshua Weed

## What Are the Air Force's Manpower Requirements?

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Every few years, the U.S. Air Force reviews its manpower requirements to ensure that it is planning for enough people with the right skills and experience to meet national security demands. The most recent review was the Total Force Assessment (TFA), the first phase of which was carried out from 1999 to 2001. TFA-I was based on the traditional assumption that the Air Force should be able to prosecute two major theater wars (MTWs) at the same time. In recent years, however, defense planners have considered the need to estimate manpower requirements for smaller scenarios of between one and two MTWs. In such cases, presumably not all existing forces would actually be used, and manpower needs might vary. As of 2001, the Air Force lacked a sanctioned method of estimating requirements for these smaller scenarios.

### A New Methodology Improves the Estimation Process

PAF observed the TFA-I process and developed an improved methodology for estimating manpower requirements. The main features of the methodology are as follows:

- **As intended, the methodology can estimate manpower requirements for MTW-sized scenarios, and in particular those short of two MTWs.**
- **The methodology is flexible enough to accommodate a variety of policy assumptions.** For example, a key question in moving from a two-MTW scenario to smaller scenarios is what to do with untasked forces. The Air Force might consider using such personnel to maintain an overseas forward presence. PAF's methodology can incorporate such assumptions into its estimate of total manpower requirements. Another potential policy issue is whether the Air Force can reduce manpower requirements by extending the longer wartime workweek for support personnel to a larger segment of the population. PAF's methodology would be able to estimate the potential benefits of such a policy.
- **The methodology avoids the double counting of personnel.** Overall manpower requirements are a combination of peacetime and wartime needs. TFA-I followed traditional practice by taking current authorizations (in the Manpower Data System) as peacetime requirements and using time-phased

force deployment data (TPFDD) to represent strategic planning guidance for wartime requirements. Without appropriate adjustments, however, this method can double count positions that appear in both the peacetime and wartime columns (as with personnel who switch jobs between peacetime and wartime). PAF modified the TFA-I methodology to avoid this potential problem. The new methodology follows TFA-I by assigning peacetime manpower to four basic categories: deployable forces, in-place combat forces, continuing missions (e.g., headquarters, depots, and training), and support. Unlike TFA-I, it extends the same categories to TPFDD positions to achieve greater consistency. Along with further adjustments for untasked personnel and other considerations, the new methodology can present a more accurate picture of total manpower needs.

### **A Centralized Process Can Improve Future Exercises**

In addition to developing an improved methodology, PAF made some observations about the overall process for conducting total force assessments. A major lesson learned from TFA-I is the need to exercise greater control and to have a detailed auditing trail of the process. These improvements could be accomplished by centralizing the initial assessment of manpower needs and the final analysis and reporting of results. TFA-I looked to functional area managers (FAMs) in the major commands to furnish manpower requirements, creating the potential for inconsistent classification of personnel and lack of an auditing trail for major decisions. PAF suggests that a handful of experts make initial manpower assignments and then solicit input from FAMs. Greater control over the process will ensure that methodologies such as PAF's will be most effective at providing more accurate estimates of future manpower needs.

TR-144-AF, *Policy and Methodology to Incorporate Wartime Plans into Total U.S. Air Force Manpower Requirements*, Manuel J. Carrillo, Hugh G. Massey, and Joseph G. Bolten

## Do Air Force Personnel Broaden Their Skills During Deployments?

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United States Air Force personnel are typically trained to perform jobs in a specific occupational category. However, they may be called upon to perform a variety of jobs during their military careers. Recognizing this, the Air Force has set goals that will require some personnel to acquire skills and competencies in more than one occupational category. For example, individuals with expertise in operations may need to expand their understanding of strategy or to improve their leadership skills.

To assist the Air Force in this effort, PAF conducted a survey to identify the settings in which individuals learn occupational skills and universal competencies outside of their primary occupations, with an emphasis on deployments. Occupational skills are specific to a particular occupation. Universal competencies are applicable across job categories and are expected to some extent among all Air Force personnel. PAF surveyed officers and enlisted personnel who had recently returned from Prince Sultan Air Base (PSAB) and Eskan Village (a military housing facility) in Saudi Arabia. The two locations were selected because the Air Force had identified deployments as a likely setting for substantial learning and because a large number of Air Force personnel in a wide variety of occupations were deployed there. Respondents were asked to consider a broad range of skills and competencies and to rank the environments that were most conducive to learning. Environments included initial and mid-career training, the PSAB/Eskan deployment, other deployments, and settings outside the Air Force. Major findings include the following:

- Personnel learn skills outside of their specialty during deployments. Seventy-five percent of survey respondents indicated that they spent some portion of their time during deployment working outside their occupational specialty.
- Personnel identified the PSAB/Eskan Village deployment as the best environment for learning more than one-third of the skills and competencies listed on the survey (see Table 2). Many of the skills and competencies learned best during deployment were from the operations, organization, and strategy categories on the Air Force list.

**Table 2—Frequency with Which Respondents Reported Learning Competencies and Skills During PSAB/Eskan Deployment**

Competency/skill	Category	Entire sample N=247	
		Freq.	Rank order
Expeditionary operations	Operations	75%	1
Skills associated with my primary specialty at PSAB/Eskan	Speciality	74%	2
Skills associated with my primary specialty	Speciality	68%	3
Team building	Leadership	66%	3
Resilience	Character	66%	4
Cooperativeness	Character	64%	4
Responsibility and self-discipline	Character	64%	4
Decisiveness	Character	64%	4
Selflessness	Character	61%	4
Integrity/honesty	Character	60%	4
Loyalty	Character	60%	4
Communications	Leadership	59%	3
How my primary specialty relates to mission areas outside my career field	Speciality	58%	2
Skills in my career field but outside my primary specialty area	Speciality	58%	2
Respectfulness	Character	56%	4
Command	Leadership	55%	2
Compassion	Character	52%	4
Management skills	Leadership	51%	3

NOTE: Shading indicates that PSAB/Eskan deployment is ranked among the top three learning environments.

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PAF recommends that if the Air Force develops a system for tracking the learning of occupational skills and universal competencies, it should incorporate the learning that occurs during deployments. Such a system would give the Air Force a better understanding of which personnel have certain combinations of skills and where gaps still exist.

DB-435-AF, *The Role of Deployments in Competency Development: Experience from Prince Sultan Air Base and Eskan Village in Saudi Arabia*, Laura Werber Castaneda, Lawrence M. Hanser, and Constance H. Davis

## The U.S.–South Korea Security Alliance After 9/11

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Issues have emerged recently between the United States and South Korea that put their decades-long security alliance under stress. For example, there is a sense in the United States that South Korea does not share America's post-9/11 security priorities. There is also growing concern over North Korea's nuclear program. In South Korea, rising nationalism has created the demand for a more "equal" relationship with the United States.

Yet, the alliance continues to benefit both countries. For example, it ensures South Korea's defense and bolsters prospects for continued economic growth and political stability. The alliance also gives the United States access to much of Asia while reducing pressure on U.S. bases elsewhere in the region. If the two Koreas unite, the alliance will facilitate the spread of democratic institutions and free-market economies to North Korea and beyond.

PAF studied the U.S.–South Korea relationship to identify initiatives that can strengthen and improve security cooperation. The study addresses both short-term alliance management issues and longer-term measures to adapt the relationship to new global and domestic conditions.

- **The two countries must redefine their common purpose.** The United States and South Korea must agree on what constitutes a "threat" and how to deal with it, as well as the appropriate nature, size, and configuration of U.S. forces deployed in South Korea. Most critical in the short term, they must agree on how to deal with North Korea.
- **The United States should ensure that the U.S. commitment to South Korea's security remains credible, identify concrete South Korean roles in the global war on terrorism, and encourage enhanced South Korean capabilities.**
- **South Korea needs to assume greater responsibility for the health of the alliance.** For example, it must demonstrate that it considers North Korea's nuclear program and the war on terrorism to be alliance issues rather than problems just for the United States. South Korea must also provide adequate training facilities and housing for U.S. troops.

MG-115-AF/KF, *Do the Ties Still Bind? The U.S.-ROK Security Relationship After 9/11*, Norman D. Levin

## Managing the U.S.-China Military-to-Military Relationship

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The United States and China have had a security relationship since 1971, when Henry Kissinger opened the door to cordial relations by sharing intelligence about the Soviet military. Recently, however, disagreements over key issues have led each country to regard the other as a strategic competitor and a potential enemy. For example, China views U.S. military assistance to Taiwan as an effort to undermine China's security and its claim to sovereignty over the island. China's failure to renounce the use of force against Taiwan—a policy opposed by the United States—has further elevated tensions and has even raised the possibility of armed conflict.

In 2001, the U.S. Department of Defense began to reassess the U.S.-China relationship to determine the appropriate nature of contact between the militaries of the two countries. A PAF study conducted in parallel with this effort recommends a program of security management with three aspects:

- **The United States should pursue communication between U.S. and Chinese senior defense and military officials** to prevent misperceptions, resolve differences, and deter China from taking actions that are hostile to U.S. interests. This approach would be consistent with China's preference for building cooperative relationships from the top down.
- **The United States should pursue improved methods of gathering information about China and its military.** In the past, China has been much less open than the United States in sharing information about its military. However, Chinese military strategy and doctrine are theorized and developed in the military education system before they are adopted. Therefore, educational exchanges may provide useful insights into Chinese warfighting that will help the United States to simultaneously avoid armed conflict and win if a conflict becomes inevitable. Properly planning visits to China (for example, choosing high-value bases and units and allowing enough time to negotiate the terms of the visits) will further increase U.S. chances of gathering useful information.
- **The United States and China should continue to cooperate in the global war on terrorism.** China demonstrated strong, early, public support for the global war on terrorism. Continued intelligence sharing and other cooperative efforts with China in response to third-party threats—and even

the sharing of some classified information about the identities and operations of terrorist groups—may benefit U.S. interests and be essential for U.S. national security.

MG-143-AF, *U.S.-China Security Management: Assessing the Military-to-Military Relationship*, Kevin Pollpeter

## Strategic Threats to Middle East Security: Challenges for U.S. Policy

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Well before the attacks of September 11, 2001, the United States had a vital interest in the security and stability of the Middle East. U.S. priorities in this region include countering terrorism, stopping the spread of weapons of mass destruction (WMD), maintaining stable oil supplies and prices, ensuring the stability of friendly regimes, ensuring Israel's security, and promoting democracy and human rights. In the past, the threat of military aggression posed the greatest danger to Middle East security, at times erupting in open warfare such as between Iran and Iraq and between Arab states and Israel. This threat is likely to continue. Moreover, a PAF study suggests that political, economic, and social trends could pose new threats to Middle East security in the coming years.

- **Declining economies and the slow pace of democratic reform will increase popular frustration with autocratic regimes.** As Table 3 shows, civil liberties remain limited, and many states face rising debt, poverty, and shortages of food and water. These conditions will fuel popular unrest and may increase support for Islamist fundamentalist groups.
- **Militaries will be weaker.** As military resources are directed to suppressing internal unrest, states will be less able to defend against hostile neighbors. U.S. allies will be less effective in the war against terrorism.
- **New leaders will be less likely to cooperate with the United States.** Incoming regimes will need to build support among competing political factions. They may be unwilling to continue unpopular policies such as cooperating in the U.S. war on terrorism or supporting Arab concessions to Israel.
- **The Middle East will have stronger economic and military ties with Asia.** As the United States turns to Russian sources of energy, Asia will become the leading consumer of Middle Eastern oil. This shift could strengthen Middle Eastern-Asian defense ties, which may include the transfer of WMD technology from China and North Korea to Middle Eastern states.
- **The spread of communications technology may increase public participation in government.** Satellite television, videocassettes, faxes, and photocopiers will facilitate popular discussion and debate beyond government

control. This trend may compel regimes to be more responsive to popular opinion, or it may cause governments to become more authoritarian.

- **Middle Eastern states will continue to develop and acquire WMD.** Many regimes seek chemical, biological, radiological, or nuclear weapons and advanced delivery systems. Continued proliferation could threaten the U.S. homeland and could limit the U.S. military's freedom of action in certain parts of the world.

**Table 3—Benefits and Limits of Political Reform in the Middle East**

Component	Potential Benefits	Limitations
Legislatures	Check on executive authority Articulate popular preferences Provide outlet for popular frustration with the regime	Restricted areas of jurisdiction Limited resources and expertise
Consultative councils	Allow some popular input into the decision process Represent previously excluded groups	No formal decisionmaking authority Members appointed by the ruler, not elected Co-optation of potential opposition
Political parties	Express a variety of political viewpoints Field diverse candidates for office	Illegal in many Middle Eastern states Lack resources to promote coherent political agendas Parties often co-opted by regime
Civic organizations	Citizens organize to represent their own interests Important check on state power Provide forums for political activity where parties are illegal or heavily restricted	Corporatist structures require close ties to the state Often co-opted or controlled by the regime Some segments of society remain unrepresented
Freedom of the press	Helps increase regime accountability Allows citizens to exchange opinions and debate political issues	Restrictive press laws Formal and informal censorship
Judiciary and the rule of law	Check on executive power Due process protects civil and human rights Enhance regime legitimacy	Judges appointed directly by ruler No independent appeals process Separate Islamic and civil codes Special court systems

NOTE: Middle Eastern regimes have implemented some political reforms. Most of these measures are designed to offset popular dissatisfaction at a general level, but a few—such as judicial reform—address problems such as civil and human rights in a limited way.

The United States must balance the aim of fostering democratic change with the goal of maintaining political security in the Middle East. Democratic reforms could destabilize existing regimes, thus increasing the threat of military conflict in the region. Such reforms could also elevate nationalist or fundamentalist groups that are opposed to U.S. interests. Consequently, the United States may choose to support certain nondemocratic regimes to prevent a larger security crisis. At the very least, the United States should make a greater effort to explain its policies to ordinary citizens in the Middle East in order to limit popular anti-Americanism.

MR-1640-AF, *The Future Security Environment in the Middle East: Conflict, Stability, and Political Change*, Nora Bensahel and Daniel L. Byman (eds.)

## **U.S. Strategy in the Muslim World After 9/11**

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The tectonic events of the past three years—including September 11 and the war on terrorism in Afghanistan, Iraq, and beyond—have dramatically affected the Muslim world and attitudes toward the United States. However, some of the dynamics that are influencing the environment in Muslim countries are also the product of trends that have been at work for many decades. The continuation of these trends will make management of the security environment in the Islamic world more difficult in the years to come and could increase the demands on U.S. political and military resources. Consequently, it is important to develop a shaping strategy toward the Muslim world that will help to ameliorate the conditions that produce religious and political extremism and anti-U.S. attitudes.

The U.S. Air Force asked PAF to study the trends that are most likely to affect U.S. interests and security in the Muslim world. Researchers developed an analytic framework to identify the major ideological orientations within Islam, to examine critical cleavages among Muslim groups, and to trace the long-term and immediate causes of Islamic radicalism. This framework will help U.S. policymakers to understand the political and military strategies available to respond to changing conditions in this critical part of the world.

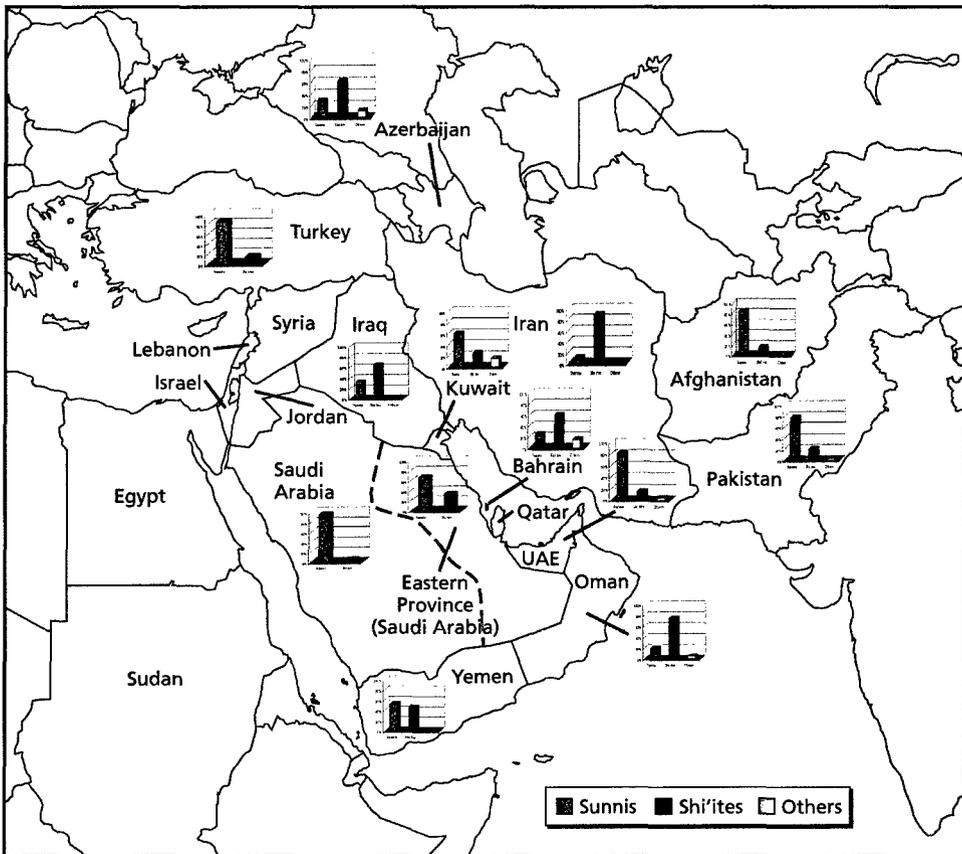
### **Attitudes Toward Democracy and Nonviolence Are Key Markers**

The Muslim world encompasses a band of countries stretching from Western Africa to the Southern Philippines and diaspora communities throughout the globe. PAF researchers developed a typology to differentiate Muslim religious and political currents according to their overarching ideologies, political and legal orientations, preferred forms of government, attitudes toward human rights, social agendas, links to terrorism, and propensity for violence. Based on these markers, Muslim groups fall within a spectrum from those that uphold democratic values and reject violence to those that oppose democracy and embrace violence. This typology can help U.S. policymakers identify potential partners in the Muslim world who may cooperate in promoting democracy and stability and countering the influence of extremist and violent groups.

## Cleavages Within the Muslim World Pose Challenges and Opportunities

In addition to the ideological differences noted above, certain divisions cut across the Muslim world and have implications for U.S. interests and strategy:

- Sunnis and Shi'ites.** As Figure 5 shows, the majority of Muslims are Sunni. Shi'ites, who number about 15 percent of the world's Muslims, are dominant in Iran and are politically excluded majorities in Bahrain and the eastern province of Saudi Arabia, as they were in Iraq prior to the removal of Saddam.



SOURCE: Central Intelligence Agency, *The World Factbook 2002*; Library of Congress Country Studies Azerbaijan (1994) and Iraq (1988).

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Figure 5—Sunni and Shi'a Populations in the Greater Middle East

The United States may have an opportunity to align its policy with Shi'ite groups, who aspire to have more participation in government and greater freedoms of political and religious expression. If this alignment can be brought about, it could erect a barrier against radical Islamic movements and may create a foundation for a stable U.S. position in the Middle East.

- **Arab and non-Arab Muslims.** Arabs constitute about 20 percent of the world's Muslims. The Arab world exhibits a higher incidence of economic, social, and political disorders than other regions of the so-called developing world. By contrast, non-Arab sectors of the Muslim world are more politically inclusive, boast the majority of democratic or partially democratic governments, and are more secular in their outlook. Although the Middle East has traditionally been regarded as the "core" of the Muslim world, it appears that the center of gravity may be shifting to non-Arab sectors. The most innovative and sophisticated thinking about Islam is taking place in areas outside the Arab world such as Southeast Asia and the diaspora communities of the West. The United States should pay attention to these progressive developments because they can counter the more extreme interpretations of Islam held in some parts of the Arab world.
- **Ethnic communities, tribes, and clans.** The failure to understand tribal politics was one of the underlying causes of the catastrophic U.S. involvement in Somalia. Ten years later, the U.S. government still knows very little about Muslim tribal dynamics in areas where U.S. forces are operating or may be operating. As the United States pursues an activist policy in disturbed areas of the world, it will be critical to understand and learn to manage subnational and tribal issues.

## Conditions, Processes, and Catalytic Events Fuel Islamic Radicalism

PAF researchers identify both ongoing and immediate causes for the spread of Islamic radicalism over the past several decades (see Table 4). More or less permanent conditions in the Muslim world, such as the failure of political and economic models in many Arab countries, have fueled anger at the West, as disenfranchised Muslims have blamed U.S. policies for their own countries' failures. This "structural" anti-Americanism is not amenable to amelioration through political or diplomatic means. Moreover, the decentralization of religious authority in Sunni Islam has opened the door for extremists with scant religious credentials to manipulate the religion for their own ends.

**Table 4—Sources of Islamic Radicalism**

<b>Conditions</b>	Failed political and economic models Structural anti-Westernism Decentralization of religious authority in Sunni Islam
<b>Processes</b>	The Islamic resurgence Arabization of the non-Arab Muslim world External funding of religious fundamentalism and extremism The convergence of Islamism and tribalism Growth of radical Islamic networks Emergence of the mass media The Palestinian-Israeli and Kashmir conflicts
<b>Catalytic events</b>	The Iranian revolution The Afghan war The Gulf War of 1991 September 11 and the global war on terrorism The Iraq war

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Several processes have developed over time to aggravate Islamic radicalism. The Islamic resurgence in the Middle East over the past 30 years and the exportation of Arab ideology and religious practices to the non-Arab Muslim world have increased support for fundamentalism. Radical Islamic ideology has spread to tribal societies that lack strong central political authority (e.g., Pashtun areas of Pakistan and Afghanistan), producing a mix that some observers believe “leads to bin Laden.” Moreover, radical Islamists have succeeded in forming networks that support fundamentalist and even terrorist activities through funding and recruitment. Many of these networks provide social services to Muslim communities, making them difficult to detect and disrupt. Finally, the emergence of satellite regional media such as Al-Jazeera has provided a powerful means to reinforce anti-American stereotypes and narratives of Arab victimization that play into radicals’ agendas.

Beyond these long-term factors, certain catalytic events have shifted the political environment in the Muslim world toward radicalism. Major events include the Iranian revolution, the Afghan war with the Soviets, the Gulf War of 1991, and the global war on terrorism after September 11. The Iraq war and the removal of Saddam Hussein have surely had an effect on the Muslim world, but the long-term implications remain to be seen. A stable, pluralistic, and democratic Iraq would challenge anti-Western views in the Middle East and would undermine extremist arguments. On the other hand, if Iraq reverts to authoritarian-

ism or fragments into ethnic enclaves, then U.S. credibility would diminish and radical groups would have greater opportunities to take hold.

## The United States and Its Friends and Allies Can Help to Ameliorate Negative Trends in the Muslim World

How can the United States respond to the challenges and opportunities that current conditions in the Muslim world pose to U.S. interests? PAF suggests a variety of social, political, and military options:

- **Promote the creation of moderate networks to counter radical messages.** Liberal and moderate Muslims have not formed the effective networks that radicals have. Creation of an international moderate Muslim network is critical to transmitting moderate messages throughout the Muslim world and to provide protection for moderate groups. The United States may need to assist moderates who lack the resources to create such networks themselves.
- **Disrupt radical networks.** It is important to understand the characteristics of radical networks and their support communities, how they communicate and recruit, and any weaknesses they have. A strategy of “nodal disruption” would target these critical areas, breaking up radical groups and empowering Muslim moderates to take control.
- **Foster madrasa and mosque reform.** There is an urgent need for the United States and the international community to support reform efforts to ensure that madrassas provide a broad, modern education and marketable skills. One course of action is to help establish or strengthen higher-education accreditation boards that monitor and review curricula in state and private schools. Although outsiders may be reluctant to involve themselves in ostensibly religious affairs, ways may be found to support the efforts of governments and moderate Muslim organizations to ensure that mosques do not serve as platforms for radical ideologies.
- **Expand economic opportunities.** The ability of some radical organizations to address entrenched social and economic problems has created a growing base of support for their politics. Provision of alternative social services in many places might help to indirectly undercut the appeal of the extremists. In particular, the United States and its allies should focus on initiatives that improve the economic prospects of the young. Programs that promote economic expansion and self-sufficiency can help to reduce the

opportunities for extremists to exploit economic hardship and the perception that the United States has only military interests in the Muslim world.

- **Support “civil Islam.”** Support of “civil Islam”—Muslim civil society groups that advocate moderation and modernity—is an essential component of an effective U.S. policy toward the Muslim world. Assistance in efforts to develop education and cultural activities by secular or moderate Muslim organizations should be a priority. The United States and its allies may also have to assist in the development of democratic and civil-society institutions.
- **Deny resources to extremists.** A complementary element of the strategy of supporting secular or moderate Muslim organizations is to deny resources to extremists. This effort needs to be undertaken at both ends of the radical funding cycle, in countries where funds either originate (e.g., Saudi Arabia) or through which funds are channeled (e.g., Pakistan) to support extremist groups.
- **Balance the requirements of the war on terrorism with the need to promote stability in moderate Muslim countries.** The United States should ensure that the actions it takes do not play into the hands of radicals, who depict such moves as a war against Islam. The United States should demonstrate that its efforts are not meant to strengthen authoritarian or oppressive regimes, but to promote democratic change.
- **Seek to engage Islamists in normal politics.** A difficult question is whether developing Muslim democracies should allow Islamist parties that may not have fully credible democratic credentials to participate in politics. While there is always a danger that an Islamist party, once in power, may move against democratic freedoms, the inclusion of such groups in open democratic institutions may encourage moderation in the long run. An unequivocal commitment to nonviolence and democratic processes should be a prerequisite for inclusion.
- **Engage Muslim diasporas.** Diaspora communities are gateways to networks and may be helpful in advancing U.S. values and interests. The United States, for instance, can work with Muslim nongovernment organizations in responding to humanitarian crises.
- **Rebuild close military-to-military relations with key countries.** Military establishments will continue to be influential political actors across the Muslim world. Therefore, military-to-military relations will be of particular importance to any U.S. shaping strategy in the Muslim world. Rebuilding a core of U.S.-trained officers in key Muslim countries is a critical need.

Programs such as International Military Education and Training can ensure that future military leaders are exposed to American military values and practices and can translate into increased U.S. influence and access.

- **Build appropriate military capabilities.** The United States faces a need to reduce the more obvious aspects of its military presence in sensitive areas of the Muslim world while working to increase different types of presence (e.g., intelligence, psychological operations, and civil affairs such as medical assistance). The U.S. military should improve its cultural intelligence through more Arab, Persian, and African regional and language specialists.

MG-246-AF, *The Muslim World After 9/11*, Angel M. Rabasa,  
Cheryl Benard, Peter Chalk, C. Christine Fair, Theodore Karasik,  
Rollie Lal, Ian Lesser, and David Thaler

## Assessing the Dynamic Terrorist Threat

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The September 11, 2001, attacks on the World Trade Center and the Pentagon illustrate the difficulty of forecasting new and emerging trends in terrorism. Although U.S. intelligence and security communities were tracking the activities of al Qaeda long before that day, many analysts appear to have underestimated either the network's degree of hostility toward the United States or its ability to carry out a catastrophic attack. Planners and policymakers must prioritize U.S. counterterrorism activities amid a constantly evolving field of potential adversaries. They must not only grasp the current threats to U.S. security but must also understand how terrorist groups' motivations and capabilities will evolve in the future.

The U.S. Air Force asked PAF to assess the character and magnitude of terrorist threats against the United States. PAF researchers developed a "threat framework" to evaluate terrorist groups on the basis of their motivations and ability to threaten U.S. interests. They also analyzed how terrorist groups maintain their capabilities and adapt to external pressures such as counterterrorism. Key insights include the following:

- **Three terrorist groups evidence both the motivation and the capability to attack the United States, thereby posing the greatest threat.** Al Qaeda, Lebanese Hizballah, and the Revolutionary Armed Forces of Colombia demonstrate the highest degrees of both hostility toward the United States and the ability to carry out sophisticated attacks. Some highly capable groups, such as the Liberation Tigers of Tamil Eelam, do not pose a significant threat to the United States because they have not demonstrated high degrees of anti-U.S. sentiment. By the same token, groups such as Jemaah Islamiya have demonstrated a willingness to attack U.S. citizens overseas but are unable to carry out large-scale operations. U.S. policymakers can use this framework to sort out which groups merit significant concern and which do not.
- **Terrorist groups require organizational and operational tools to sustain their activities.** Organizational tools such as ideology, leadership, recruitment pools, and publicity are necessary to sustain a terrorist group's existence as a cohesive entity. Operational tools such as command and control, weapons, training, intelligence, and money allow terrorists to conduct successful attacks. Understanding these factors may help U.S. policymakers identify means of reducing a particular group's capabilities. For example, if

the United States wants to completely dismantle a terrorist group over the long term, then counterterrorism activities should seek to dismantle the group's organizational tools. If the United States wants to prevent a particular attack or alleviate an immediate threat, then it should target a group's operational tools.

- **Terrorist groups can adapt to pressures, but they are vulnerable when undergoing transition.** Groups such as al Qaeda and Hizballah have shown the ability to evolve when faced with countermeasures by state authorities, changes in support from other states or militant groups, or shifts in popular support. However, terrorist groups in transition face difficult choices about their organizational structure, strategy, and tactics. Understanding the pressures at work on a group may help counterterrorism authorities apply measures that increase the chances of terrorists making bad decisions.

U.S. policymakers can use these insights to track the development of terrorist groups over time and to plan counterterrorism measures that are most likely to weaken or destroy a particular group.

MR-1782-AF, *The Dynamic Terrorist Threat: An Assessment of Group Motivations and Capabilities in a Changing World*, Kim Cragin and Sara A. Daly

## Counterterror Coalitions: What Role Will Pakistan and India Play?

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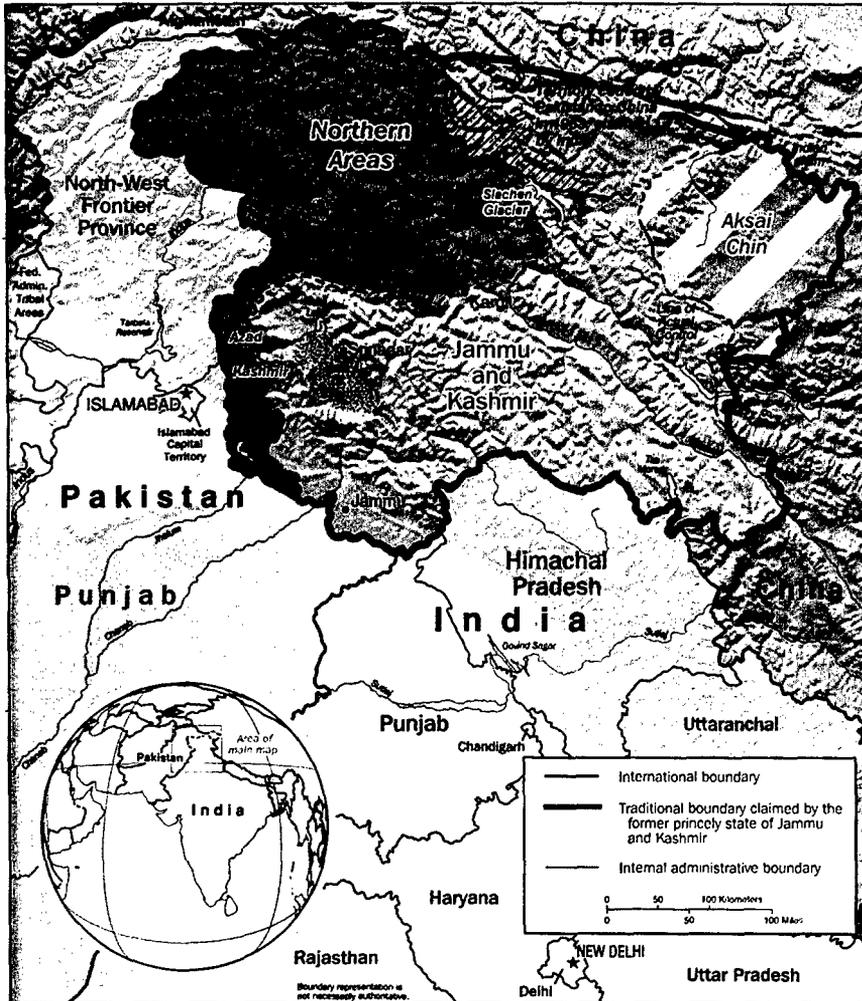
After September 11, 2001, Pakistan and India played critical, albeit different, roles in U.S. counterterrorism operations in Afghanistan and elsewhere. Pakistan provided access to bases, ports, and air space and permitted the United States to use special forces and agents of the Federal Bureau of Investigation to track down al Qaeda and Taliban fugitives inside Pakistan. India provided intelligence, naval escorts through the Strait of Malacca, and diplomatic and political support to the United States. Although both countries can continue to make positive contributions to U.S. counterterrorism efforts, policy decisions by each country have the potential to seriously interfere with U.S. operations in Afghanistan and the war on terrorism generally. This is especially true in light of the ongoing dispute between Pakistan and India over Kashmir and its potential to erupt into conflict.

PAF studied the roles that Pakistan and India will likely play in future U.S. counterterrorism strategy and identified policy options that the United States might pursue to ensure continued cooperation by each country. Major findings include the following:

- **Pakistan is an important—but uncertain—partner in counterterrorism.** Pakistan remains unwilling to jettison its active role in supporting, training, guiding, and launching militant operations in Indian-held Kashmir and elsewhere. This support directly challenges U.S. interests in diminishing the capacity of terrorist organizations and degrading their force-projection capabilities. Moreover, Pakistan's prosecution of a low-intensity conflict with Indian-held Kashmir has exacerbated New Delhi's vexation with Islamabad. Pakistan is unlikely to ease its policy of supporting militants until the major sources of conflict with India are resolved, most prominently the disputed disposition of Kashmir.
- **India is a long-term partner in counterterrorism.** Cooperation is fostered by the natural overlap between India's core strategic interests and those of the United States. Equally important, India can contribute to U.S. efforts by not militarily challenging Pakistan while Pakistani forces are needed for operations on the eastern border with Afghanistan. Nevertheless, India is not likely to follow U.S. policy in every instance. New Delhi is less inclined to give Islamabad the strategic and political space it needs to stop supporting militants. India also chose not to participate in Operation Iraqi Freedom.

In the long run, however, India will continue to share many interests with the United States and will continue to play an important role in the war against terrorism.

- **Kashmir poses a serious challenge to the counterterrorism coalition.** Without effective diplomacy to resolve the conflict, the ongoing dispute over Kashmir (see Figure 6) is likely to frustrate and complicate U.S. efforts to



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Figure 6—Detail of South Asia

pursue bilateral relations with Pakistan and India. Both states will consistently depend upon the United States and others to acquire exit strategies from an escalating conflict, to compel the adversary to make concessions, and to find political and diplomatic support. These factors suggest that some kind of U.S. intervention in the region may be beneficial for all.

PAF identifies five policy options that the United States may consider in crafting its policy in this region:

- **Maintain the status quo.** The United States may continue its bilateral relations and play the role of crisis manager on an as-needed basis.
- **Take an active role in resolving the Kashmir dispute.** This policy would complicate bilateral relations in the short term, but the long-term benefits could be worthwhile.
- **Completely disengage from the Indo-Pakistani conflict.** This approach would deprive Pakistan and India of a convenient exit strategy, leading either to a de-escalation of the conflict or to the emergence of new paths to escalation.
- **Explicitly side with India.** In the long term, India's interests may be more consonant with those of the United States than those of Pakistan. This approach would seek to "contain" Pakistan while expanding the U.S. strategic relationship with India.
- **Side with Pakistan on the Kashmir issue and other security concerns pertaining to India.** This approach would seek to endow Pakistan with the security it needs to ease its policy of supporting militants against India. The strategy assumes that, over time, India and the United States would remain close as "natural allies."

MG-141-AF, *The Counterterror Coalitions: Cooperation with Pakistan and India*, C. Christine Fair

## Publications

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MG-109-AF, *Test and Evaluation Trends and Costs for Aircraft and Guided Weapons*, Bernard Fox, Michael Boito, John C. Graser, Obaid Younossi.

As military systems have become more complex, testing those systems has become more time consuming and costly. A number of efficiencies to address this issue have been proposed and implemented, such as increasing the use of modeling and simulation and combining developmental and operational testing. How have these approaches worked in practice? And do traditional metrics for estimating the cost of testing still apply? This monograph addresses these questions by examining system-level testing for selected fixed-wing aircraft, missiles, and guided-munitions programs. The actual testing times and costs appear to be largely in step with the increasing complexity of military systems and test programs; therefore, the proportion of development costs that the testing represents has not changed markedly. Although the available data are not sufficient to isolate the effects of discrete initiatives, some initiatives, such as modeling and simulation and combined testing, have empirically demonstrated their value on a variety of programs. The authors also provide cost-estimating methodologies and reference information for the programs they studied.

MG-115-AF/KF, *Do the Ties Still Bind? The U.S.-ROK Security Relationship After 9/11*, Norman D. Levin.

The United States and South Korea enjoy many benefits from their close security cooperation, but this relationship, although not currently endangered, is shifting. The paramount short-term challenge in sustaining this relationship is ensuring that the two countries stay in lockstep in dealing with North Korea. Sustaining the relationship over the long haul, however, will require a focused effort on the part of both countries to adapt the relationship to new global and domestic conditions. Recently, attention has been given to questions regarding the appropriate nature, size, and configuration of U.S. forces deployed in Korea. These central questions deserve heavy emphasis, but the answers to those questions will remain vulnerable to domestic political currents in both countries without affirmation of a larger common purpose. Other important issues addressed in this monograph include a joint agreement to move the U.S. garrison out of Seoul, South Korea's role within the alliance, and the South Korean desire for a more "equal" partnership. The author recommends that the United States should examine whether restrictions on weapons sales and

technology transfers to Korea might be relaxed in certain areas while creating opportunities for South Koreans to help shape a new security relationship that gives them a greater sense of equal partnership. For its part, South Korea must act like an equal partner if it wants to be treated like one by taking responsibility for the health of the alliance. While continuing to address such "future of the alliance" issues, the United States also needs to address a broad set of issues relating to current management of the alliance.

MG-116-AF, *Organizational Concepts for Purchasing and Supply Management Implementation*, Lynne M. Leftwich, James A. Leftwich, Nancy Y. Moore, C. Robert Roll, Jr.

Purchasing and supply management (PSM) is a strategic, enterprise-wide, long-term, multifunctional, and dynamic approach to selecting suppliers of goods and services. PSM also involves managing not only suppliers but the whole supply network—from raw materials to final use and disposal—while continuously reducing costs, managing risks, and improving quality, responsiveness, reliability, and flexibility. This monograph presents a construct for organizing Air Force acquisition and purchasing activities to execute PSM. A PSM demonstration was chartered as a result of the Air Force "Spares Campaign," which was intended to review the Air Force parts-supply process. Eight initiatives, the last of which focuses on improving PSM, were targeted to modernize the spares process and ultimately put more spares into the hands of maintainers. As a first step, PSM was to be implemented at the F-100 engine shop at the Oklahoma Air Logistics Center. This monograph suggests organizational options for implementing PSM to better align contracting and logistics functions with process changes. It presents a flexible "springboard" design to guide implementation of the process.

MG-141-AF, *The Counterterror Coalitions: Cooperation with Pakistan and India*, C. Christine Fair.

This monograph examines U.S. strategic relations with India and Pakistan both historically and in the current context of the global war on terrorism and Operation Enduring Freedom in Afghanistan. The author discusses Pakistan's unwillingness to halt its active role in supporting militant operations in Indian-held Kashmir and elsewhere, which challenges U.S. interests in reducing terrorism. India, for its part, could lessen Pakistan's perception of India as a threat. An inescapable conclusion from this study is that the intractable dispute over the disposition of Kashmir remains a critical flashpoint between India and Pakistan and a continual security challenge for the United States and the larger inter-

national community. The author offers five policy options on how the United States might proceed: maintain the status quo, take an active role in resolving the dispute, distance itself from the dispute, side with India, or side with Pakistan's position on Kashmir. Each position, with its benefits and disadvantages, is discussed in detail in this report.

MG-143-AF, *U.S.-China Security Management: Assessing the Military-to Military Relationship*, Kevin Pollpeter.

Restrictions on U.S. military-to-military relations with China that were imposed in 2001 stirred a debate about the value of those activities and their place in the overall U.S.-China relationship. This monograph examines the debate on security cooperation between the two countries and finds that there is value in the relationship, despite its problems. The debate centers around four major issues of contention: the potential risk to U.S. national security from military relations with China, the potential benefits of the U.S.-China military relationship to the United States, whether the United States can expect to influence China through the relationship, and the relative levels of reciprocity and transparency between each country's military. The report concludes that the U.S. military relationship with China should concentrate on security management rather than on security cooperation and that three-part program of dialogue, information gathering, and limited cooperation can have mutual benefits in minimizing misperceptions and the chance of conflict.

MG-176-AF, *Supporting Air and Space Expeditionary Forces: A Methodology for Determining Air Force Deployment Requirements*, Don Snyder, Patrick Mills.

The Air Force's transition from a threat-based planning posture to a capabilities-based planning posture suggests the need for a means to swiftly calculate the manpower and equipment required to generate those capabilities. This monograph outlines just such a methodology for determining manpower and equipment deployment requirements. The methodology employs a prototype research tool called the Strategic Tool for the Analysis of Required Transportation (START). The START program generates lists of capability units, called Unit Type Codes, which are required to support a user-specified operation. The program also estimates materiel-movement requirements to achieve initial operating capability at deployed locations. The appendix to this monograph serves as a user's guide to the START program. A fully implemented tool based on this prototype should prove useful for both deliberate planning and crisis-action planning.

MG-214-AF, *Air Force Procurement Workforce Transformation: Lessons from the Commercial Sector*, John Ausink, Laura H. Baldwin, Christopher Paul.

The Air Force is in the process of significantly changing the way it purchases goods and services, with the goal of reducing costs and increasing performance to better support its missions. A procurement transformation division was created to lead this effort, and the new division has focused on two related areas: (1) implementation of cross-functional teams (commodity councils) designed to develop strategies for purchasing individual groups of commodities and (2) procurement workforce development to support implementation of new purchasing practices. This monograph reviews commercial-sector commodity councils. A preliminary review of the curricula of the Defense Acquisition University and Air Force Institute of Technology indicates that both institutions currently cover a number of skills needed to implement new practices; however, there are fewer, if any, opportunities to acquire some of the more-sophisticated skills associated with the new purchasing and supply management practices the Air Force is implementing. This monograph's literature review and the study team's commercial-sector interviews suggest that training programs tend to be multifunctional, involving personnel that have diverse backgrounds relevant to new practices, and these programs are matched to learning goals. While structured classroom or Web-based learning is used to develop foundational skills, more-applied forms of learning such as formal on-the-job training and mentoring programs are used to develop higher levels of expertise. Finally, the monograph includes a framework to monitor and refine efforts to develop the procurement workforce over time.

MG-246-AF, *The Muslim World After 9/11*, Angel M. Rabasa, Cheryl Benard, Peter Chalk, C. Christine Fair, Theodore Karasik, Rollie Lal, Ian Lesser, David Thaler.

Momentous events since September 11, 2001—Operation Enduring Freedom, the global war on terrorism, and the war in Iraq—have dramatically altered the political environment of the Muslim world. Many of the forces influencing this environment, however, are the products of trends that have been at work for many decades. This monograph examines the major dynamics that drive changes in the religio-political landscape of the Muslim world—a vast and diverse region that stretches from Western Africa through the Middle East to the Southern Philippines and includes Muslim communities and diasporas throughout the world—and draws implications from these trends for global security and U.S. and Western interests. It presents a typology of ideological tendencies in the various regions of the Muslim world and identifies the factors

that produce religious extremism and violence. It assesses key cleavages along sectarian, ethnic, regional, and national lines and examines how those cleavages generate challenges and opportunities for the United States. Finally, the authors identify possible strategies and political and military options for the United States to pursue in response to changing conditions in this critical and volatile part of the world.

MR-1231-AF, *Future Roles of U.S. Nuclear Forces: Implications for U.S. Strategy*, Glenn C. Buchan, David Matonick, Calvin Shipbaugh, Richard Mesic.

Since the end of the Cold War, the United States has been re-examining its basic assumptions about foreign policy and instruments of national security policy. This report examines the possible roles of nuclear weapons in contemporary U.S. national security policy. Today, U.S. nuclear forces are only somewhat reduced from what the nation had maintained for decades. The authors state that the United States can choose from among a range of nuclear strategies and postures, from abolition of U.S. nuclear weapons, to aggressive reductions in weapons and "dealtering," a "business as usual, only smaller" posture, a more aggressive nuclear posture, or an emphasis on nuclear forces as the main focus of U.S. military operations. The authors find that, for most foreseeable combat situations, advanced conventional weapons are probably sufficiently effective if there are enough of them and if they are used properly; still, if other options are inadequate and the stakes are high enough, nuclear weapons could give the United States a decisive advantage. Nuclear weapons remain the final guarantor of U.S. security, and the United States might wish to retain the traditional threat of nuclear retaliation to deter threats to the nation's existence. At the same time, the United States should have the operational flexibility to use a modest number of nuclear weapons if the need to do so were overwhelming and other options were inadequate. Any nuclear strategy the United States chooses will require a different set of nuclear forces and operations practices than it has now.

MR-1603-AF, *Interoperability of U.S. and NATO Allied Air Forces: Supporting Data and Case Studies*, Eric Larson, Gustav Lindstrom, Myron Hura, Ken Gardiner, Jim Keffer, Bill Little.

The United States conducts air operations both with willing NATO allies and with non-NATO countries. This report presents background research for a larger RAND study titled "Interoperability: A Continuing Challenge in Coalition Air Operations." The objective of this background research is twofold: (1) to help the U.S. Air Force identify potential interoperability problems that may arise over the next decade in coalition air operations involving the United States and

non-NATO countries, as well as operations involving its NATO allies, and (2) to suggest solutions to mitigate those problems. This report focuses on command, control, communications, intelligence, surveillance, and reconnaissance (C3ISR) systems and out-of-NATO-area operations. The authors present a data-based historical overview of the U.S. experience in coalition operations with NATO allies up to 1999 and seek to provide a deeper understanding of interoperability through answers to several key questions: For what missions is interoperability required? With which NATO allies is interoperability required? For what capabilities and services is interoperability required? The authors present detailed case-study analyses of coalition operations in Southwest Asia, Bosnia, Somalia, and Rwanda, which identify key interoperability challenges and workarounds (i.e., short-term solutions) at the strategic, operational, tactical, and technological levels, and they provide relevant lessons for meeting those challenges and improving the interoperability of U.S. and NATO air and C3ISR capabilities.

MR-1640-AF, *The Future Security Environment in the Middle East: Conflict, Stability, and Political Change*, Nora Bensahel, Daniel L. Byman (eds.).

The security environment in the Middle East has become increasingly complicated during the past decade. This report identifies several important trends that are shaping regional security and identifies the implications of those trends for the United States. Many traditional security concerns, such as energy security and the proliferation of weapons of mass destruction, will remain significant factors in the future. However, ongoing domestic changes throughout the region will become increasingly important as well. Issues such as political reform, economic reform, civil-military relations, leadership change, and the information revolution are all affecting regional security dynamics. This report examines each of these issues and identifies some of the challenges they pose for U.S. foreign policy.

MR-1701-AF, *Models of Operational Training in Fighter Squadrons*, James H. Bigelow, William W. Taylor, S. Craig Moore, Brent Thomas.

Operational squadrons spend most of their time training to maintain readiness and to prepare aircrew members for subsequent assignments. Although some operational training is needed to achieve these objectives, it has been difficult historically to justify any specific amount of flying for this purpose. This report describes a linear programming model that calculates the minimum sorties that must be flown within a certain period of time to provide all crew members with the operational training they need.

MR-1711-AF, *Organizational Policy Levers Can Affect Acquisition Reform Implementation in Air Force Repair Contracts*, Mary E. Chenoweth, Sarah Hunter, Brent Keltner, David Adamson.

To identify barriers to implementing acquisition reform for Air Force repair contracts, the study team examined the incorporation of Contract Repair Enhancement Program (CREP) tenets in repair contracts at Robins Warner Air Logistics Center (ALC). The study team attempted to link successful incorporation of those tenets to various organizational levers—the practices that senior leadership can use to influence individual behavior to achieve policy objectives. After conducting a literature review, the study team surveyed Warner Robins ALC to assess behaviors and attitudes toward acquisition reform, with emphasis on the organizational levers that existed during the CREP initiative. The team then developed regression models to explore the relationship between organizational levers and the number of CREP tenets incorporated in a repair contract. The team found that organizational levers can help to explain the degree to which repair and sustainment contracts use CREP tenets. The study results suggest that training in acquisition reform, fostering positive attitudes toward acquisition reform, and effective teaming had consistent statistical relationships with the use of certain CREP tenets.

MR-1744-AF, *NATO's Eastern Agenda in a New Strategic Era*, F. Stephen Larrabee.

With the conclusion of the Prague summit, NATO faces a number of new challenges in its Eastern Europe agenda. As this report discusses, NATO must first ensure that the democratic transitions in Central and Eastern Europe are consolidated and that there is no backsliding. These countries must modernize their military forces and make them interoperable with those of NATO. Second, NATO must remain engaged in and ensure the security of the Baltic states. The problem of Kaliningrad should be addressed and the enclave stabilized. Third, NATO needs to develop a strategy for the Ukraine to support the country's continued democratic evolution and integration into Euro-Atlantic structures. Fourth, Russia must be incorporated into a broader European and Euro-Atlantic security framework. Finally, NATO needs to develop a coherent strategy toward the Caucasus and Central Asia. The author discusses that the Partnership for Peace can provide the framework for developing relations with these countries. Other U.S. and NATO policies can encourage greater openness, reform, and democratic practices. Furthermore, these challenges must be addressed in a new strategic context. In the post-Prague period, a key issue is NATO's transformation and its strategic purpose—what should be its missions and strategic rationale?

MR-1763-AF, *Investigating Optimal Replacement of Aging Air Force Systems*, Edward G. Keating, Matthew C. Dixon.

Whether to continue to repair an aging aircraft or to invest in a new replacement is a decision the Air Force commonly faces. As part of a continuing project on aging aircraft and the replacement-or-repair decision, the authors present a model that compares the annual cost of repairing an older platform with the annualized cost of purchasing a new one to determine when replacement is optimal and apply it to the U.S. Air Force's C-21A transport and KC-135 tanker aircraft. For the C-21A, the authors find that undertaking a 20,000-flight-hour system and component replacement schedule-prescribed renovation in the 2012 time frame would probably be appropriate, but the aircraft should be retired around 2020. Replacing the KC-135 tanker before the end of the decade would be optimal, assuming that its maintenance costs and availability continue to worsen at the current rate. In general, the Air Force should repair, rather than replace, an aging system if, and only if, the availability-adjusted marginal cost of maintaining the existing aircraft is less than the replacement's average cost per available year. Because parameter estimates are speculative, the authors urge more in-depth analysis of this subject.

MR-1782-AF, *The Dynamic Terrorist Threat: An Assessment of Group Motivations and Capabilities in a Changing World*, Kim Cragin, Sara A. Daly.

As the war on terrorism wages on, U.S. policymakers will continue to face the challenge of assessing threats that various terrorist groups pose to the U.S. homeland and the nation's interests abroad. In addition, the struggle against terrorism likely will be in constant competition with other U.S. international policy issues that come to the fore. As part of the RAND Corporation's year-long "Thinking Strategically About Combating Terrorism" project, the authors of this report develop a way to assess, analyze, and prioritize the danger posed by various terrorist organizations around the world. The authors also look at how various terrorist groups adapt and change over time, emphasizing that understanding these changes may help policymakers to identify terrorists' greatest vulnerabilities. Of course, the very nature of terrorism creates difficulties in predicting new and emerging threats; however, by establishing these types of parameters, the report creates a fresh foundation of threat analysis on which future counterterrorism strategy may be built.

MR-1797-AF, *Air Education and Training Command Cost and Capacity System: Implications for Organizational and Data Flow Changes*, Thomas Manacapilli, Bart Bennett, Lionel Galway, Joshua Weed.

Impediments to planning and management of education and training in the current Air Force organizational structure can inhibit the flow of cost and capacity data and hinder effective decisionmaking. This report examines the Air Force's training management and decision processes to determine the need for data to support informed decisionmaking. It briefly reviews training management systems and associated organizational arrangements in the other services and the private sector to draw insights for a model management system for the Air Force. A four-level model of management was developed for this study to evaluate the flow of data in the Air Education and Training Command (AETC) training pipeline. In the model, a corporate level validates and arbitrates training requirements; a strategic training management level concentrates on the training system's long-term effectiveness; a training management level handles the day-to-day operations of training; and a direct training level delivers training in the classrooms. The authors conclude that a consolidation of the strategic management functions would resolve many current data-flow problems. Methodological tools, including simulations to evaluate tradeoffs in the training pipeline, should be developed to improve data combination and interpretation, particularly in the area of cost data. The authors also conclude that a minute-by-minute data-tracking system would not be cost effective, but cost and capacity data could be fit into the AETC Decision Support System/ Technical Training Management System architecture.

MR-1812-AF, *Defining Needs and Managing Performance of Installation Support Contracts: Perspectives from the Commercial Sector*, Laura H. Baldwin, Sarah Hunter.

This report describes an analysis of best commercial practices in purchasing facilities services and food services and how buyers and providers apply performance-based practices in their contracts. The authors interviewed relevant personnel at six commercial firms that are prominent buyers or providers of facilities and food services to draw "lessons learned" for the Air Force. They found that (1) two-way communication is at the heart of productive buyer-provider relationships; (2) a reasonable number of meaningful performance metrics can enhance buyer-provider communication; (3) contracts that describe what is needed rather than how needs should be met support providers' efforts to innovate and reduce costs; (4) benchmarking can enhance evaluation of prospective providers' proposals or performance during a contract; (5) formal contractual

incentives can be powerful tools to improve providers' performance; and (6) contract flexibility can yield important performance and cost benefits.

MR-1819-AF, *Supporting Air and Space Expeditionary Forces: Lessons from Operation Enduring Freedom*, Robert S. Tripp, Kristin F. Lynch, John G. Drew, Edward W. Chan.

Since 1997, RAND has studied options for configuring a future Agile Combat Support (ACS) system that would enable Air and Space Expeditionary Force (AEF) goals to be achieved. In 2000, Project AIR FORCE helped evaluate combat support lessons from Joint Task Force Noble Anvil (JTF NA), the U.S. component of Operation Allied Force (OAF) in Serbia. In 2001, Operation Enduring Freedom (OEF) in Afghanistan offered an opportunity to examine the implementation of new ACS concepts in a contingency environment. This report presents an analysis of combat support experiences associated with OEF and compares those experiences with those associated with OAF. The objectives of this analysis were to determine the performance of combat support in OEF, examine how ACS concepts were implemented in OEF, and compare JTF NA and OEF experiences to determine similarities and applicability of lessons across experiences and to determine whether some experiences are unique to particular scenarios. The report also focuses on what those experiences imply for a combat support system designed to ensure that AEF goals can be achieved. Both JTF NA and OEF illustrated, among other things, that more attention should be focused on political agreements and engagement policies required to develop forward operating locations. In addition, in many cases in JTF NA and OEF, the current resource-usage factors were more demanding than the assumptions used to fund resources—an imbalance that creates resource shortages in contingency operations.

MR-1821-AF, *Measuring Changes in Service Costs to Meet the Requirements of the 2002 National Defense Authorization Act*, Chad Shirley, John Ausink, Laura H. Baldwin.

The 2002 National Defense Authorization Act set goals for the Department of Defense to achieve savings in service contract expenditures over a ten-year period through changes in contracting practices and improvements in management techniques. The authors of this report investigated ways to measure whether the Air Force is achieving these cost-reduction goals. Measurement of changes in the cost of purchased services over time first requires defining a clear universe of those services. A successful service-cost measurement methodology then must control for changes in the nature of services purchased over time and

estimate what those services would have cost in a given year in the absence of changes in contracting practices and management techniques. The National Defense Authorization Act requires the cost measurements to be reported not only historically but also forecast up to five years in the future. The authors recommend how best to implement each element of the legislative requirement for services that have stable demand. Statistical analyses can then extrapolate savings estimates to those services for which the demand is less stable.

TR-144-AF, *Policy and Methodology to Incorporate Wartime Plans into Total U.S. Air Force Manpower Requirements*, Manuel J. Carrillo, Hugh G. Massey, Joseph G. Bolten.

Every few years, the U.S. Air Force reviews its authorized manpower to ensure that it has enough people with the right skills and experience to meet national security demands. In the past, this authorized manpower was assumed to include the ability to prosecute two concurrent major theater wars, but that assumption is being re-examined. RAND was asked to develop a methodology for examining less-extensive scenarios and to comment on the Total Force Assessment Phase I (TFA-I), which drew to a close in 2001. This technical report presents the resulting methodology, demonstrates its use by applying it to suitable data (including that from TFA-I), and draws lessons from RAND's assessment of the TFA-I experience. Among the authors' conclusions are that the TFA methodology and process could fall prey to pitfalls, the most significant of which is the potential for double counting. The authors also found that it would be helpful to develop models outside the TFA process, because the short deadlines of TFA-like models make it impossible to develop a requirements methodology that can consider the various changes affecting the Air Force. Finally, controls—including quality control, accountability, and auditing trails—should be improved.

TR-159-AF, *Communications Networks to Support Integrated Intelligence, Surveillance, Reconnaissance, and Strike Operations*, Elham Ghashghai.

Combat systems operating at medium and low altitudes pose challenges that differ from those for intelligence, surveillance, and reconnaissance (ISR) platforms operating at high altitudes. As the author observes, medium- and low-altitude platforms are closer to jammers and signals intelligence receivers, enabling an adversary to more readily intercept or jam signals. Further, the low observability of these platforms can be compromised, increasing their chance of detection, if they transmit large amounts of data. After discussing data requirements and threats and examining the current communications programs and

shortfalls, the author finds that there is no single solution for all situations and platforms. A combination of options will be needed to ensure a reliable and robust communications link. These options will vary depending on altitude, range, data rate, and threat. Although communications do not appear to be a limiting factor for future ISR forces, programmatic action will be required to develop the necessary systems, and the costs for those systems could be high.

DB-385-AF, *A Simple Game-Theoretic Approach to Suppression of Enemy Defenses and Other Time-Critical Target Analyses*, Thomas Hamilton, Richard Mesic.

The effectiveness of attacks on time-critical targets (e.g., suppression of enemy air defenses, interdiction, and anti-theater ballistic missile missions) often depends on decisions made by the adversary. Game theory is a way to study likely changes in enemy behavior resulting from various attack capabilities and goals. As the authors discuss, engagement-level combat is treated as a two-player game in which each player is free to choose its own strategy. The response that an intelligent opponent is likely to make to differing levels of threat capability is critical to understanding and measuring the capability necessary to induce the opponent to follow a preferred course of action. The enemy's willingness to engage also is an important factor. If the enemy decides not to launch missiles or move ground vehicles, it has become paralyzed, in itself a worthy goal. This study emphasizes the choice of strategies in realistic military situations; all can be analyzed with straightforward mathematics. Finally, the authors discuss situations in which the two sides have differing views of the duration of a conflict or the appropriate measures of effectiveness, because it is greatly advantageous to a combatant to know an opponent's real objectives.

DB-434-AF, *Using a Spend Analysis to Help Identify Prospective Air Force Purchasing and Supply Management Initiatives: Summary of Selected Findings*, Nancy Y. Moore, Cynthia Cook, Clifford Grammich, Charles Lindenblatt.

This documented briefing summarizes how the Air Force might analyze its spending to develop better supply strategies, improve its relationships with suppliers, and better manage its supply base. Best practices offer many ways in which the Air Force can improve the performance of purchasing and supply management and save money. Such practices include consolidating multiple contracts with existing providers, selecting the best providers and offering them longer contracts with a broader scope of goods and services, and working with selected strategic partners to improve quality, responsiveness, reliability, and cost. The authors analyzed the most complete centralized source of information available on Air Force expenditures—DD350 data. DD350 transactions

constitute 96 percent of all Air Force contract dollars spent directly. From this analysis, the authors recommend several actions the Air Force might wish to take: consolidation of a large number of contracts with the same or a similar supplier; grouping contractor ID codes and purchase office codes associated with the same contractor to avoid paying for the contractor's repetitive bidding and contract administration costs; and examining contracts for goods or services available from only one supplier, which gives the Air Force only limited opportunities to gain leverage over the supplier. Conducting a more-detailed Air Force spend analysis would require information on the needs, preferences, and priorities of commodity users, which is not available in the DD350 data.

DB-435-AF, *The Role of Deployments in Competency Development: Experience from Prince Sultan Air Base and Eskan Village in Saudi Arabia*, Laura Werber Castaneda, Lawrence M. Hanser, Constance H. Davis.

In fall 2001, the RAND Corporation conducted a survey of officers and enlisted personnel who had recently returned from a deployment to Prince Sultan Air Base (PSAB) or to Eskan Village in Saudi Arabia. This documented briefing reports the results of that effort, using survey data to consider the utility of a PSAB/Eskan deployment as a setting for broadening the skills and developing the competencies of Air Force staff. This briefing also addresses the larger issue of whether the learning that occurs during deployments merits tracking.

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